

# **2024 Procedure-Specific Readmission Measures Updates and Specifications Report**

## **Isolated Coronary Artery Bypass Graft (CABG) Surgery — Version 11.0 Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) — Version 13.0**

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### **Prepared For:**

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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 that are publicly reported [here](#) on Medicare.gov. The measures are used to calculate 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 [here](#) on *QualityNet*.

**Specifications that define cohort inclusions and exclusions, risk-adjustment variables, and the planned readmission algorithm described in this report are detailed in the following supplemental files:**

- 2024 CABG Surgery Readmission Measure Code Specifications
- 2024 THA/TKA Readmission Measure Code Specifications

These supplemental files are posted [here](#) on *QualityNet*.

This 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 scores
- **Section 3** — **2024 measure updates**
- **Section 4** — **2024 measure results**
- **Section 5** — **Glossary**

The appendices include:

- [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](#): Cohort inclusion/exclusion criteria and outcome criteria
- [Appendix E](#): Overview of the planned readmission algorithm

The original measure methodology reports and prior updates and specifications reports are available in the "Methodology" section and "Archived Measure Methodology" section (under "Resources") on the readmission measures page [here](#) on *QualityNet*.

The measure methodology is also described in the peer-reviewed medical literature.<sup>1</sup>

For a list of the supporting resource files for the 2024 readmission measures that are available on *QualityNet* (including hyperlinks to the resources), or to review the 2024 Frequently Asked Questions document, refer to the “Resources” section on the readmission measures page [here](#) on *QualityNet*.

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 on the readmission measures page [here](#) on *QualityNet*.

If you have questions about the information in this report or the complementary supplemental files, please submit your inquiry using the QualityNet Q&A tool:  
[https://cmsqualitysupport.servicenowservices.com/qnet\\_qa?id=ask\\_a\\_question](https://cmsqualitysupport.servicenowservices.com/qnet_qa?id=ask_a_question) > Program: Inpatient Claims-Based Measures > Readmission > Understanding Measure Methodology. **Do NOT submit patient-identifiable information (for example, date of birth, Social Security number, Medicare Beneficiary Identifier, and encounter dates such as admission dates, discharge dates, procedure dates, and emergency department [ED]/observation dates) into this tool.**

## 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 Service hospitals) and critical access hospitals (CAHs). In 2015, CMS began publicly reporting an additional readmission measure; namely, CABG surgery. This measure also includes admissions to non-federal short-term acute care hospitals (including Indian Health Service hospitals) and CAHs.

In 2021, CMS and the VHA collaborated to include admissions in Veterans Administration (VA) hospitals in the THA/TKA readmission measure. However, the CABG surgery measure does not include VA hospital admissions.

Results for both of these readmission measures are posted and updated annually here on Medicare.gov.

CMS contracted with the Yale New Haven Health Services Corporation — Center for Outcomes Research and Evaluation (YNHHSC/CORE) to update the CABG surgery and THA/TKA readmission measures for 2024 public reporting through a process of measure reevaluation.

### 2.2. Overview of Measure Methodology

The 2024 risk-adjusted readmission measures use specifications from the original measure methodology reports posted here on *QualityNet*, with refinements to the measures as listed in Appendix C and described in the prior measures updates and specifications reports posted here on *QualityNet*. An overview of the methodology is presented in this section.

For more information on the CMS programs that use these measures for fiscal year (FY) 2025, as well as their use in future FYs, please refer to the FY 2024 Inpatient Prospective Payment System (IPPS) Final Rule posted here 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 Part A during the index admission (not applicable to VA hospitalizations in the THA/TKA readmission measure);
- aged 65 or over; and

- discharged alive from a non-federal short-term acute care hospital (or VA hospital, in the case of the THA/TKA readmission measure).

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, or intracranial vascular procedures
- other chest and thoracic procedures

The CABG surgery readmission measure uses International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) codes on claims to define a CABG surgery and to identify a CABG surgery as non-isolated (and disqualify the admission from cohort inclusion). These codes are listed in the 2024 CABG Surgery Readmission Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

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

- fracture of the pelvis or lower limbs coded in the principal or secondary discharge diagnosis fields on the index admission claim (Note: Periprosthetic fractures must be additionally coded as present on admission [POA] in order to disqualify a THA/TKA from cohort inclusion, unless exempt from POA reporting.)
- a concurrent partial hip or knee arthroplasty procedure
- a concurrent revision, resurfacing, or implanted device/prosthesis removal procedure
- mechanical complication coded in the principal discharge diagnosis field on the index admission claim
- 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 on the index admission claim
- transfer from another acute care facility for the THA/TKA

The THA/TKA readmission measure uses ICD-10-PCS codes on claims to define a THA/TKA procedure. It also uses ICD-10-PCS codes as well as International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes on claims to identify a THA/TKA procedure as non-elective or non-primary (and disqualify the admission from cohort inclusion). These codes are listed in the 2024 THA/TKA Readmission Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

## Index Admissions Excluded from the Measures

The readmission measures exclude index admissions for patients:

- without at least 30 days of post-discharge enrollment in Medicare FFS (not applicable to VA hospitalizations in the THA/TKA readmission measure);
- discharged against medical advice; or
- with a principal diagnosis code of COVID-19 (ICD-10-CM code U07.1) **or** with a secondary diagnosis code of COVID-19 coded as POA on the index admission claim. These code specifications are outlined in the 2024 supplemental files [here](#) on *QualityNet*.

Note that patients who do not have a full 30 days of post-discharge enrollment in Medicare FFS due to death are eligible for inclusion in the cohorts. Thus, if a patient had an unplanned readmission and later died, all within 30 days of discharge from the index admission, the case would be captured in the outcome, assuming they met inclusion/exclusion criteria.

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 admissions are excluded from the cohort.

The THA/TKA measure also excludes index admissions for patients:

- admitted for the index procedure and subsequently transferred to another acute care facility; or
- 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 for non-VA hospitalizations 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 ineligible provider IDs.

The percentage of admissions excluded based on each criterion is shown in [Section 4](#) in [Figure 4.2.1.1](#) and [Figure 4.3.1.1](#) for CABG surgery and THA/TKA, respectively.

### Patients Transferred between Hospitals

The measures consider multiple hospitalizations that result from hospital-to-hospital transfers 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 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 perioperative 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. This is true also for patients that are transferred in from another hospital for their CABG surgery. Therefore, in a series of one or more transfers, the first admission where an eligible CABG procedure was done is included in the cohort, regardless of whether the patient is transferred in or transferred out. Furthermore, the measure assigns an unplanned readmission that occurs within 30 days of discharge 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, the Hospital A admission would be included in the cohort, and 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’s perspective, an unplanned readmission for

any cause is an adverse event. In addition, making inferences about quality of care based solely on the documented cause of readmission is difficult. For example, a patient might experience a procedure-related complication following their THA/TKA that goes untreated, resulting in renal failure after discharge and subsequent readmission. In this context, considering the readmission to be unrelated to the care that the patient received for the THA/TKA during the index admission would be inappropriate.

Readmissions with a principal diagnosis code of COVID-19 (U07.1) or with a secondary diagnosis code of COVID-19 coded as POA on the readmission claim are not eligible for the readmission outcome and are excluded. These code specifications are outlined in the 2024 supplemental files [here](#) on *QualityNet*.

### 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.<sup>2</sup> 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>3-6</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) a patient began an unplanned readmission with an ED visit, observation stay, or care received in another outpatient location within the same facility (for example, outpatient diagnostic imaging), (b) the patient was admitted as an inpatient to that hospital within three days of that outpatient encounter, and (c) the care was 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 regarding 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.

In the case where one of the multiple readmissions is a COVID-19 readmission (as described above and defined in the 2024 supplemental files [here](#) on *QualityNet*), the first readmission continues to drive the readmission outcome. If the first readmission is coded with COVID-19, any subsequent unplanned readmission is not considered in the outcome, and the readmission outcome is “no.” However, if the first readmission is not coded with COVID-19, it is considered an eligible readmission, regardless of whether a

COVID-19 readmission follows, and the readmission outcome would be “yes” (if unplanned).

### 2.2.3 Planned Readmission Algorithm (Version 4.0 2024)

The planned readmission algorithm is a set of criteria for classifying readmissions as planned using Medicare claims and VA administrative data (in the case of the THA/TKA readmission measure). 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:

- A few specific, limited types of care are always considered planned (transplant surgery, maintenance chemotherapy/immunotherapy, rehabilitation).
- A planned readmission is defined as a non-acute readmission for a scheduled procedure.
- 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 and measure experts reviewed the algorithm in the context of each measure-specific cohort and, where clinically indicated, adapted the content of the algorithm to better reflect the likely clinical experience of each measure’s cohort. The CABG and THA/TKA readmission measures make a few modifications to the planned readmission algorithm.

For each measure, the planned readmission algorithm uses a flowchart and four tables of specific Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) Clinical Classification Software (CCS) procedure categories, AHRQ CCS diagnosis categories, and singular ICD-10 codes to classify readmissions as planned. As illustrated in Figure E.1 in Appendix E, readmissions are considered planned if ANY of the following occurs during the readmission:

- A procedure is performed that is in one of the procedure categories that are always planned regardless of diagnosis.
- The principal diagnosis is in one of the diagnosis categories that are always planned.
- A procedure is performed that is one of the defined potentially planned procedures and the principal diagnosis is not in the list of defined acute discharge diagnoses.

The diagnoses and procedures referred to above can be found in Tables PR.1, PR.2, PR.3 (CABG), and PR.4 (CABG) for CABG surgery, and Tables PR.1, PR.2, PR.3 (THA/TKA), and PR.4 (THA/TKA) for THA/TKA, in the 2024 supplemental files posted here on *QualityNet*.

Note that CCS mappings to ICD-10-CM and ICD-10-PCS codes are available here on *QualityNet*.

## 2.2.4 Risk-Adjustment Variables

To account for differences in case mix among hospitals, the measures include an adjustment for factors such as age, comorbid diseases, and indicators of patient frailty, which 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 up to 12 months prior to the index admission, and all claims data for the index admission itself. Risk-adjustment variables are also obtained from VA administrative data in the case of VA beneficiaries in the THA/TKA readmission measure. Inpatient, outpatient, and physician claims/VA data from January 1, 2020 through June 30, 2020 encounters are not used due to the declared COVID-19 public health emergency (PHE), as discussed in Section 3.2.2; as a result, the pre-index admission time frame would be less than 12 months for some patients, depending on their index admission date.

The measures' adjustment for case mix differences among hospitals is 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 the time of the index admission, or any time within the preceding 12 months (or less), are included in risk adjustment. Complications that arise during the course of the hospitalization are not used in risk adjustment.

The process for determining patient comorbidities present at the time of the index admission from the index admission claim/VA data uses a POA algorithm. In brief, a secondary diagnosis ICD-10-CM code on the index admission is used in risk adjustment if **one** of the following is true:

1. The POA indicator for the secondary diagnosis code = 'Y' on the index admission.
2. The secondary diagnosis code is classified as a POA-exempt code that is considered "always POA" (as designated by our clinical experts).
3. If the index claim/VA data is void of POA coding (that is, no reported POA indicator values for any of the secondary diagnoses), then the secondary diagnosis is used in risk adjustment if it is NOT mapped to a Condition Category (CC) that is included in the potential complications list.

The POA algorithm applies only in the case of secondary diagnosis codes on the index admission that are assigned to a CC used in risk adjustment of a measure. ICD-10 code-defined risk variables, such as 'Post traumatic osteoarthritis' (used in the THA/TKA readmission measure), do not use the algorithm.

Refer to the 2024 supplemental files posted here on *QualityNet* for the list of CC-defined risk-adjustment variables and the specifications for the ICD-10 code-defined risk-adjustment variables. The lists of potential complications referred to in Step 3 of the algorithm are also included in the 2024 supplemental files.

CC mappings to ICD-10-CM codes, as well as the "POA-Exempt Codes Considered Always POA for 2024" table (referred to in Step 2 of the algorithm), are available here on *QualityNet*.

The measures do not include an adjustment for social drivers of health because the association between social drivers of health and health outcomes can be due, in part, to differences in the quality of health care that these groups of patients receive. The intent is for the measures to adjust for patient demographic and clinical characteristics while illuminating important quality differences. The CMS consensus-based entity (CBE) re-endorsed the measures without adjustment for patient-level social drivers of health in the last endorsement maintenance submission prior to 2024.

### 2.2.5 Data Sources

The data sources for these analyses are Medicare administrative claims for both measures; VA administrative data for the THA/TKA readmission measure; and enrollment information for patients having hospitalizations with discharge dates between July 1, 2020 and June 30, 2023. 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 July 1, 2020 and March 31, 2023, 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 and associated inpatient and outpatient VA administrative data (in the case of the THA/TKA readmission measure) from up to 12 months prior to the index admission (as discussed in [Section 2.2.4](#)), as well as inpatient Medicare administrative claims and VA administrative data (in the case of the THA/TKA readmission measure) for the 30-day period after discharge from the index admission, for patients having hospitalizations with discharge dates in the aforementioned time period. Refer to the original methodology reports posted [here](#) on *QualityNet* for further descriptions of these data sources and an explanation of the three-year measurement period.

### 2.2.6 Measure Calculation

The hospital-level 30-day all-cause RSRR for each measure is estimated using a [hierarchical logistic regression model](#). 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>7</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. 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](#), as illustrated in [Figure 2.2.6.1](#).

**Figure 2.2.6.1 — Equation for RSRR Calculation**

$$\text{RSRR} = \frac{\text{Predicted Readmissions}}{\text{Expected Readmissions}} \times \text{National Observed Readmission Rate}$$

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; 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 4.2.3.1](#) and [Table 4.3.3.1](#), for the CABG surgery and THA/TKA readmission 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 transformed using the inverse-link-function 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 that a common effect using all hospitals in our sample is added in place of the hospital-specific effect. These results are also transformed using the inverse-link-function 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 time 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 posted [here](#) on *QualityNet*.

## 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:

- “Better than the National Rate” if the entire 95% interval estimate surrounding the hospital’s rate is lower than the national observed readmission rate
- “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

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 conclude how the hospital is performing. If a hospital has fewer than 25 eligible cases, the hospital’s readmission rate and interval estimates will not be publicly reported for the measure.

The distribution of hospitals by performance category in the U.S. for this reporting period is described in [Section 4.2.5](#) and [Section 4.3.5](#), for CABG surgery and THA/TKA, respectively.

### 3. UPDATES TO MEASURES FOR 2024 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, empirical analyses, and assessment of coding trends that reveal shifts in clinical practice or billing patterns. Input is solicited from a workgroup composed of up to 20 clinical and measure experts, inclusive of internal and external consultants and subcontractors. As this report describes, for 2024 public reporting, we made the following modifications to the measures:

- Updated the ICD-10 code-based specifications used in the measures. Specifically, we:
  - incorporated ICD-10-CM/PCS code changes into the cohort definitions and risk models that occurred in the following releases:
    - October 1, 2022 (FY 2023); and
    - April 1, 2023.
  - applied a YNHHS/CORE-modified v4.0 of the AHRQ HCUP’s beta version 2019.1 CCS for ICD-10-CM/PCS to the planned readmission algorithm.
  - applied a modified version of the FY 2023 V24 CMS-Hierarchical Condition Category (HCC) crosswalk that is maintained by RTI International to the risk models.

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

- Monitored code frequencies to identify any warranted specification changes due to possible changes in coding practices and patterns;
- Reviewed potentially clinically relevant codes that “neighbor” existing codes used in the measures to identify any warranted specification changes;
- Reviewed select pre-existing ICD-10 code-based specifications with our workgroup to confirm the appropriateness of specifications unaffected by the updates;
- Updated the measures’ SAS analytic packages (SAS packs) and documentation;
- Evaluated and validated model performance for the three years combined (July 2020 – June 2023); and
- Evaluated the stability of the risk-adjustment models over the three-year measurement period by examining the model variable frequencies, model coefficients, and the performance of the models in each year (July 2020 – June 2021, July 2021 – June 2022, and July 2022 – June 2023).

## 3.2. Detailed Discussion of Measure Updates

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

#### Cohort Definitions

We examined the code sets from the two ICD-10-CM/PCS releases outlined above, with particular attention to newly added codes. We then solicited input from our workgroup to determine which, if any, of the newly implemented ICD-10 codes in the code sets should be added to the cohort definitions. We reviewed approximately 1,218 new ICD-10-CM codes and 365 new ICD-10-PCS codes. These code totals reflect new code additions since 2023 public reporting.

These processes, in addition to the surveillance and workgroup processes described above in the Rationale for Measure Updates section, led to the following change:

- added ICD-10-PCS codes to the list of codes that identify a THA/TKA procedure as non-elective or non-primary and disqualify the admission from THA/TKA cohort inclusion

#### Readmission Outcome and the Planned Readmission Algorithm

In September 2019 and December 2020, the AHRQ HCUP released new versions of the CCS for ICD-10-CM and ICD-10-PCS codes, respectively, called the CCS Refined (CCSR). The magnitude of changes from the CCS beta versions to the CCSR is extensive. Until comprehensive testing can be completed on the CCSR, we will continue utilizing the existing beta version v2019.1 of the CCS for ICD-10-CM/PCS as the basis for the planned readmission algorithm specifications, updating it as appropriate with clinical expert input.

For 2024 public reporting, we examined the new ICD-10-CM and ICD-10-PCS codes in the two code set releases to determine the most appropriate CCS categorizations for the newly implemented ICD-10 codes, using the existing YNHHS/CORE-modified v3.0 of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS that was utilized in 2023 public reporting. We then solicited input from our workgroup to confirm the clinical appropriateness of the CCS categorizations of the newly implemented ICD-10 codes in relation to the planned readmission algorithm, and whether any changes were warranted. Updates to the CCS mappings included the incorporation of the new ICD-10-CM codes and ICD-10-PCS codes into approximately 49 AHRQ CCS diagnosis categories and 31 AHRQ CCS procedure categories, respectively. Additionally, two ICD-10-PCS codes were remapped from one CCS procedure category to another.

The workgroup also reviewed the newly implemented ICD-10 codes in the two ICD-10-CM/PCS code set releases to determine which, if any, should be added to the singular ICD-10 code lists that are also used in the algorithm (conditions that are not captured by AHRQ CCS categories). The intent was to maintain the clinical integrity of the algorithm.

These processes, in addition to the surveillance and workgroup processes described above, led to the following changes:

- Potentially planned procedures:
  - added one ICD-10-PCS code (associated with AHRQ CCS procedure category 49) to the singular ICD-10-PCS code list [This change only applies to the THA/TKA readmission measure.]
- Acute diagnoses:
  - added ICD-10-CM codes (associated with AHRQ CCS diagnosis categories 97, 101, 106, 115, 233, 238, 244, and 662) to the singular ICD-10-CM code lists

The YNHHS/CORE-modified mappings that were used for 2024 public reporting are posted [here](#) on *QualityNet*. They show the assignment of ICD-10 codes to the AHRQ CCS diagnosis and procedure categories, and detail the changes made for 2024 public reporting.

Analyses of the changes to the specifications suggest minimal impact to readmission measure rates.

### Risk Adjustment

We reviewed RTI International’s FY 2023 modified version of the V24 CMS-HCC crosswalk, examining how the newly implemented ICD-10 codes in the FY 2023 ICD-10-CM/PCS code set releases were classified and where there may be codes that RTI International reclassified from one HCC to another when they updated to the FY 2023 version. We then solicited input from our workgroup to confirm the clinical appropriateness of the HCC classifications of the newly implemented ICD-10 codes and any changes warranted due to code shifts. CC to ICD-10-CM code crosswalks were updated based on these processes, in addition to the surveillance and workgroup processes described above. The 2024 crosswalk files are available [here](#) on *QualityNet*.

The workgroup also reviewed the newly implemented ICD-10 codes in the two ICD-10-CM/PCS code set releases to determine which, if any, should be added to the singular ICD-10 code lists that are also used in risk adjustment (conditions that are not captured by CCs). This process, in addition to the surveillance and workgroup processes described above, led to the following change:

- added ICD-10-PCS and ICD-10-CM codes to the code list used to define the ‘History of coronary artery bypass graft (CABG) or valve surgery’ risk-adjustment variable [This change only applies to the CABG surgery readmission measure. For more details, refer to the 2024 CABG Surgery Readmission Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.]

Additionally, we reviewed the 1,218 new codes in the two ICD-10-CM releases and the changes made by CMS to the POA-exempt code list for FY 2023, to determine updates to the “POA-Exempt Codes Considered Always POA” table for 2024, as part of the risk-adjustment methodology used by the measures (discussed in [Section 2.2.4](#)). The resulting changes are detailed in the table posted [here](#) on *QualityNet*.

### 3.2.2 COVID-19

The following modifications made to the measures in prior public reporting years in response to the COVID-19 PHE will continue for 2024 public reporting:

- Claims data for January 1, 2020 through June 30, 2020 are excluded from use in the measures under CMS’s Extraordinary Circumstances Exception (ECE) policy.<sup>8-11</sup> As a result, the typical 12-month look-back period for use of claims/VA data in risk adjustment totals less than 12 months for those patients whose 12-month period includes any portion of the January 1, 2020 through June 30, 2020 time frame.
- A ‘History of COVID-19’ risk variable is incorporated into the risk-adjustment models for both measures.
- COVID-19 index admissions are excluded from the cohorts. COVID-19 index admissions are defined by a principal diagnosis code of COVID-19 **or** a secondary diagnosis code of COVID-19 coded as POA on the index admission claim.
- COVID-19 readmissions are not eligible for the readmission outcome and are excluded. COVID-19 readmissions are defined by a principal diagnosis code of COVID-19 **or** a secondary diagnosis code of COVID-19 coded as POA on the readmission claim.

A brief summary of how COVID-19 is addressed in each measure, including code specifications, can be found in the 2024 supplemental files [here](#) on *QualityNet*.

### 3.2.3 Additional Notes

The goal of these specification updates was to maintain the intent of the measures.

**Changes made to the specifications are detailed in the following supplemental files that accompany this report:**

- 2024 CABG Surgery Readmission Measure Code Specifications
- 2024 THA/TKA Readmission Measure Code Specifications

These supplemental files are posted [here](#) on *QualityNet*.

The ICD-10 code listings in this report and the 2024 supplemental files reflect the most current descriptions for each code.

### 3.3. Changes to SAS Packs

We revised the measure SAS packs to accommodate the specification updates discussed in [Section 3.1](#) and [Section 3.2](#) above. The new SAS packs and documentation are available upon request. Please submit your request using the QualityNet Q&A tool: [https://cmsqualitysupport.servicenow.com/qnet\\_qa?id=ask\\_a\\_question](https://cmsqualitysupport.servicenow.com/qnet_qa?id=ask_a_question) > Program: Inpatient Claims-Based Measures > Readmission > Understanding Measure Methodology. **Do NOT submit patient-identifiable information (for example, date of birth, Social Security**

**number, Medicare Beneficiary Identifier, and encounter dates such as admission dates, discharge dates, procedure dates, and ED/observation dates) into this tool.**

The SAS packs include descriptions of 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 packs 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 the longitudinal patient data from the entire national sample of acute care hospitals that is used to estimate the individual hospital-specific effects, the average hospital-specific effect, and the risk-adjustment coefficients used in the equations.

## 4. RESULTS FOR 2024 PUBLIC REPORTING

### 4.1. Assessment of Updated Models

The hospital-level 30-day all-cause RSRRs for the measures are estimated 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 updates and specification reports on the readmission measures page [here](#) on *QualityNet*, for further details.

We evaluated the performance of the models using the July 2020 to June 2023 data for the 2024 reporting period. We examined the differences in the frequencies of patient risk factors and the model parameter coefficients.

For each of the procedures, we assessed logistic regression model performance in terms of discriminant ability 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 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.

***Please note that, due to seasonal fluctuations and other factors, the statistics from one individual year within these sections may not be directly comparable to the other two years.***

## 4.2. CABG Surgery Readmission 2024 Model Results

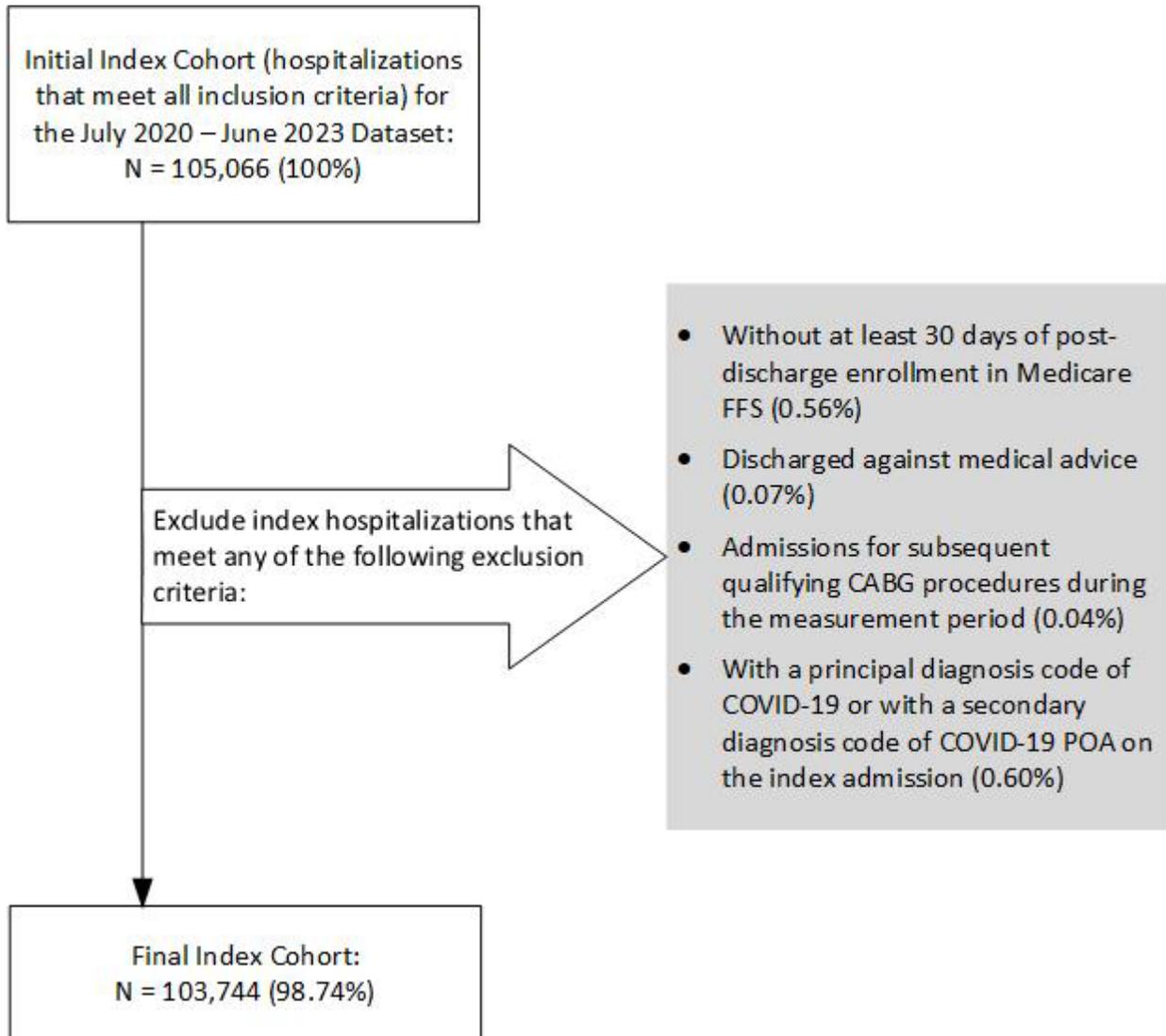
### 4.2.1 Index Cohort Exclusions

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 2020 – June 2023 dataset is presented in [Figure 4.2.1.1](#).

Admissions may have been counted in more than one exclusion category because they are not mutually exclusive. The index cohort includes short-term acute care hospitalizations for 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 Part A during the index admission; and
- were alive at discharge.

**Figure 4.2.1.1 — CABG Surgery Cohort Exclusions in the July 2020 – June 2023 Dataset**



#### 4.2.2 Frequency of CABG Surgery Model Variables

We examined the frequencies of clinical and demographic variables. Frequencies of model variables were relatively stable over the measurement period.

Refer to [Table 4.2.2.1](#) for more detail.

**Table 4.2.2.1 — Frequency of CABG Surgery Model Variables over Different Time Periods**

Variable (% unless otherwise indicated)	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Total N	35,866	34,075	33,803	103,744
Mean age (SD)	73.5 (5.3)	73.6 (5.2)	73.6 (5.1)	73.5 (5.2)
Male	74.7	75.4	76.0	75.4

<b>Variable (% unless otherwise indicated)</b>	<b>07/2020 – 06/2021</b>	<b>07/2021 – 06/2022</b>	<b>07/2022 – 06/2023</b>	<b>07/2020 – 06/2023</b>
History of COVID-19	4.5	11.1	18.6	11.3
Cardiogenic shock	2.3	2.5	2.3	2.4
History of coronary artery bypass graft (CABG) or valve surgery	8.0	8.7	8.5	8.4
Cancer; metastatic cancer and acute leukemia (CC 8 – 14)	15.9	19.6	20.2	18.5
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	50.7	51.8	51.4	51.3
Protein-calorie malnutrition (CC 21)	2.5	2.7	3.0	2.7
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25 – 26)	95.3	96.5	96.9	96.2
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	23.2	25.8	26.1	25.0
Severe hematological disorders (CC 46)	0.4	0.4	0.5	0.4
Dementia or other specified brain disorders (CC 51 – 53)	4.5	5.1	5.3	4.9
Major psychiatric disorders (CC 57 – 59)	4.2	4.9	5.1	4.7
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	3.3	3.8	3.9	3.7
Polyneuropathy; other neuropathies (CC 75, 81)	13.5	16.4	16.6	15.5
Congestive heart failure (CC 85)	35.6	36.7	36.9	36.4
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	43.2	47.0	48.4	46.1
Stroke (CC 99 – 100)	3.2	4.2	4.3	3.9
Cerebrovascular disease (CC 101 – 102, 105)	30.4	34.7	34.7	33.2
Vascular or circulatory disease (CC 106 – 109)	37.3	41.5	42.1	40.2
Chronic obstructive pulmonary disease (COPD) (CC 111)	20.0	18.9	18.6	19.2
Fibrosis of lung or other chronic lung disorders (CC 112)	3.5	4.1	4.4	3.9
Pneumonia (CC 114 – 116)	7.9	9.0	8.7	8.5
Other respiratory disorders (CC 118)	28.9	32.4	34.4	31.9
Dialysis status (CC 134)	2.3	2.2	2.2	2.3
Renal failure (CC 135 – 140)	33.8	34.9	34.4	34.3
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	2.9	3.3	3.3	3.2

### 4.2.3 CABG Surgery Model Parameters and Performance

Table 4.2.3.1 shows hierarchical logistic regression model parameter coefficients by individual year and for the combined three-year dataset.

**Table 4.2.3.1 — Hierarchical Logistic Regression Model Parameter Coefficients for CABG Surgery over Different Time Periods**

Variable	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Intercept	-2.623	-2.717	-2.838	-2.694
Years over 65 (continuous)	0.026	0.024	0.035	0.028
Male	-0.261	-0.345	-0.253	-0.285
History of COVID-19	-0.194	-0.046	0.039	-0.049
Cardiogenic shock	0.244	-0.113	0.215	0.121
History of coronary artery bypass graft (CABG) or valve surgery	0.035	0.053	-0.073	0.006
Cancer; metastatic cancer and acute leukemia (CC 8 – 14)	0.026	0.023	-0.018	0.006
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	0.140	0.209	0.132	0.158
Protein-calorie malnutrition (CC 21)	0.268	0.188	0.316	0.260
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25 – 26)	-0.125	-0.116	-0.054	-0.110
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	0.181	0.211	0.200	0.193
Severe hematological disorders (CC 46)	0.498	0.088	0.127	0.262
Dementia or other specified brain disorders (CC 51 – 53)	0.157	0.177	0.114	0.146
Major psychiatric disorders (CC 57 – 59)	0.155	0.072	0.053	0.092
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	0.039	0.071	0.214	0.109
Polyneuropathy; other neuropathies (CC 75, 81)	0.148	0.101	0.131	0.124
Congestive heart failure (CC 85)	0.337	0.225	0.283	0.286
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	0.038	0.164	0.110	0.098
Stroke (CC 99 – 100)	0.238	0.025	-0.025	0.072
Cerebrovascular disease (CC 101 – 102, 105)	-0.045	-0.011	-0.007	-0.024
Vascular or circulatory disease (CC 106 – 109)	0.104	0.118	0.102	0.104
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.234	0.312	0.253	0.269
Fibrosis of lung or other chronic lung disorders (CC 112)	0.067	0.041	-0.055	0.018
Pneumonia (CC 114 – 116)	0.123	0.152	0.217	0.154
Other respiratory disorders (CC 118)	0.165	0.102	0.089	0.118

Variable	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Dialysis status (CC 134)	0.264	0.348	0.416	0.346
Renal failure (CC 135 – 140)	0.309	0.307	0.225	0.284
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	0.286	0.238	0.296	0.271

Table 4.2.3.2 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.

**Table 4.2.3.2 — Adjusted OR and 95% CIs for the CABG Surgery Hierarchical Logistic Regression Model over Different Time Periods**

Variable	07/2020 – 06/2021 OR (95% CI)	07/2021 – 06/2022 OR (95% CI)	07/2022 – 06/2023 OR (95% CI)	07/2020 – 06/2023 OR (95% CI)
Years over 65 (continuous)	1.03 (1.02-1.03)	1.02 (1.02-1.03)	1.04 (1.03-1.04)	1.03 (1.02-1.03)
Male	0.77 (0.71-0.83)	0.71 (0.65-0.77)	0.78 (0.72-0.84)	0.75 (0.72-0.79)
History of COVID-19	0.82 (0.70-0.97)	0.95 (0.85-1.07)	1.04 (0.95-1.14)	0.95 (0.89-1.01)
Cardiogenic shock	1.28 (1.06-1.54)	0.89 (0.72-1.11)	1.24 (1.02-1.52)	1.13 (1.01-1.27)
History of coronary artery bypass graft (CABG) or valve surgery	1.04 (0.92-1.17)	1.05 (0.93-1.19)	0.93 (0.82-1.06)	1.01 (0.94-1.08)
Cancer; metastatic cancer and acute leukemia (CC 8 – 14)	1.03 (0.94-1.12)	1.02 (0.94-1.12)	0.98 (0.90-1.07)	1.01 (0.96-1.06)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	1.15 (1.07-1.23)	1.23 (1.14-1.33)	1.14 (1.06-1.23)	1.17 (1.12-1.22)
Protein-calorie malnutrition (CC 21)	1.31 (1.10-1.56)	1.21 (1.00-1.45)	1.37 (1.16-1.63)	1.30 (1.17-1.44)
Morbid obesity; other endocrine/metabolic/nutritional disorders (CC 22, 25 – 26)	0.88 (0.75-1.03)	0.89 (0.73-1.09)	0.95 (0.77-1.17)	0.90 (0.81-1.00)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	1.20 (1.11-1.30)	1.24 (1.14-1.34)	1.22 (1.13-1.33)	1.21 (1.16-1.27)
Severe hematological disorders (CC 46)	1.64 (1.10-2.47)	1.09 (0.68-1.76)	1.14 (0.73-1.76)	1.30 (1.01-1.67)
Dementia or other specified brain disorders (CC 51 – 53)	1.17 (1.01-1.35)	1.19 (1.03-1.38)	1.12 (0.97-1.29)	1.16 (1.06-1.26)
Major psychiatric disorders (CC 57 – 59)	1.17 (1.00-1.36)	1.07 (0.92-1.25)	1.05 (0.91-1.23)	1.10 (1.00-1.20)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	1.04 (0.87-1.24)	1.07 (0.90-1.27)	1.24 (1.05-1.46)	1.12 (1.01-1.23)
Polyneuropathy; other neuropathies (CC 75, 81)	1.16 (1.06-1.27)	1.11 (1.01-1.21)	1.14 (1.04-1.25)	1.13 (1.07-1.19)

Variable	07/2020 – 06/2021 OR (95% CI)	07/2021 – 06/2022 OR (95% CI)	07/2022 – 06/2023 OR (95% CI)	07/2020 – 06/2023 OR (95% CI)
Congestive heart failure (CC 85)	1.40 (1.30-1.51)	1.25 (1.16-1.35)	1.33 (1.23-1.43)	1.33 (1.27-1.39)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	1.04 (0.97-1.11)	1.18 (1.09-1.27)	1.12 (1.04-1.20)	1.10 (1.06-1.15)
Stroke (CC 99 – 100)	1.27 (1.07-1.51)	1.02 (0.87-1.21)	0.98 (0.82-1.16)	1.08 (0.97-1.19)
Cerebrovascular disease (CC 101 – 102, 105)	0.96 (0.89-1.03)	0.99 (0.92-1.07)	0.99 (0.92-1.07)	0.98 (0.93-1.02)
Vascular or circulatory disease (CC 106 – 109)	1.11 (1.03-1.19)	1.13 (1.04-1.21)	1.11 (1.03-1.19)	1.11 (1.06-1.16)
Chronic obstructive pulmonary disease (COPD) (CC 111)	1.26 (1.17-1.37)	1.37 (1.25-1.49)	1.29 (1.18-1.40)	1.31 (1.25-1.37)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.07 (0.90-1.27)	1.04 (0.88-1.23)	0.95 (0.80-1.12)	1.02 (0.93-1.12)
Pneumonia (CC 114 – 116)	1.13 (1.01-1.27)	1.16 (1.04-1.30)	1.24 (1.11-1.39)	1.17 (1.09-1.24)
Other respiratory disorders (CC 118)	1.18 (1.10-1.27)	1.11 (1.03-1.20)	1.09 (1.01-1.18)	1.13 (1.08-1.18)
Dialysis status (CC 134)	1.30 (1.09-1.56)	1.42 (1.17-1.71)	1.52 (1.25-1.83)	1.41 (1.27-1.57)
Renal failure (CC 135 – 140)	1.36 (1.27-1.47)	1.36 (1.26-1.47)	1.25 (1.16-1.35)	1.33 (1.27-1.39)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	1.33 (1.13-1.58)	1.27 (1.07-1.50)	1.34 (1.14-1.59)	1.31 (1.19-1.44)

Overall, model performance was stable over the three-year time period (Table 4.2.3.3).

**Table 4.2.3.3 — CABG Surgery Logistic Regression Model Performance over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Predictive ability, % (lowest decile – highest decile)	5.2 – 22.5	4.6 – 20.8	4.9 – 21.9	4.8 – 21.6
c-statistic	0.64	0.64	0.64	0.64

#### 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 10.7%. For the individual years, the *observed* rates were as follows:

- July 1, 2020 – June 30, 2021: 11.1%
- July 1, 2021 – June 30, 2022: 10.4%
- July 1, 2022 – June 30, 2023: 10.6%

Table 4.2.4.1 shows the distribution of hospital admission volumes.

**Table 4.2.4.1 — Distribution of Hospital CABG Surgery Admission Volumes over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Number of hospitals	1,038	1,035	1,018	1,082
Mean number of admissions (SD)	34.6 (30.2)	32.9 (30.2)	33.2 (30.8)	95.9 (89.8)
Range (min. – max.)	1 – 236	1 – 274	1 – 278	1 – 788
25 <sup>th</sup> percentile	14	13	13	38
50 <sup>th</sup> percentile	26	25	25	71
75 <sup>th</sup> percentile	45	43	44	126

Table 4.2.4.2 shows the distribution of hospital RSRRs.

**Table 4.2.4.2 — Distribution of Hospital CABG Surgery RSRRs over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Number of hospitals	1,038	1,035	1,018	1,082
Mean (SD)	11.2 (0.9)	10.4 (0.6)	10.6 (0.5)	10.7 (0.8)
Range (min. – max.)	9.0 – 16.3	8.7 – 13.2	8.9 – 12.9	8.1 – 14.3
25 <sup>th</sup> percentile	10.7	10.0	10.3	10.3
50 <sup>th</sup> percentile	11.1	10.3	10.5	10.7
75 <sup>th</sup> percentile	11.6	10.8	10.9	11.2

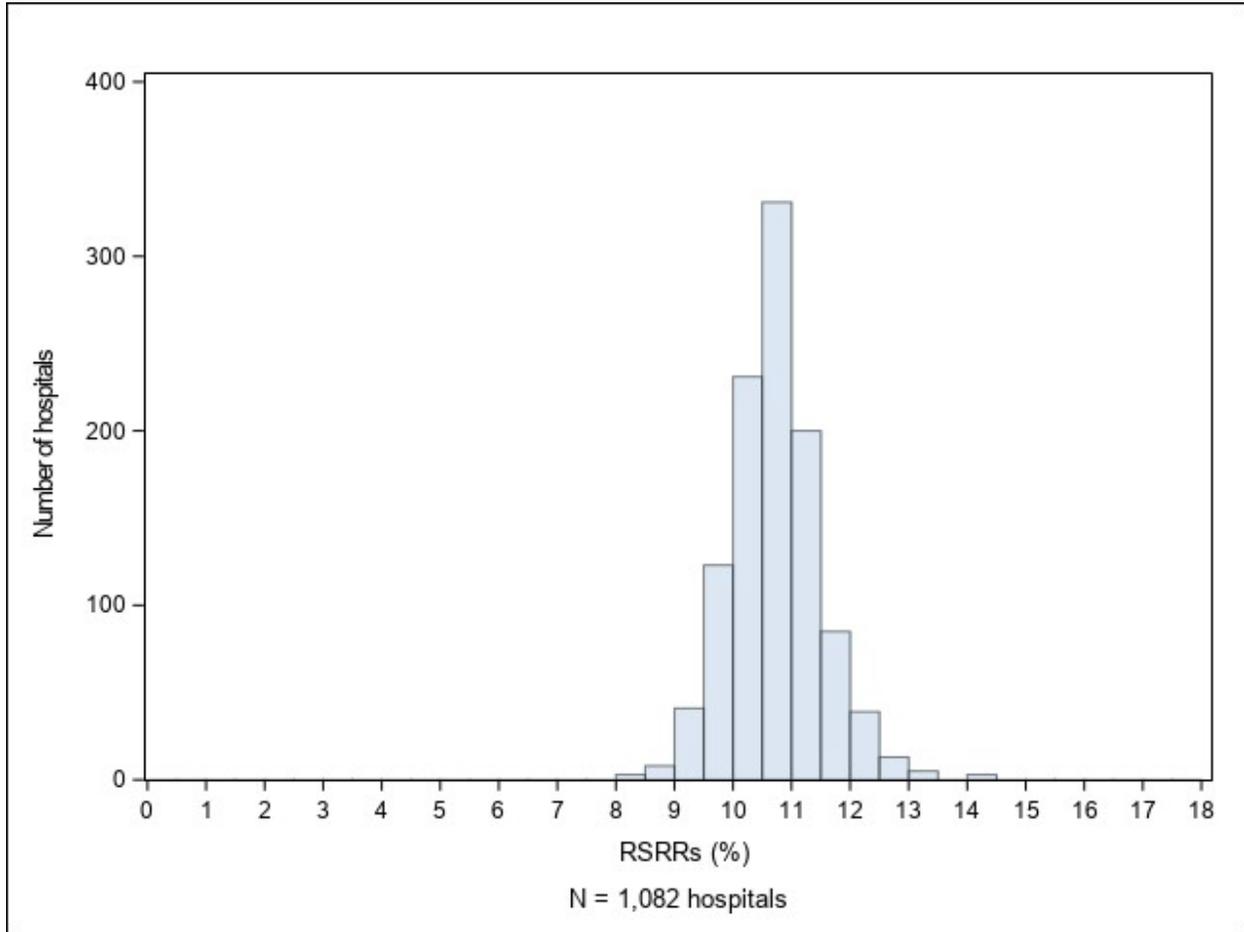
Table 4.2.4.3 shows the between-hospital variance by individual year as well as for the combined three-year dataset.

**Table 4.2.4.3 — Between-Hospital Variance for CABG Surgery over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Between-hospital variance (SE)	0.054 (0.014)	0.043 (0.015)	0.036 (0.014)	0.034 (0.006)

Figure 4.2.4.1 shows the overall distribution of the hospital RSRRs for the combined three-year dataset, which indicates that the hospital RSRRs are normally distributed. The odds of all-cause readmission if a patient is treated at a hospital one standard deviation (SD) above the national rate were 1.44 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>7</sup>

**Figure 4.2.4.1 — Distribution of Hospital 30-Day CABG Surgery RSRRs between July 2020 and June 2023**



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

Of 1,082 hospitals in the study cohort, 2 hospitals performed “Better than the National Rate,” 888 performed “No Different than the National Rate,” and 3 performed “Worse than the National Rate.” 189 were classified as “Number of Cases Too Small” (fewer than 25) to reliably conclude how the hospital is performing.

### 4.3. THA/TKA Readmission 2024 Model Results

#### 4.3.1 Index Cohort Exclusions

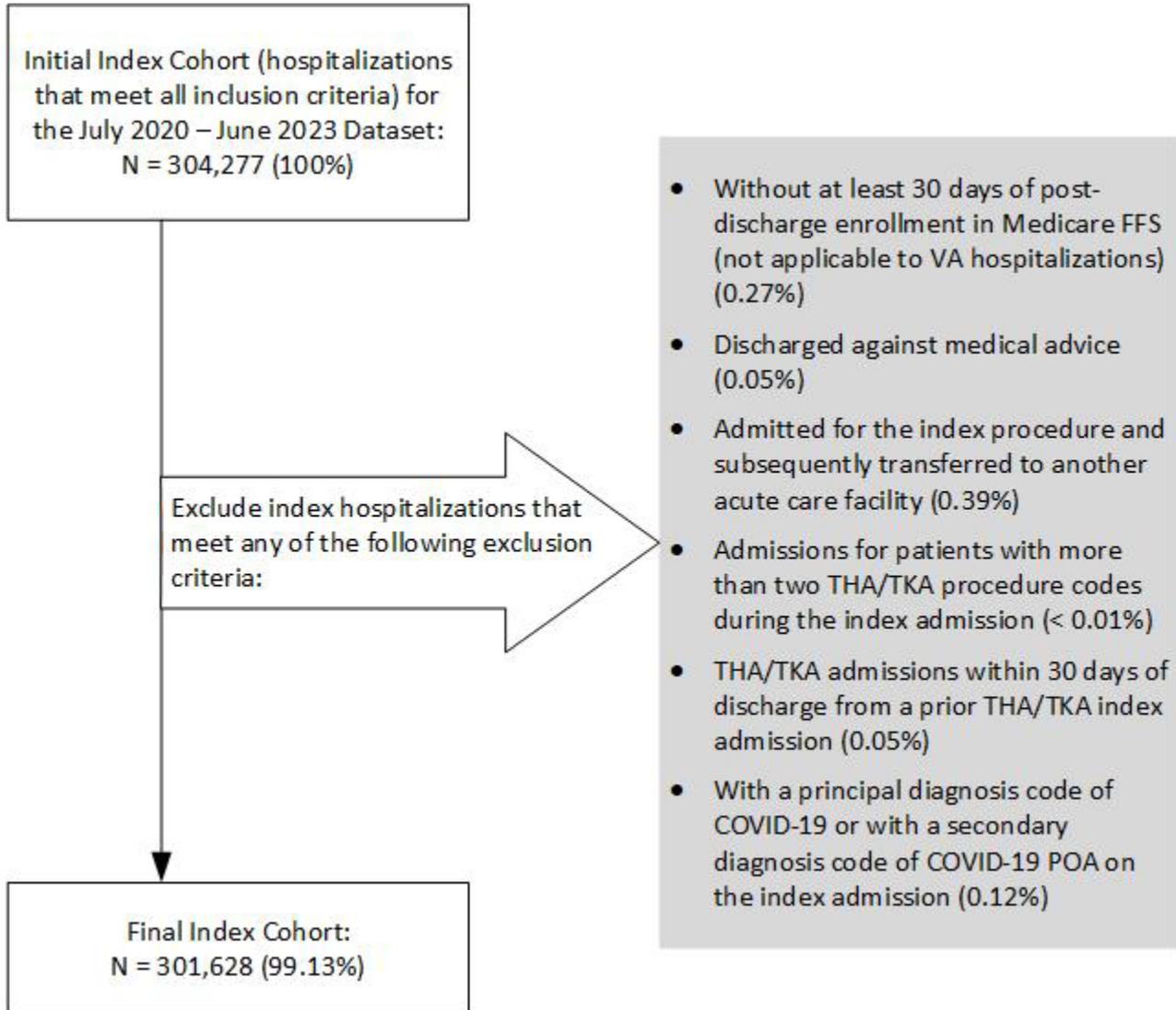
The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of THA/TKA admissions that met each exclusion criterion in the July 2020 – June 2023 dataset is presented in [Figure 4.3.1.1](#).

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 patients:

- aged 65 or over;
- enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission (not applicable to VA hospitalizations);
- with a qualifying elective primary THA/TKA procedure; and
- who were alive at discharge.

Of note, the decrease in measure cohort size that was observed in recent public reporting years continues for 2024 public reporting. These declines may reflect the growing impact of the THA/TKA procedures being performed on an outpatient basis.

**Figure 4.3.1.1 — THA/TKA Cohort Exclusions in the July 2020 – June 2023 Dataset**



**4.3.2 Frequency of THA/TKA Model Variables**

We examined the frequencies of clinical and demographic variables. Frequencies of model variables were relatively stable over the measurement period.

Refer to [Table 4.3.2.1](#) for more detail.

**Table 4.3.2.1 — Frequency of THA/TKA Model Variables over Different Time Periods**

Variable (% unless otherwise indicated)	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Total N	126,690	95,107	79,831	301,628
Mean age (SD)	74.4 (6.0)	74.9 (6.1)	75.3 (6.1)	74.8 (6.0)
Male	38.7	37.8	37.7	38.2

<b>Variable (% unless otherwise indicated)</b>	<b>07/2020 – 06/2021</b>	<b>07/2021 – 06/2022</b>	<b>07/2022 – 06/2023</b>	<b>07/2020 – 06/2023</b>
History of COVID-19	3.1	9.0	17.8	8.9
Index admissions with an elective THA procedure	39.5	36.9	35.4	37.6
Number of procedures (two vs. one)	2.1	1.9	2.1	2.0
Other congenital deformity of hip (joint)	0.3	0.3	0.2	0.3
Post traumatic osteoarthritis	1.3	1.8	2.0	1.7
Severe infection; other infectious diseases (CC 1, 3 – 7)	14.3	19.1	20.4	17.4
Metastatic cancer and acute leukemia (CC 8)	0.8	1.0	1.1	0.9
Cancer (CC 9 – 14)	15.8	20.3	21.1	18.6
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	26.8	30.0	31.2	29.0
Protein-calorie malnutrition (CC 21)	0.7	1.0	1.3	1.0
Morbid obesity (CC 22)	10.6	12.4	13.7	12.0
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	14.0	18.2	20.2	16.9
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	10.0	11.5	11.9	11.0
Severe hematological disorders (CC 46)	0.4	0.5	0.6	0.4
Dementia or other specified brain disorders (CC 51 – 53)	4.2	5.9	7.0	5.5
Major psychiatric disorders (CC 57 – 59)	7.3	9.0	10.3	8.6
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	1.6	2.2	2.6	2.1
Polyneuropathy; other neuropathies (CC 75, 81)	18.6	22.1	23.2	20.9
Congestive heart failure (CC 85)	11.7	14.1	15.9	13.6
Coronary atherosclerosis or angina (CC 88 – 89)	24.7	27.8	28.5	26.7
Hypertension (CC 95)	75.6	79.7	79.8	78.0
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	28.0	31.9	34.0	30.8
Stroke (CC 99 – 100)	1.7	2.6	2.9	2.3
Vascular or circulatory disease (CC 106 – 109)	22.3	28.4	30.7	26.4
Chronic obstructive pulmonary disease (COPD) (CC 111)	11.6	12.7	13.3	12.4
Pneumonia (CC 114 – 116)	2.6	3.9	4.3	3.5
Dialysis status (CC 134)	0.3	0.4	0.4	0.4
Renal failure (CC 135 – 140)	17.9	20.9	23.2	20.2
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	2.0	2.9	3.3	2.6
Cellulitis, local skin infection (CC 164)	4.8	6.9	7.4	6.1
Other injuries (CC 174)	18.5	26.4	27.7	23.4
Major symptoms, abnormalities (CC 178), except ICD-10-CM codes R09.01 and R09.02	62.4	71.7	74.3	68.5

### 4.3.3 THA/TKA Model Parameters and Performance

Table 4.3.3.1 shows hierarchical logistic regression model parameter coefficients by individual year and for the combined three-year dataset.

**Table 4.3.3.1 — Hierarchical Logistic Regression Model Parameter Coefficients for THA/TKA over Different Time Periods**

Variable	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Intercept	-4.308	-4.394	-4.253	-4.279
Years over 65 (continuous)	0.039	0.039	0.039	0.039
Male	0.095	0.200	0.136	0.143
History of COVID-19	-0.139	0.075	-0.036	-0.026
Index admissions with an elective THA procedure	0.180	0.158	0.130	0.158
Number of procedures (two vs. one)	0.109	0.141	0.115	0.117
Other congenital deformity of hip (joint)	0.180	0.444	0.119	0.248
Post traumatic osteoarthritis	-0.101	-0.016	0.041	-0.025
Severe infection; other infectious diseases (CC 1, 3 – 7)	0.092	0.035	0.059	0.057
Metastatic cancer and acute leukemia (CC 8)	0.177	0.008	0.118	0.109
Cancer (CC 9 – 14)	0.004	0.013	-0.048	-0.012
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	0.122	0.196	0.021	0.112
Protein-calorie malnutrition (CC 21)	0.214	0.097	0.106	0.134
Morbid obesity (CC 22)	0.272	0.203	0.163	0.214
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	0.268	0.259	0.204	0.239
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	0.134	0.162	0.119	0.137
Severe hematological disorders (CC 46)	0.437	0.054	0.357	0.292
Dementia or other specified brain disorders (CC 51 – 53)	0.178	0.124	0.157	0.147
Major psychiatric disorders (CC 57 – 59)	0.259	0.235	0.178	0.221
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	0.069	0.227	0.042	0.107
Polyneuropathy; other neuropathies (CC 75, 81)	0.169	0.053	0.041	0.093
Congestive heart failure (CC 85)	0.312	0.230	0.261	0.268
Coronary atherosclerosis or angina (CC 88 – 89)	0.147	0.083	0.138	0.125
Hypertension (CC 95)	0.136	0.127	0.151	0.133
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	0.191	0.149	0.157	0.169
Stroke (CC 99 – 100)	0.099	0.063	0.143	0.097
Vascular or circulatory disease (CC 106 – 109)	0.106	0.113	0.102	0.103
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.336	0.268	0.237	0.281
Pneumonia (CC 114 – 116)	0.222	0.141	0.147	0.161
Dialysis status (CC 134)	0.442	0.659	0.640	0.571

Variable	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Renal failure (CC 135 – 140)	0.252	0.202	0.253	0.234
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	0.223	0.255	0.141	0.203
Cellulitis, local skin infection (CC 164)	0.129	0.150	0.186	0.150
Other injuries (CC 174)	0.143	0.157	0.168	0.147
Major symptoms, abnormalities (CC 178), except ICD-10-CM codes R09.01 and R09.02	0.082	0.120	0.159	0.112

Table 4.3.3.2 shows the risk-adjusted ORs and 95% CIs for the THA/TKA readmission model by individual year and for the combined three-year dataset.

**Table 4.3.3.2 — Adjusted OR and 95% CIs for the THA/TKA Hierarchical Logistic Regression Model over Different Time Periods**

Variable	07/2020 – 06/2021 OR (95% CI)	07/2021 – 06/2022 OR (95% CI)	07/2022 – 06/2023 OR (95% CI)	07/2020 – 06/2023 OR (95% CI)
Years over 65 (continuous)	1.04 (1.03 – 1.04)	1.04 (1.03 – 1.05)	1.04 (1.03 – 1.05)	1.04 (1.04 – 1.04)
Male	1.10 (1.04 – 1.17)	1.22 (1.14 – 1.31)	1.15 (1.07 – 1.23)	1.15 (1.11 – 1.20)
History of COVID-19	0.87 (0.75 – 1.02)	1.08 (0.97 – 1.20)	0.96 (0.89 – 1.05)	0.97 (0.92 – 1.03)
Index admissions with an elective THA procedure	1.20 (1.13 – 1.27)	1.17 (1.10 – 1.25)	1.14 (1.07 – 1.22)	1.17 (1.13 – 1.21)
Number of procedures (two vs. one)	1.11 (0.90 – 1.39)	1.15 (0.89 – 1.48)	1.12 (0.87 – 1.45)	1.12 (0.98 – 1.29)
Other congenital deformity of hip (joint)	1.20 (0.73 – 1.97)	1.56 (0.94 – 2.58)	1.13 (0.59 – 2.15)	1.28 (0.94 – 1.75)
Post traumatic osteoarthritis	0.90 (0.70 – 1.16)	0.98 (0.77 – 1.25)	1.04 (0.83 – 1.31)	0.98 (0.85 – 1.12)
Severe infection; other infectious diseases (CC 1, 3 – 7)	1.10 (1.02 – 1.18)	1.04 (0.96 – 1.12)	1.06 (0.98 – 1.15)	1.06 (1.01 – 1.11)
Metastatic cancer and acute leukemia (CC 8)	1.19 (0.92 – 1.54)	1.01 (0.75 – 1.35)	1.13 (0.85 – 1.49)	1.12 (0.95 – 1.31)
Cancer (CC 9 – 14)	1.00 (0.93–1.08)	1.01 (0.94–1.09)	0.95 (0.88–1.03)	0.99 (0.94–1.03)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	1.13 (1.06 – 1.20)	1.22 (1.14 – 1.30)	1.02 (0.95 – 1.10)	1.12 (1.08 – 1.16)
Protein-calorie malnutrition (CC 21)	1.24 (0.99 – 1.55)	1.10 (0.87 – 1.39)	1.11 (0.89 – 1.39)	1.14 (1.00 – 1.30)
Morbid obesity (CC 22)	1.31 (1.21 – 1.43)	1.22 (1.12 – 1.34)	1.18 (1.07 – 1.29)	1.24 (1.18 – 1.30)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	1.31 (1.22 – 1.40)	1.30 (1.20 – 1.40)	1.23 (1.13 – 1.33)	1.27 (1.22 – 1.33)

Variable	07/2020 – 06/2021 OR (95% CI)	07/2021 – 06/2022 OR (95% CI)	07/2022 – 06/2023 OR (95% CI)	07/2020 – 06/2023 OR (95% CI)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	1.14 (1.05 – 1.24)	1.18 (1.07 – 1.29)	1.13 (1.02 – 1.24)	1.15 (1.09 – 1.21)
Severe hematological disorders (CC 46)	1.55 (1.12 – 2.14)	1.06 (0.72 – 1.55)	1.43 (1.03 – 1.99)	1.34 (1.10 – 1.63)
Dementia or other specified brain disorders (CC 51 – 53)	1.19 (1.07 – 1.34)	1.13 (1.01–1.27)	1.17 (1.05–1.31)	1.16 (1.09–1.24)
Major psychiatric disorders (CC 57 – 59)	1.30 (1.18 – 1.42)	1.27 (1.14 – 1.40)	1.19 (1.08 – 1.32)	1.25 (1.18 – 1.32)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	1.07 (0.89 – 1.29)	1.26 (1.05 – 1.50)	1.04 (0.87 – 1.25)	1.11 (1.00 – 1.23)
Polyneuropathy; other neuropathies (CC 75, 81)	1.18 (1.11 – 1.26)	1.05 (0.98 – 1.14)	1.04 (0.97–1.12)	1.10 (1.05–1.14)
Congestive heart failure (CC 85)	1.37 (1.27–1.47)	1.26 (1.16–1.37)	1.30 (1.19 – 1.41)	1.31 (1.25 – 1.37)
Coronary atherosclerosis or angina (CC 88 – 89)	1.16 (1.09 – 1.23)	1.09 (1.01 – 1.17)	1.15 (1.07 – 1.24)	1.13 (1.09 – 1.18)
Hypertension (CC 95)	1.15 (1.07 – 1.23)	1.14 (1.04 – 1.24)	1.16 (1.06 – 1.27)	1.14 (1.09 – 1.20)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	1.21 (1.14 – 1.29)	1.16 (1.08 – 1.24)	1.17 (1.09 – 1.26)	1.18 (1.14 – 1.23)
Stroke (CC 99 – 100)	1.10 (0.93 – 1.32)	1.07 (0.90 – 1.26)	1.15 (0.98 – 1.36)	1.10 (1.00 – 1.21)
Vascular or circulatory disease (CC 106 – 109)	1.11 (1.04 – 1.18)	1.12 (1.04 – 1.20)	1.11 (1.03 – 1.19)	1.11 (1.07 – 1.15)
Chronic obstructive pulmonary disease (COPD) (CC 111)	1.40 (1.30 – 1.51)	1.31 (1.20 – 1.42)	1.27 (1.16 – 1.38)	1.33 (1.27 – 1.39)
Pneumonia (CC 114 – 116)	1.25 (1.09 – 1.42)	1.15 (1.01 – 1.31)	1.16 (1.02 – 1.32)	1.17 (1.09 – 1.27)
Dialysis status (CC 134)	1.56 1.16 – 2.09)	1.93 (1.41 – 2.64)	1.90 (1.39 – 2.58)	1.77 (1.48 – 2.11)
Renal failure (CC 135 – 140)	1.29 (1.20 – 1.38)	1.22 (1.14 – 1.32)	1.29 (1.20 – 1.39)	1.26 (1.21 – 1.32)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	1.25 (1.08 – 1.45)	1.29 (1.12 – 1.49)	1.15 (0.99 – 1.34)	1.23 (1.13 – 1.33)
Cellulitis, local skin infection (CC 164)	1.14 (1.02 – 1.27)	1.16 (1.04 – 1.30)	1.20 (1.08 – 1.34)	1.16 (1.09 – 1.24)
Other injuries (CC 174)	1.15 (1.08 – 1.23)	1.17 (1.09 – 1.25)	1.18 (1.10 – 1.27)	1.16 (1.11 – 1.21)
Major symptoms, abnormalities (CC 178), except ICD-10-CM codes R09.01 and R09.02	1.09 (1.02 – 1.16)	1.13 (1.04 – 1.22)	1.17 (1.08 – 1.28)	1.12 (1.07 – 1.17)

Overall, model performance was stable over the three-year time period (Table 4.3.3.3).

**Table 4.3.3.3 — THA/TKA Logistic Regression Model Performance over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Predictive ability, % (lowest decile – highest decile)	1.6 – 10.8	1.4 – 10.4	1.7 – 11.2	1.5 – 10.8
c-statistic	0.67	0.67	0.66	0.67

**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 4.5%. For the individual years, the *observed* rates were as follows:

- July 1, 2020 – June 30, 2021: 4.3%
- July 1, 2021 – June 30, 2022: 4.4%
- July 1, 2022 – June 30, 2023: 5.0%

Table 4.3.4.1 shows the distribution of hospital admission volumes.

**Table 4.3.4.1 — Distribution of Hospital THA/TKA Admission Volumes over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Number of hospitals	3,056	2,921	2,820	3,266
Mean number of admissions (SD)	41.5 (84.9)	32.6 (69.9)	28.3 (55.5)	92.4 (194.2)
Range (min. – max.)	1 – 2,142	1 – 1,574	1 – 940	1 – 4,501
25 <sup>th</sup> percentile	5	4	4	10
50 <sup>th</sup> percentile	16	11	10	33
75 <sup>th</sup> percentile	46	32	28	95

Table 4.3.4.2 shows the distribution of hospital RSRRs.

**Table 4.3.4.2 — Distribution of Hospital THA/TKA RSRRs over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Number of hospitals	3,056	2,921	2,820	3,266
Mean (SD)	4.3 (0.3)	4.4 (0.4)	5.0 (0.4)	4.5 (0.5)
Range (min. – max.)	2.7 – 6.3	2.2 – 7.3	3.1 – 7.2	2.2 – 7.2
25 <sup>th</sup> percentile	4.2	4.2	4.8	4.3
50 <sup>th</sup> percentile	4.3	4.3	4.9	4.5
75 <sup>th</sup> percentile	4.5	4.6	5.2	4.7

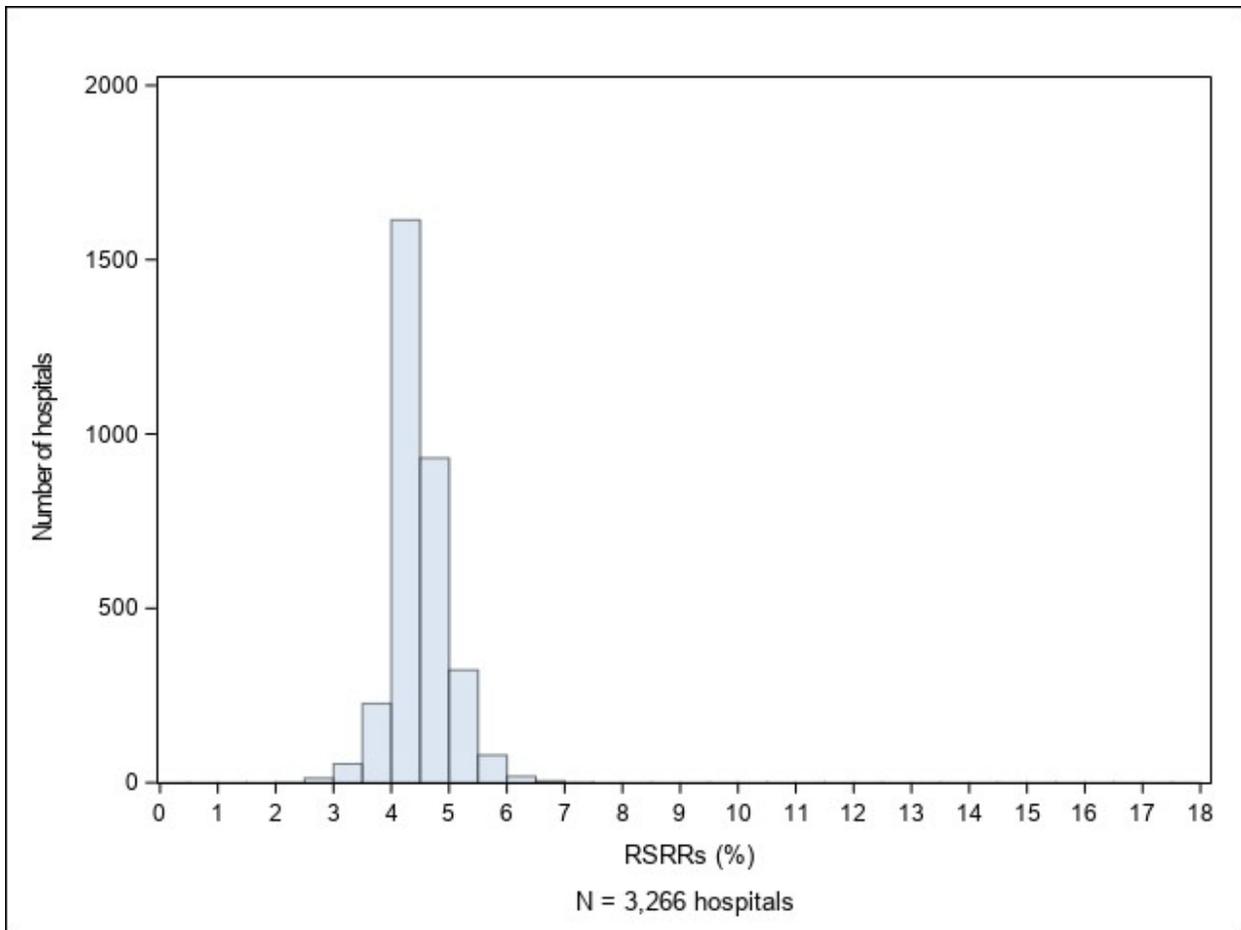
Table 4.3.4.3 shows the between-hospital variance by individual year as well as for the combined three-year dataset.

**Table 4.3.4.3 — Between-Hospital Variance for THA/TKA over Different Time Periods**

Characteristic	07/2020 – 06/2021	07/2021 – 06/2022	07/2022 – 06/2023	07/2020 – 06/2023
Between-hospital variance (SE)	0.065 (0.013)	0.108 (0.018)	0.091 (0.018)	0.075 (0.008)

Figure 4.3.4.1 shows the overall distribution of the hospital RSRRs for the combined three-year dataset, which indicates that the RSRRs are normally distributed. The odds of all-cause readmission if a patient is treated at a hospital one SD above the national rate were 1.73 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>7</sup>

**Figure 4.3.4.1 — Distribution of Hospital 30-Day THA/TKA RSRRs between July 2020 and June 2023**



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

Of 3,266 hospitals in the study cohort, 29 performed “Better than the National Rate,” 1,794 performed “No Different than the National Rate,” and 5 performed “Worse than the National Rate.” 1,438 were classified as “Number of Cases Too Small” (fewer than 25) to reliably conclude how the hospital is performing.

## 5. GLOSSARY

**Acute care hospital:** A hospital that provides inpatient medical care for surgery and acute medical conditions or injuries. Short-term acute care hospitals provide care for short-term illnesses and conditions. In contrast, long-term care hospitals generally treat medically complex patients who require long-stay hospital-level care, which is generally defined as an inpatient length of stay more than 25 days.

**Bootstrapping:** The bootstrap is a computer-based method for estimating the standard error of an estimate when the estimate is based on a sample with an unknown probability distribution. Bootstrap methods depend on the bootstrap sample, which is a random sample of size  $n$  drawn with replacement from the population of  $n$  objects. The bootstrap algorithm works by drawing many independent bootstrap samples, evaluating the corresponding bootstrap replications, and estimating the standard error of the statistic by the empirical SD of the replications.

**C-statistic:** An indicator of the model's discriminant ability or ability to correctly classify those patients 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 HCUP 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-10 codes to the AHRQ CCS diagnosis and procedure categories for 2024 public reporting are posted [here](#) on *QualityNet*.

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

**Comorbidities:** Medical conditions the patient had in addition to their 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-10-CM diagnosis codes into clinically relevant categories, from the HCC system.<sup>12, 13</sup> CMS uses modified groupings, but not the hierarchical logic of the system, to create risk factor variables. Mappings which show the assignment of ICD-10 codes to the CCs are available [here](#) on *QualityNet*.

**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" means that we are confident that 95 out of 100 times the estimated 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 Generalized Linear Model (HGLM):** 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:

- how much variation in hospital readmission rates overall is accounted for by patients' individual risk factors (such as age and other medical conditions); and
- how much variation is accounted for by hospital contribution to readmission risk.

A hierarchical logistic regression model is a type of HGLM used for binary outcomes.

**Hospital-specific effect:** A measure of a hospital's quality of care that is calculated using hierarchical logistic regression, taking into consideration the number of patients who are eligible for the cohort, these patients' risk factors, and the number who are readmitted. The hospital-specific effect is the calculated random effect intercept for each hospital. A hospital-specific effect less than the average hospital-specific effect indicates the hospital performed better on the measure than the average hospital with the same case mix, a hospital-specific effect greater than the average hospital-specific effect indicates the hospital performed worse than average, and a hospital-specific effect near the average hospital-specific effect indicates about average performance. 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 directly from Medicare for each individual service provided. Patients in managed care (Medicare Advantage) are excluded from 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-adjustment variable present relative to those without the risk-adjustment variable present. The model coefficient for each risk-adjustment variable is the log (odds) for that variable.

**Outcome:** The result of a broad set of healthcare activities that affect patients' well-being. For 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.

**Predictive ability:** An indicator of the model's discriminant ability or ability to distinguish high-risk subjects from low-risk subjects. A wide range between the lowest decile and highest decile suggests better discrimination.

**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.

**VA beneficiary:** For the purposes of the THA/TKA readmission measure, a "VA beneficiary" is a patient who has VA healthcare benefits (according to VA administrative data). They may or may not be dually enrolled in Medicare FFS.

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## 7. APPENDICES

### Appendix A. Statistical Approach for CABG Surgery and THA/TKA Measures

The procedure-specific measures use hierarchical generalized linear model (HGLMs) to estimate RSRRs for hospitals. This modeling approach accounts for the within-hospital correlation of the observed outcome and accommodates the assumption that underlying differences in quality across hospitals lead to systematic differences in outcomes.

In each measure, an HGLM model is estimated. Then for each hospital, a standardized readmission ratio (SRR) is calculated. The RSRR is calculated by multiplying the SRR for each hospital by the national observed readmission rate.

#### Hierarchical Generalized Linear Model

For each measure, we fit an HGLM, which accounts for clustering of observations within hospitals. We assume the outcome has a known exponential family distribution and relates linearly to the covariates via a known link function,  $h$ . Specifically, we assume a binomial distribution and a logit link function. Further, we account for the clustering within hospitals by estimating a hospital-specific effect,  $\alpha_i$ , which we assume follows a normal distribution with a mean  $\mu$  and variance  $\tau^2$ , the between-hospital variance component. The following equation defines the HGLM:

$$h(\Pr(Y_{ij} = 1|Z_{ij}, \omega_i)) = \log\left(\frac{\Pr(Y_{ij}=1|Z_{ij}, \omega_i)}{1-\Pr(Y_{ij}=1|Z_{ij}, \omega_i)}\right) = \alpha_i + \beta Z_{ij} \quad (1)$$

$$\text{where } \alpha_i = \mu + \omega_i; \omega_i \sim N(0, \tau^2)$$

$$i=1, \dots, l; j=1, \dots, n_i$$

where  $Y_{ij}$  denotes the outcome (equal to 1 if the patient is readmitted within 30 days of discharge, 0 otherwise) for the  $j$ -th patient at the  $i$ -th hospital;  $Z_{ij} = (Z_{ij1}, Z_{ij2}, \dots, Z_{ijp})^T$  is a set of  $p$  patient-specific covariates derived from the data;  $l$  denotes the total number of hospitals; and  $n_i$  denotes the number of index admissions at hospital  $i$ . The hospital-specific intercept of the  $i$ -th hospital,  $\alpha_i$ , defined above, comprises  $\mu$ , the adjusted average intercept over all hospitals in the sample, and  $\omega_i$ , the hospital-specific intercept deviation from  $\mu$ .<sup>14</sup>

We estimate the HGLMs using the SAS software system (GLIMMIX procedure).

#### Risk-Standardized Measure Score Calculation

Using the HGLM defined by Equation (1), to obtain the parameter estimates  $\hat{\mu}$ ,  $\{\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_l\}$ ,  $\hat{\beta}$ , and  $\hat{\tau}^2$ , we calculate an SRR,  $\hat{s}_i$ , for each hospital by computing the ratio of the number of predicted readmissions to the number of expected readmissions. Specifically, we calculate:

$$\text{Predicted Value: } \hat{p}_{ij} = h^{-1}(\hat{\alpha}_i + \hat{\beta} Z_{ij}) = \frac{\exp(\hat{\alpha}_i + \hat{\beta} Z_{ij})}{\exp(\hat{\alpha}_i + \hat{\beta} Z_{ij}) + 1} \quad (2)$$

$$\text{Expected Value: } \hat{e}_{ij} = h^{-1}(\hat{\mu} + \hat{\beta}Z_{ij}) = \frac{\exp(\hat{\mu} + \hat{\beta}Z_{ij})}{\exp(\hat{\mu} + \hat{\beta}Z_{ij}) + 1} \quad (3)$$

$$\text{Standardized Readmission Ratio: } \hat{s}_i = \frac{\sum_{j=1}^{n_i} \hat{p}_{ij}}{\sum_{j=1}^{n_i} \hat{e}_{ij}} \quad (4)$$

We calculate an RSRR,  $\widehat{RSRR}_i$ , for each hospital by using the estimate from Equation (4) and multiplying by the national observed readmission rate, denoted by  $\bar{y}$ . Specifically, we calculate:

$$\text{Risk-Standardized Readmission Rate: } \widehat{RSRR}_i = \hat{s}_i \times \bar{y} \quad (5)$$

### Creating Interval Estimates

The measure score is a complex function of parameter estimates; therefore, we use re-sampling and simulation techniques to derive an interval estimate to determine if a hospital is performing better than, worse than, or no different than expected. A hospital is considered better than expected if the upper bound of their CI falls below the national observed readmission rate,  $\bar{y}$ , and considered worse if the lower bound of their CI falls above  $\bar{y}$ . A hospital is considered no different than expected if the CI overlaps  $\bar{y}$ .

More specifically, we use bootstrapping procedures to compute the CIs. Because the theoretical-based standard errors are not easily derived, and to avoid making unnecessary assumptions, we use the bootstrap to empirically construct the sampling distribution for each hospital risk-standardized ratio. The bootstrapping algorithm is described below.

### Bootstrapping Algorithm

Let  $I$  denote the total number of hospitals in the sample. We repeat steps 1 – 4 below for  $b = 1, 2, \dots, B$  times:

1. Sample  $I$  hospitals with replacement.
2. Fit the HGLM defined by Equation (1) using all patients within each sampled hospital. The starting values are the parameter estimates obtained by fitting the model to all hospitals. 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. After 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,  $\{\hat{\alpha}_i^{(b)}, \text{var}(\alpha_i^{(b)})\}; i = 1, 2, \dots, I\}$ .

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  $\alpha_i^{(b*)} \sim N(\hat{\alpha}_i^{(b)}, v\hat{\sigma}_i^2(\alpha_i^{(b)}))$  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  $\hat{p}_{ij}^{(b)}$ ,  $\hat{e}_{ij}^{(b)}$ , and  $\hat{s}_i^{(b)}$  where  $\hat{\beta}^{(b)}$  and  $\hat{\mu}^{(b)}$  are obtained from Step 2 and  $\alpha_i^{(b*)}$  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 a large selected number of estimates for all hospitals (or the percentiles corresponding to the alternative desired intervals).<sup>15</sup>

## **Appendix B. Data QA**

This production year required updates to all SAS packs to account for updates in ICD-10 codes and associated mappings of clinical groupers.

This section represents QA for the subset of the work YNHSC/CORE conducted to maintain and report these readmission measures. It does not describe the QA for processing data and creating 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.

To assure the quality of measure output, we utilize a multi-phase approach to QA of the readmission measures.

### **Phase I**

As the first step in the QA process, we review changes in the cohort and outcome definitions as determined by the measure-specific code set files that were updated to account for changes in ICD-10 coding. This includes updates to the AHRQ HCUP CCS and the HCC clinical category maps.

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

### **Phase II**

We update the existing SAS packs to accommodate the new codes and updates to the measures. To ensure accuracy in SAS pack coding, two analysts independently write SAS code for any major changes made in calculating the readmission measures: data preparation, sample selection, hierarchical modeling, and calculation of RSRRs. This process highlights any programming errors in syntax or logic. Once the parallel programming process is complete, the analysts cross-check their codes by analyzing datasets in parallel, checking for consistency of output, and reconciling any discrepancies.

### **Phase III**

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

During this phase, we also compare prior years' risk-adjustment coefficients and variable frequencies to enable us to check for potential inconsistencies in the data and the impact of any changes to the SAS packs. Anything that seems outside of normal coding fluctuation is reviewed in more detail.

## Appendix C. Annual Updates

Prior annual updates for the measures can be found in the annual updates and specifications reports available [here](#) 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.

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### 2024

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#### 2024 Measures Updates and Specifications Report (Version 13.0 — THA/TKA Readmission) (Version 11.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the ICD-10-CM/PCS code set releases since 2023 public reporting (namely, October 1, 2022 [FY 2023] and April 1, 2023) into the cohort definitions and risk models, as warranted;
  - applied a YNHHS/CORE-modified v4.0 of the AHRQ HCUP’s beta version 2019.1 CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - applied a modified version of the FY 2023 V24 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
  - made additional code specification changes prompted by the activities described in [Section 3.1](#).
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS and CMS-HCC crosswalk as well as the workgroup review activities.
- Expanded the measurement period for 2024 public reporting to three years (resumption of the typical measurement period prior to the COVID-19 PHE)
  - Rationale: The rates for the measures are calculated using rolling data. Each year, the rates are updated by dropping the data representing the oldest year and adding data for the newest available year. As a result, the 2024 measurement period begins with July 2020 discharges (incremented one year from the start of the 2023 public reporting period of July 2019).

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### 2023

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#### 2023 Measures Updates and Specifications Report (Version 12.0 — THA/TKA Readmission) (Version 10.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the ICD-10-CM/PCS code set releases since 2022 public reporting (namely, October 1, 2021 [FY 2022] and April 1, 2022) into the cohort definitions and risk models;
  - applied a YNHHS/CORE-modified v3.0 of the AHRQ HCUP’s beta version 2019.1 CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - applied a modified version of the FY 2022 V24 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
  - made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches.
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS and CMS-HCC crosswalk as well as the workgroup review activities.

## 2022

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### 2022 Measures Updates and Specifications Report (Version 11.0 — THA/TKA Readmission) (Version 9.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the ICD-10-CM/PCS code set releases since 2021 public reporting (namely, April 1, 2020; August 1, 2020; October 1, 2020 [FY 2021]; and January 1, 2021) into the cohort definitions and risk models;
  - applied a YNHHS/CORE-modified v2.0 of the AHRQ HCUP’s beta version 2019.1 CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - applied a modified version of the FY 2021 V24 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
  - made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches.
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS and CMS-HCC crosswalk as well as the workgroup review activities.
- Adjusted the specifications and methodologies for the measures in response to the COVID-19 PHE — Specifically, we:
  - removed COVID-19 index admissions from the cohorts;
  - rendered COVID-19 readmissions ineligible for the readmission outcome and excluded them;
  - added a new ‘History of COVID-19’ risk variable to the risk-adjustment models;
  - shortened the measurement period for 2022 public reporting to approximately 29 months (from the typical three-year measurement period), similar to 2021 public reporting; and
  - reduced the look-back period for use of claims/VA data in risk adjustment to less than 12 months (from the typical 12 months) for those patients whose 12-month period included any portion of the January 1, 2020 through June 30, 2020 claims exclusion time frame.
    - Rationale: The COVID-19 PHE continues to have significant and enduring effects on the provision of medical care in the country and around the world. Adjustments to measure specifications and methodologies for 2022 help to ensure the intent of the measures is maintained. The measurement period and look-back period reductions (in certain cases) are in response to CMS’s decision to exclude claims data for January 1, 2020 through June 30, 2020 (Q1 and Q2 of 2020) under its ECE policy.
- Added a POA algorithm to the risk-adjustment methodology used to pull CC-defined risk-adjustment variables from the index admission claim/VA data
  - Rationale: POA coding is a logical reflection of comorbidities. POA indicators more accurately distinguish complications of care from conditions already present at admission, in comparison to the previous methodology that utilized only the potential complications list.<sup>16</sup> Additionally, use of POA indicators helps particularly in cases where a patient has not been hospitalized or had provider visits in the last year or where a comorbid condition present at the time of admission is relatively new.

## 2021

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### 2021 Measures Updates and Specifications Report (Version 10.0 — THA/TKA Readmission) (Version 8.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:

- incorporated the code changes that occurred in the FY 2020 version of the ICD-10-CM/PCS (effective with October 1, 2019+ discharges) into the cohort definitions and risk models;
- applied a YNHHS/CORE-modified version of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS to the planned readmission algorithm;
- applied a modified version of the FY 2020 V24 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
- made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches.
  - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS and CMS-HCC crosswalk as well as the workgroup review activities.
- Shortened the measurement period for 2021 public reporting to approximately 29 months (from the typical three-year measurement period)
  - Rationale: The measurement period reduction is in response to the COVID-19 PHE and CMS's decision to exclude claims data for January 1, 2020 through June 30, 2020 (Q1 and Q2 of 2020) under its ECE policy.
- Removed the International Classification of Diseases, Ninth Revision (ICD-9) code-based specifications from the measures and SAS packs
  - Rationale: The Medicare claims (and VA administrative data, in the case of the THA/TKA readmission measure) for the measurement period of July 1, 2017 through December 1, 2019 are completely ICD-10 code-based. 2020 public reporting was the last year that warranted any ICD-9 code specifications.
- Added admission data from VA hospitals to the THA/TKA readmission measure
  - Rationale: Creates a more inclusive perspective of the relative quality of U.S. hospitals

## 2020

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### 2020 Measures Updates and Specifications Report (Version 9.0 — THA/TKA Readmission) (Version 7.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the FY 2019 version of the ICD-10-CM/PCS (effective with October 1, 2018+ discharges) into the cohort definitions and risk models;
  - applied version 2019.1 (beta version) of the AHRQ HCUP CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - applied a modified version of the FY 2019 V22 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
  - made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches.
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS, AHRQ HCUP CCS, and CMS-HCC crosswalk as well as the workgroup review activities.
- Added the revenue center codes 0138 (Semi\_private 3 and 4 beds-rehabilitation) and 0158 (Room&Board ward (medical or general)-rehabilitation) to the revenue center code list used to identify transfers to rehabilitation units, to ensure these transfers are not captured as readmissions for any hospital (Refer to the [2018 updates](#) below)
  - Rationale: Revenue center codes 0138 and 0158 are appropriate codes for identifying rehabilitation claims.

## 2019

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### 2019 Measures Updates and Specifications Report (Version 8.0 — THA/TKA Readmission) (Version 6.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the FY 2018 version of the ICD-10-CM/PCS (effective with October 1, 2017+ discharges) into the cohort definitions, planned readmission algorithm, and risk models;
  - applied version 2018.1 of the AHRQ HCUP CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - applied a modified version of the FY 2018 V22 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and
  - made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches. For example, ICD-10-PCS code 021W0JG, Bypass Thoracic Aorta, Descending to Axillary Artery with Synthetic Substitute, Open Approach, was identified through a “neighboring code search” (found near existing code 021W0JD, Bypass Thoracic Aorta, Descending to Carotid with Synthetic Substitute, Open Approach) and determined through clinical review to be a code which meets measure intent. As a result, it was added to the CABG cohort exclusion list.
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS, AHRQ HCUP CCS, and CMS-HCC crosswalk as well as the workgroup review activities.
- Added a POA code requirement to the ‘Cardiogenic shock’ risk-adjustment variable for index admission claims (discharges prior to October 1, 2015 as well as discharges on or after October 1, 2015). This only applies to the CABG surgery readmission measure.
  - Rationale: Revision was made per clinical expert recommendation.

## 2018

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### 2018 Measures Updates and Specifications Report (Version 7.0 — THA/TKA Readmission) (Version 5.0 — CABG Surgery Readmission)

- Updated the ICD-10 code-based specifications used in the measures — Specifically, we:
  - incorporated the code changes that occurred in the FY 2017 version of the ICD-10-CM/PCS into the cohort definitions, planned readmission algorithm, and risk models;
  - applied the 2017.1 and 2017.2 versions of the AHRQ HCUP CCS to the planned readmission algorithm for diagnoses and procedures, respectively;
  - applied the FY 2017 version of the V22 CMS-HCC crosswalk maintained by RTI International to the risk models; and
  - monitored code frequencies to identify any code specification changes warranted due to possible changes in coding practices and patterns. Additionally, our clinical and measure experts reviewed the pre-existing ICD-10 code-based specifications to confirm the appropriateness of the specifications unaffected by the updates.
    - Rationale: Updated versions of the ICD-10-CM/PCS, AHRQ HCUP CCS, and CMS-HCC crosswalk were released. Revisions to the measure specifications were warranted to accommodate these updates.
- Updated the methodology used in analytic input file production to identify transfers to rehabilitation units, to further ensure these transfers are not captured as readmissions for any hospital. In addition to the previous methods described in the [2013](#) and [2017](#) updates below as well

as the 2010 AMI, HF, and pneumonia readmission measures maintenance report posted [here](#) on *QualityNet*, use of revenue center codes has been implemented to help identify these cases in both ICD-9 and ICD-10 code-based claims. Specifically:

- 0024: Inpatient Rehabilitation Facility services paid under PPS submitted as TOB 11X
- 0118: Private medical or general-rehabilitation
- 0128: Semi-private 2 bed (medical or general)-rehabilitation
- 0148: Private (deluxe)-rehabilitation
  - Rationale: The inability to use principal discharge diagnosis codes to identify rehabilitation stays (due to ICD-10 coding guidance) has led to an under-counting of these transfers primarily for Maryland hospitals and CAHs, hospitals that are not part of the IPPS. Utilization of revenue center codes augments our ability to identify and exclude admissions to rehabilitation beds in these hospitals that are not identified through discharge disposition codes alone. Of note, rehabilitation units are most often identified by CMS certification number (CCN).
- Removed the obstetric AHRQ CCS procedure and diagnosis categories from the planned readmission algorithm. Specifically, AHRQ CCS procedure categories 134 and 135 and AHRQ CCS diagnosis categories 194 and 196 were deleted from the always planned procedure and diagnosis lists, respectively. They remain in the SAS packs but are commented out.
  - Rationale: The obstetric codes were incorporated into the initial planned readmission algorithm specifications during development. They were provided for all-payer settings but are not applicable to the CMS readmission measures that include only those patients aged 65 or over.

## 2017

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

- Revised the measure specifications to accommodate the implementation of ICD-10 coding — Specifically, we:
  - 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 applying the most recent (2016) version of the ICD-10-based AHRQ HCUP 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; and
  - 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. The U.S. Department of Health and Human Services mandated that ICD-10 codes be used for medical coding, effective with 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.
- Updated the methodologies used to identify transfers to psychiatric and rehabilitation units, to ensure these transfers are not captured as readmissions for any hospital (as described in the [2013 update](#) below and the 2010 AMI, HF, and pneumonia readmission measures maintenance report posted [here](#) on *QualityNet*) — Specifically:
  - Psychiatric admissions — Criteria (2) and (3) from the 2013 update apply. However, criterion (1) was modified slightly to: 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 discharges on or after October 1, 2015, 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 discharges on or after October 1, 2015 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)

- 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).
- Applied the 2015 version of the AHRQ HCUP CCS to the planned readmission algorithm
  - Rationale: A 2015 version of the AHRQ HCUP CCS was released.

## 2015

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

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

## 2014

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

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

## 2013

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

- 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.
- Updated the 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.
- Updated the ICD-9-CM code listings in Table A3 that exclude admissions from the measure cohort
  - Rationale: New ICD-9 codes were released that were relevant to the code lists that define the femur, hip, or pelvic fracture exclusions.
- Updated the methodology used to determine readmission outcome in cases of admission to psychiatric and rehabilitation hospital units — Specifically:
  - Rehabilitation admissions are identified by the 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.
    - (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 captured 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 posted [here](#) on *QualityNet*.
    - Rationale: Psychiatric and rehabilitation units within short-term acute care hospitals in Maryland have the same type of provider ID number (or CCN) as the acute care hospital in which they are housed. Transfers to these units can therefore look like readmissions. 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 captured as readmissions for any hospital.

## Appendix D. Measure Specifications

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

#### Cohort

##### Inclusion Criteria for CABG Surgery Measure

- **Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission**
  - Rationale: The 12-month Part A and Part B prior enrollment criterion ensures that the comorbidity data used in risk adjustment can be captured from inpatient, outpatient, and physician claims data for up to 12 months prior to the index admission, to augment the index admission claim itself. Medicare Part A during the index admission is required to ensure Medicare FFS enrollment at the time of admission.
- **Aged 65 or over**
  - Rationale: Patients younger than 65 are not included in the measure because they are considered to be too clinically distinct from patients 65 or over.
- **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.
- **Having a qualifying isolated CABG procedure during the index admission**
  - Rationale: Isolated CABG surgery is the procedure targeted for measurement. Isolated CABG procedures are defined as those procedures performed without concomitant valve or other major cardiac, vascular, or thoracic procedures, because they represent a population of patients with higher risk. These procedure groups include:
    - valve procedures;
    - atrial and/or ventricular septal defects;
    - congenital anomalies;
    - other open cardiac procedures;
    - heart transplants;
    - aorta or other non-cardiac arterial bypass procedures;
    - head, neck, or intracranial vascular procedures; and
    - other chest and thoracic procedures.

##### Exclusion Criteria for CABG Surgery Measure

- **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.
- **Discharged against medical advice**
  - Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- **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.
- **With a principal diagnosis code of COVID-19 or with a secondary diagnosis code of COVID-19 coded as POA on the index admission claim**
    - Rationale: COVID-19 patients are removed from the CABG surgery cohort in response to the COVID-19 PHE, and to maintain alignment with CABG surgery readmission measure included in the FY 2025 Hospital Readmissions Reduction Program (HRRP).

The ICD-10 codes used to define the CABG surgery cohort are outlined in the 2024 CABG Surgery Readmission Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

## **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’s 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.
- **Readmissions with a principal diagnosis code of COVID-19 or with a secondary diagnosis code of COVID-19 coded as POA on the readmission claim are not eligible and are excluded**
  - Rationale: COVID-19 readmissions are not eligible for the readmission outcome in response to the COVID-19 PHE, and to maintain alignment with CABG surgery readmission measure included in the FY 2025 HRRP.

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

### Cohort

#### Inclusion Criteria for THA/TKA Measure

- **Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission (not applicable to VA hospitalizations)**
  - Rationale: For patients who are not VA beneficiaries, the 12-month Part A and Part B prior enrollment criterion ensures that the comorbidity data used in risk adjustment can be captured from inpatient, outpatient, and physician claims data for up to 12 months prior to the index admission, to augment the index admission claim itself. Medicare Part A during the index admission is required to ensure Medicare FFS enrollment at the time of admission.
- **Aged 65 or over**
  - Rationale: Patients younger than 65 are not included in the measure because they are considered to be too clinically distinct from patients 65 or over.
- **Discharged alive from a non-federal short-term acute care hospital or VA hospital**
  - Rationale: It is only possible for patients to be readmitted if they are discharged alive.
- **Having a qualifying elective primary THA/TKA procedure during the index admission**
  - Rationale: Elective primary THA or TKA is the procedure targeted for measurement. Elective primary THA/TKA procedures are defined as those THA/TKA procedures *without* the following:
    - **Fracture of the pelvis or lower limbs coded in the principal or secondary discharge diagnosis fields on the index admission claim** (Note: Periprosthetic fractures must be additionally coded as POA in order to disqualify a THA/TKA from cohort inclusion, unless exempt from POA reporting.)
      - Rationale: Patients with fractures have higher mortality, complication, and readmission rates, and the procedures are typically not elective.
    - **A concurrent partial hip or knee arthroplasty procedure**
      - Rationale: Partial arthroplasty procedures are done primarily for hip and knee fractures and are typically performed on patients who are older, frailer, and who have more comorbid conditions.
    - **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/prosthesis procedures may be more complicated.
    - **Mechanical complication coded in the principal discharge diagnosis field on the index admission claim**
      - 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.

- **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 on the index admission claim**
  - Rationale: Patients with these malignant neoplasms are at increased risk for readmission, and the procedure may not be elective.
- **Transfer from another acute care facility for the THA/TKA**
  - Rationale: The THA/TKA readmission measure does not include admissions for patients transferred to the index hospital, as they likely do not represent elective THA/TKA procedures.

#### **Exclusion Criteria for THA/TKA Measure**

- **Without at least 30 days of post-discharge enrollment in Medicare FFS (not applicable to VA hospitalizations)**
  - Rationale: The 30-day readmission outcome cannot be assessed in this group since claims data are used to determine whether a patient was readmitted.
- **Discharged against medical advice**
  - Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- **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.
- **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. Coding in such cases may reflect a coding error.
- **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 determination of the outcome. CMS does not want to potentially count the additional admission as both an index admission and an unplanned readmission outcome for the first admission.
- **With a principal diagnosis code of COVID-19 or with a secondary diagnosis code of COVID-19 coded as POA on the index admission claim**
  - Rationale: COVID-19 patients are removed from the THA/TKA cohort in response to the COVID-19 PHE, and to maintain alignment with the THA/TKA readmission measure included in the FY 2025 HRRP.

The ICD-10 codes used to define the THA/TKA cohort are outlined in the 2024 THA/TKA Readmission Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

#### **Outcome**

##### **Outcome Criteria for the THA/TKA 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’s 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.
- **Readmissions with a principal diagnosis code of COVID-19 or with a secondary diagnosis code of COVID-19 coded as POA on the readmission claim are not eligible and are excluded**
  - Rationale: COVID-19 readmissions are not eligible for the readmission outcome in response to the COVID-19 PHE, and to maintain alignment with the THA/TKA readmission measure included in the FY 2025 HRRP.

**Appendix E. Planned Readmission Algorithm**

**Figure E.1 — Planned Readmission Algorithm Version 4.0 2024 Flowchart**

