

# **2023 Hospital-Wide Readmission Measure Updates and Specifications Report — Version 12.0**

## **Submitted By:**

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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) hospital-wide readmission (HWR) measure that is publicly reported [here](#) on *Care Compare*. The measure is used to calculate hospital-level 30-day risk-standardized readmission rates (RSRRs) following admission. This report provides a single source of information about this measure 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 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.**

This report includes:

- **[Section 2](#) — An overview of the HWR measure:**
  - Background
  - Cohort inclusions and exclusions
    - Included and excluded hospitalizations
    - How transferred patients are handled
    - [Specialty cohort](#) assignment
  - [Unplanned readmission](#) outcome
  - Risk-adjustment variables
  - Data sources
  - Readmission rate calculation
  - Categorization of hospitals' performance scores
- **[Section 3](#) — 2023 measure updates**
- **[Section 4](#) — 2023 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 measure since measure development
- [Appendix D](#): Cohort inclusion/exclusion criteria and outcome criteria
- [Appendix E](#): Overview of the planned readmission algorithm

The original measure methodology report 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>1,2</sup>

For a list of the supporting resource files for the 2023 HWR measure that are available on *QualityNet* (including hyperlinks to the resources), or to review the 2023 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 file, 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.



## 2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

### 2.1. Background on HWR Measure

In July 2009, CMS began publicly reporting 30-day RSRRs for acute myocardial infarction (AMI), heart failure (HF), and pneumonia for the nation's non-federal short-term acute care hospitals (including Indian Health Service hospitals) and critical access hospitals (CAHs). To provide a broader assessment of the quality of care at hospitals, CMS developed the HWR measure, a claims-based, risk-adjusted HWR measure for public reporting that reflects the quality of care for hospitalized patients in the U.S. CMS began publicly reporting the measure in 2013.

In 2020, CMS and the Veterans Health Administration (VHA) collaborated to include admissions in Veterans Administration (VA) hospitals in the measure.

Results for this measure are posted and updated annually here on *Care Compare*.

CMS contracted with the Yale New Haven Health Services Corporation — Center for Outcomes Research and Evaluation (YNHHSC/CORE) to update the HWR measure for 2023 public reporting through a process of measure reevaluation.

### 2.2. Overview of Measure Methodology

The 2023 risk-adjusted HWR measure uses specifications from the original measure methodology report posted here on *QualityNet*, with refinements to the measure as listed in Appendix C and described in the prior measure 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 the measure for fiscal year (FY) 2024, as well as its use in future FYs, please refer to the FY 2023 Inpatient Prospective Payment System (IPPS) Final Rule posted here on the CMS website.

#### 2.2.1 Cohort

##### Index Admissions Included in the Measure

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

- enrolled in Medicare Fee-For-Service (FFS) Part A for the 12 months prior to the date of admission and during the index admission;
  - For VA beneficiaries hospitalized in VA hospitals, there are no Medicare FFS enrollment requirements.
  - For VA beneficiaries hospitalized in non-VA hospitals, they must be concurrently enrolled in Medicare FFS Part A at the time of the index admission to be eligible for cohort inclusion (but the 12-month Part A enrollment prior to admission is not required).

- aged 65 or over;
- discharged alive from a non-federal short-term acute care hospital or VA hospital; and
- not transferred to another acute care facility.

See the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet* for specific diagnosis and procedure Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) Clinical Classification Software (CCS) categories used to define the specialty cohorts included in the measure. The supplemental file also includes singular International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) codes used to define additional cases for the surgery/gynecology specialty cohort (further detailed in the Specialty Cohort Assignment Section below).

#### Index Admissions Excluded from the Measure

This measure excludes index admissions for patients:

- admitted to a Prospective Payment System (PPS)-exempt cancer hospital;
- without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries);
- discharged against medical advice;
- admitted for primary psychiatric diagnoses;
- admitted for rehabilitation;
- admitted for medical treatment of cancer; or
- with a principal diagnosis code of COVID-19 (International Classification of Diseases, Tenth Revision, Clinical Modification [ICD-10-CM] code U07.1) **or** with a secondary diagnosis code of COVID-19 coded as present on admission (POA) on the index admission claim. These code specifications are outlined in the 2023 HWR Measure Code Specifications supplemental file [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 cohort. 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.

See the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet* for specific AHRQ CCS diagnosis categories excluded from the measure.

It is important to note that a readmission is included as an index admission if it meets all other eligibility criteria. This differs from the publicly reported condition-specific and procedure-specific readmission measures, which do not consider a readmission as a new index admission within the same measure.

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.

Note that CCS mappings to ICD-10-CM and ICD-10-PCS codes are available [here](#) on *QualityNet*.

The percentage of admissions excluded based on each criterion is shown in Section 4 in [Figure 4.2.1](#).

#### Patients Transferred between Hospitals

The measure considers 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. Admissions to a hospital within one day of discharge from another hospital are considered transfers regardless of whether the first institution indicates intent to transfer the patient in the discharge disposition code or whether the second inpatient admission is for the same condition.

To include an admission in the measure cohort, the patient must ultimately be discharged to a non-acute care setting (for example, to home or a skilled nursing facility). Thus, for patients transferred from one short-term acute care hospital to another, only the last admission in the series of transfers is eligible for inclusion in the cohort. The previous admissions are not included. For example, if a patient is admitted to Hospital A, transferred to Hospital B, and then discharged from Hospital B to a non-acute care setting, only the Hospital B 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 B's readmission outcome.

#### Specialty Cohort Assignment

Each eligible admission is assigned to one of five mutually exclusive specialty cohorts: medicine, surgery/gynecology, cardiorespiratory, cardiovascular, and neurology. The cohorts reflect how care for patients is organized within hospitals. To assign admissions to cohorts, admissions are first screened for the presence of an eligible AHRQ CCS surgical procedure category or one of the defined singular ICD-10-PCS codes listed in the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet*. Admissions with an eligible surgical procedure are assigned to the surgical cohort, regardless of the principal discharge diagnosis code of the admission. All remaining admissions are assigned to cohorts based on the AHRQ CCS diagnosis category of the principal discharge diagnosis. Refer to [Figure D.1](#) for more information on the assignment of admissions to specialty cohort groups.

## 2.2.2 Outcome

### All-Cause Unplanned Readmissions

The measure is 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 details 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 with renal failure who develops a hospital-acquired infection may ultimately be readmitted for sepsis. In this context, considering the readmission to be unrelated to the care that the patient received for renal failure during the index admission would be inappropriate.

Note that if a patient is readmitted to the **same** hospital on the **same** calendar day of discharge for the **same diagnosis** as the index admission, the measure considers the patient to have had one single continuous admission (that is, one index admission). This methodology is employed to assist hospitals who might bill two separate claims in such cases, instead of adjusting the original claim and combining both the original and subsequent stay onto a single claim, as directed by Medicare. In effect, this added step prevents the second stay from being captured as a readmission (if unplanned). If the condition is **different** from the index admission, this is considered a readmission in the measure, if unplanned. For complete details on the same hospital/day/condition methodology used by the measure, please refer to the SAS analytic packages (SAS packs). Guidance on how to request SAS packs is provided in [Section 3.3](#).

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 2023 HWR Measure Code Specifications supplemental file [here](#) on *QualityNet*.

### 30-Day Time Frame

The measure assesses unplanned readmissions within a 30-day period from the date of discharge from an index admission. The measure uses a 30-day time frame because older adult patients are more vulnerable to adverse health outcomes during this time.<sup>3</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 to reduce readmissions.<sup>4-7</sup>

In determining whether an unplanned readmission occurred within 30 days of discharge from the index admission, the measure uses 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 emergency department 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 measure assesses 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 2023 HWR Measure Code Specifications supplemental file [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 2023)**

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

The planned readmission algorithm has three fundamental principles:

- 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 HWR measure. In 2013, CMS applied the algorithm to its other readmission measures.

The planned readmission algorithm uses a flowchart and four tables of specific AHRQ CCS procedure categories, AHRQ CCS diagnosis categories, and singular ICD-10 codes to classify readmissions as planned. As illustrated in [Figure PR.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 through PR.4 in the 2023 HWR Measure Code Specifications supplemental file 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**

For each patient, risk-adjustment variables are obtained from inpatient Medicare claims data extending 12 months prior to the index admission, and all claims data for the index admission itself. For VA beneficiaries, the risk-adjustment variables are also obtained from VA administrative data.

To account for differences in case mix among hospitals, the measure includes an adjustment for factors such as age and comorbid diseases, which are clinically relevant and have relationships with the outcome. Case mix differences among hospitals are 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, are included in risk adjustment. Complications that arise during the course of the hospitalization are not used in risk adjustment.

To account for differences in service mix among hospitals, the measure adjusts for the principal discharge diagnosis of the index admission (grouped into AHRQ CCS diagnosis categories). Thus, for the cardiorespiratory, cardiovascular, neurology, and medicine specialty cohorts, the AHRQ CCS diagnosis categories used for risk adjustment are the same as those used to define each of these cohorts (listed in the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet*). For the surgery/gynecology cohort, which is defined by AHRQ CCS procedure categories and ICD-10-PCS codes, the AHRQ CCS diagnosis category used for risk adjustment is simply the AHRQ CCS diagnosis category that the principal discharge diagnosis for that surgical admission falls into.

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 the measure. The ICD-10-CM-defined risk variable 'History of COVID-19' (captured, in part, by a secondary diagnosis code of Z86.16 [Personal history of COVID-19] on the index claim), does not use the algorithm.

Refer to the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet* for the list of CC-defined risk-adjustment variables and the specifications for the ICD-10 code-defined 'History of COVID-19' risk-adjustment variable used in the measure. The list of potential complications referred to in Step 3 of the algorithm is also included in the 2023 supplemental file. The risk-adjustment variable specifications outlined in the supplemental file apply to all five specialty cohorts.

CC mappings to ICD-10-CM codes, as well as the "POA-Exempt Codes Considered Always POA for 2023" table (referred to in Step 2 of the algorithm), are available [here](#) on *QualityNet*.

The measure does 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 measure to adjust for age and clinical characteristics while illuminating important quality differences. The CMS consensus-based entity (CBE) re-endorsed the measure without adjustment for patient-level social drivers of health in the last endorsement maintenance submission prior to 2023.

### **2.2.5 Data Sources**

The data sources for these analyses are Medicare administrative claims, VA administrative data, and enrollment information for patients having hospitalizations with discharge dates between July 1, 2021 and June 30, 2022. For the purpose of feasibility, the HWR risk-adjustment models use only inpatient Medicare claims and VA administrative data for the 12 months prior to the index admission in addition to the Medicare claim/VA data for the index admission. The dataset also contains associated inpatient Medicare and VA administrative data for the 30-day period after discharge from the index admission, for patients having hospitalizations with discharge dates in the July 1, 2021 through June 30, 2022 time period. Refer to the original methodology report posted [here](#) on *QualityNet* for further descriptions of these data sources.



## 2.2.6 Measure Calculation

The hospital-level 30-day all-cause RSRR is estimated using a hierarchical logistic regression model. In brief, the approach simultaneously models data at the patient and hospital levels to account for variance in patient outcomes within and between hospitals.<sup>8</sup> At the patient level, it models the log-odds of hospital readmission within 30 days of discharge using age, selected clinical covariates, and a hospital-specific effect. At the hospital level, the approach models the hospital-specific effects as arising from a normal distribution. The hospital effect represents the underlying risk of a readmission at the hospital, after accounting for patient risk. The hospital-specific effects are given a distribution to account for the clustering (non-independence) of patients within the same hospital.<sup>8</sup> If there were no differences among hospitals, then after adjusting for patient risk, the hospital effects should be identical across all hospitals.

Admissions are assigned to one of five mutually exclusive specialty cohort groups consisting of related conditions or procedures. For each specialty cohort group, the standardized readmission ratio (SRR) is calculated as the ratio of the number of “predicted” readmissions to the number of “expected” readmissions at a given hospital. For each hospital, the numerator of the ratio is the number of readmissions within 30 days predicted based on the hospital’s performance with its observed case mix and service mix; the denominator is the number of readmissions expected based on the nation’s performance with that hospital’s case mix and service 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 and service mix, to be compared to an average hospital’s performance with the same case mix and service 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.

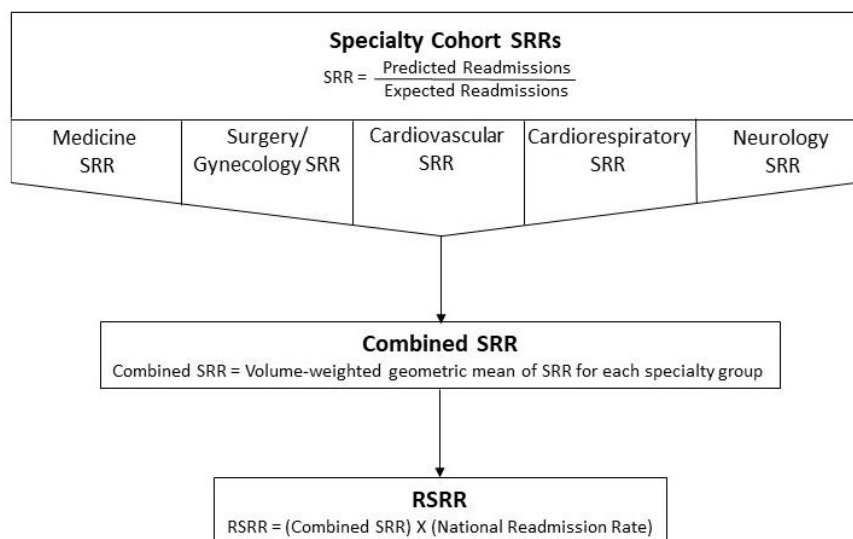
For each specialty cohort, the “predicted” number of readmissions (the numerator) is calculated by using the coefficients estimated by regressing the risk factors (found in Table 4.2.1, Table 4.2.2, Table 4.2.3, Table 4.2.4, and Table 4.2.5, for the medicine, surgery/gynecology, cardiorespiratory, cardiovascular, and neurology specialty cohorts, respectively) and the hospital-specific effect on the risk of readmission. The estimated hospital-specific effect for each cohort 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 data in that period.

The specialty cohort SRRs are then pooled for each hospital using a volume-weighted geometric mean to create a hospital-wide combined SRR. The combined SRR is multiplied by the national observed readmission rate to produce the RSRR.



The steps to calculate the RSRR are illustrated in Figure 2.2.6.1.

**Figure 2.2.6.1 — RSRR Calculation for the HWR Measure**



The statistical modeling approach is described fully in [Appendix A](#) and in the original methodology report 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 rates and interval estimates will not be publicly reported for the measure.

[Section 4.2.4](#) describes the distribution of hospitals by performance category in the U.S. for this reporting period.

### 3. UPDATES TO MEASURE FOR 2023 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 specialty cohorts, the 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 2023 public reporting, we made the following modifications to the measure:

- Updated the ICD-10 code-based specifications used in the measure — Specifically, we:
  - incorporated ICD-10-CM/PCS code changes into the surgery/gynecology cohort definitions and risk models that occurred in the following releases:
    - October 1, 2021 (FY 2022); and
    - April 1, 2022.
  - applied a YNNHSC/CORE-modified v3.0 of the AHRQ HCUP’s beta version 2019.1 CCS for ICD-10-CM/PCS to the specialty cohort definitions and planned readmission algorithm.
  - applied a modified version of the FY 2022 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 measure 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 measure’s SAS pack and documentation; and
- Evaluated and validated model performance in the July 1, 2021 through June 30, 2022 dataset.

## 3.2. Detailed Discussion of Measure Updates

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

#### Cohort Definitions, the Planned Readmission Algorithm, and Readmission Outcome

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 (CCS-R). The magnitude of changes from the CCS beta versions to the CCS-R is extensive. Until comprehensive testing can be completed on the CCS-R, we will continue utilizing the existing beta version v2019.1 of the CCS for ICD-10-CM/PCS as the basis for the specialty cohort definitions and planned readmission algorithm specifications, updating it as appropriate with clinical expert input.

For 2023 public reporting, we first reviewed the new ICD-10-CM and ICD-10-PCS codes in the two code set releases to determine the most appropriate categorizations for the newly implemented ICD-10 codes, using the existing YNNHSC/CORE-modified v2.0 of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS that was utilized in 2022 public reporting. The process involved multiple workgroup meetings with clinical experts. Updates to the CCS mappings included the incorporation of the new ICD-10-CM codes and ICD-10-PCS codes into approximately 35 AHRQ CCS diagnosis categories and 30 AHRQ CCS procedure categories, respectively. These YNNHSC/CORE-modified mappings that were used for 2023 public reporting are posted [here](#) on *QualityNet*. They show the assignment of ICD-10 codes to the AHRQ CCS diagnosis and procedure categories.

Secondly, we 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 specialty cohort definitions and planned readmission algorithm, and whether any changes were warranted. 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 either added to the singular ICD-10 code lists that are also used in the algorithm (conditions that are not captured by AHRQ CCS categories) or added to the surgery/gynecology cohort definition (if not appropriately covered in AHRQ CCS categories).

We reviewed approximately 160 new ICD-10-CM codes and 200 new ICD-10-PCS codes. These code totals reflect new code additions since 2022 public reporting. The intent was to maintain the clinical integrity of the algorithm and cohort definitions.

These processes, in addition to the surveillance and workgroup processes described above in the [Rationale for Measure Updates](#) section, led to the following changes:

- Surgery/gynecology cohort inclusion list: The addition of singular ICD-10-PCS codes (associated with AHRQ CCS procedure category 49).
- Potentially planned procedures:
  - the addition of ICD-10-PCS codes (associated with AHRQ CCS procedure categories 48 and 49) to the singular ICD-10-PCS code list. The singular ICD-10-

PCS code list previously had ICD-10-PCS codes associated with both of these AHRQ CCS procedure categories.

- Acute diagnoses:
  - the addition of ICD-10-CM codes (associated with AHRQ CCS diagnosis categories 155, 233, 238, 253, and 662) to the singular ICD-10-CM code lists. The singular ICD-10-CM code lists previously had ICD-10-CM codes associated with all of these AHRQ CCS diagnosis categories.
  - the addition of AHRQ CCS diagnosis categories 237 (Complication of device; implant or graft) and 661 (Substance-related disorders) as whole categories (and removal of the previous subsets of ICD-10-CM codes that fell under these categories from the singular ICD-10-CM code lists).

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

### Risk Adjustment

We examined RTI International’s FY 2022 modified version of the V24 CMS-HCC crosswalk to see how the newly implemented ICD-10 codes in the FY 2022 ICD-10-CM/PCS code set releases were classified, and to examine codes which RTI International reclassified from one HCC to another when they updated to the FY 2022 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 where code shifts may have occurred. 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).

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

- the addition of two ICD-10-CM codes to the code list used to define the ‘History of COVID-19’ risk-adjustment variable: J12.82 (Pneumonia due to coronavirus disease 2019) and U09.9 (Post COVID-19 condition, unspecified).

Additionally, we reviewed the newly added codes from the two ICD-10-CM releases outlined in the Rationale for Measure Updates section and the changes made by CMS to the POA-exempt code list for FY 2022, to determine what updates to the “POA-Exempt Codes Considered Always POA” table were warranted for 2023, as part of the risk-adjustment methodology used by the measure (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 measure in 2021 and/or 2022 public reporting in response to the COVID-19 public health emergency (PHE) will continue for 2023 public reporting.<sup>9-12</sup>

- A 'History of COVID-19' risk variable is incorporated into the risk-adjustment model.
- 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 the measure, including code specifications, can be found in the 2023 supplemental file [here](#) on *QualityNet*.

### 3.2.3 Additional Notes

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

**Changes made to the specifications are detailed in the 2023 HWR Measure Code Specifications supplemental file that accompanies this report [here](#) on *QualityNet*.**

The ICD-10 code listings in this report and the 2023 supplemental file reflect the most current narrative descriptions for each code.

## 3.3. Changes to SAS Pack

We revised the measure SAS pack to accommodate specification updates discussed in [Section 3.1](#) and [Section 3.2](#) above. The new SAS pack 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/health insurance claim number) into this tool.**

The SAS pack includes 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 pack available to be completely transparent regarding the measure calculation methodology. However, note that even with the SAS pack, it is not possible to replicate the RSR 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 2023 PUBLIC REPORTING

### 4.1. Assessment of Updated Models

The hospital-level 30-day all-cause RSRRs for the measure 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 specifications reports on the readmission measures page [here](#) on *QualityNet* for further details.

We evaluated the performance of the models using the July 1, 2021 through June 30, 2022 data for the 2023 reporting period. We examined the frequencies of patient risk factors and the model parameter coefficients by specialty cohort.

For each of the specialty cohorts, we assessed logistic regression model performance in terms of discriminant ability for the July 1, 2021 through June 30, 2022 period. We computed two summary statistics to assess model performance: the [predictive ability](#) and the area under the receiver operating characteristic (ROC) curve ([c-statistic](#)).

The results of these analyses are presented in [Section 4.2](#).

## **4.2. HWR 2023 Model Results**

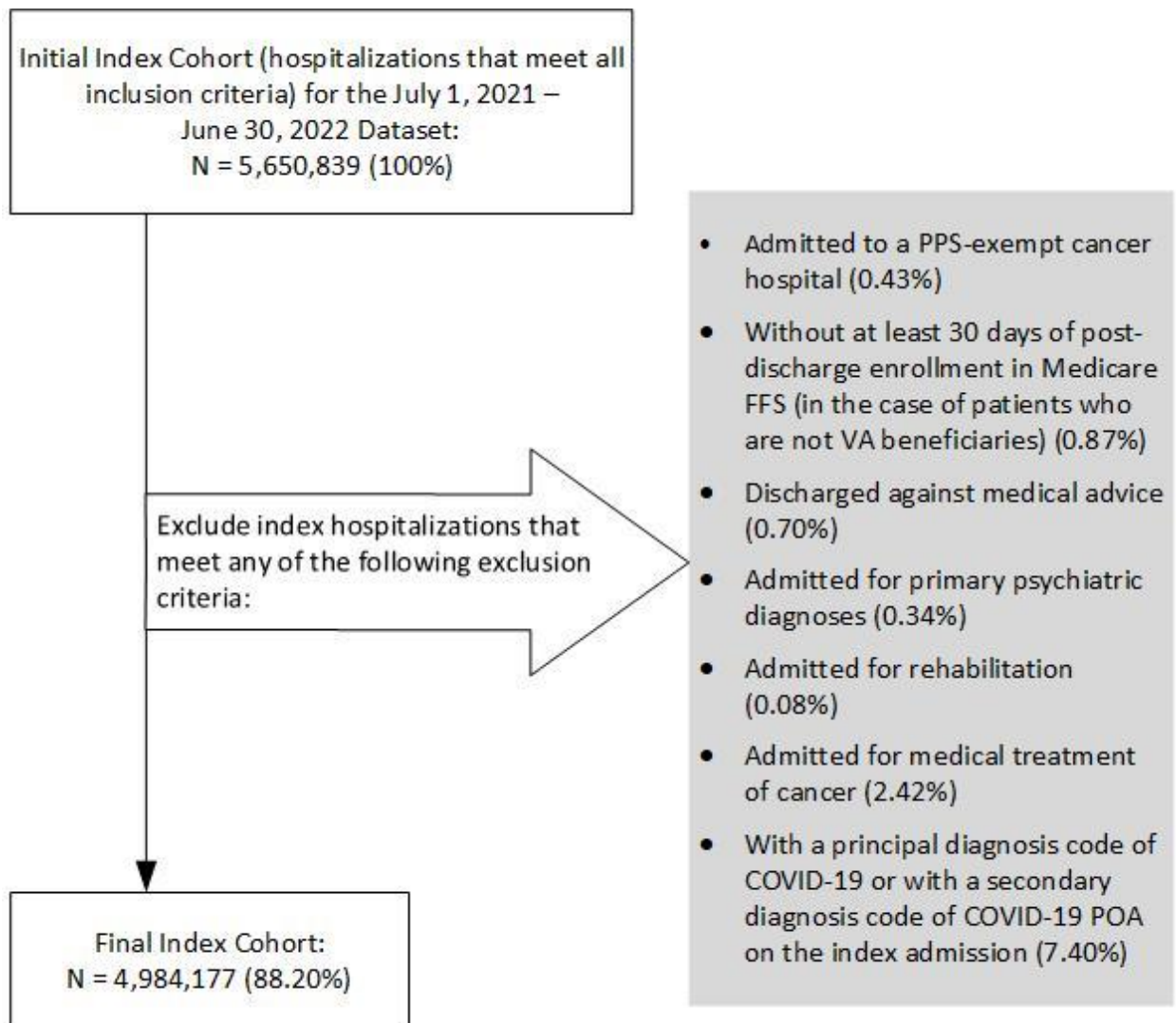
### **4.2.1 Index Cohort Exclusions**

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of admissions that met each exclusion criterion in the July 2021 through June 2022 dataset is presented in [Figure 4.2.1](#).

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;
- enrolled in Medicare FFS Part A for the 12 months prior to the date of admission and during the index admission;
  - For VA beneficiaries hospitalized in VA hospitals, there are no Medicare FFS enrollment requirements.
  - For VA beneficiaries hospitalized in non-VA hospitals, they must be concurrently enrolled in Medicare FFS Part A at the time of the index admission, to be eligible for cohort inclusion (but the 12-month Part A enrollment prior to admission is not required).
- who were not transferred to another acute care facility; and
- were alive at discharge.

**Figure 4.2.1 — Cohort Exclusions in the July 2021 through June 2022 Dataset**





#### 4.2.2 HWR Specialty Cohort Model Parameters and Performance

Table 4.2.1, Table 4.2.2, Table 4.2.3, Table 4.2.4, and Table 4.2.5 show the specialty cohort-level frequency of risk factors, risk-adjusted odds ratios (ORs) and 95% confidence intervals (CIs), and hierarchical logistic regression model parameter coefficients and standard errors (SEs) for the July 1, 2021 through June 30, 2022 data sample. Table 4.2.6 presents the specialty cohort-level model performance. Table 4.2.7 presents the number of index hospitalizations and *observed* readmission rates for each specialty cohort.

#### 4.2.3 Distribution of Hospital Observed Rates, SRRs and RSRRs

Table 4.2.8 shows the number of hospitals with at least one admission in each specialty cohort, the mean and median hospital-level *observed* readmission rates, and the mean and median SRRs for each specialty cohort. Table 4.2.9 shows the distribution of hospital-level *observed* rates and RSRRs. Figure 4.2.2 shows the overall distribution of the hospital RSRRs for the dataset, which indicates that the hospital RSRRs are roughly normally distributed.

#### 4.2.4 Distribution of Hospitals by Performance Category

Of 4,676 hospitals in the study cohort, 185 performed “Better than the National Rate,” 4,028 performed “No Different than the National Rate,” and 195 performed “Worse than the National Rate.” 268 were classified as “Number of Cases Too Small” (fewer than 25) to reliably conclude how the hospital is performing.

**Table 4.2.1 — Medicine Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2021 through June 2022)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Intercept	N/A	N/A	-2.438 (0.008)
Years over 65 (continuous)	N/A	1.00 (1.00 – 1.00)	-0.003 (0.000)
History of COVID-19	8.92	1.02 (1.00-1.03)	0.016 (0.006)
Severe infection (CC 1, 3 – 6)	1.65	1.08 (1.05 – 1.10)	0.073 (0.012)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	20.30	1.06 (1.05 – 1.07)	0.054 (0.005)
Other infectious diseases and pneumonias (CC 7, 114 – 116)	39.28	1.11 (1.10 – 1.12)	0.103 (0.004)
Metastatic cancer and acute leukemia (CC 8)	4.86	1.26 (1.24 – 1.28)	0.228 (0.008)
Severe cancer (CC 9 – 10)	7.28	1.21 (1.19 – 1.23)	0.190 (0.007)
Other cancers (CC 11 – 14)	10.85	1.07 (1.06 – 1.09)	0.071 (0.006)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	41.66	1.12 (1.11 – 1.12)	0.110 (0.004)

<b>Risk Variable</b>	<b>% of Hospitalizations with This Risk Variable</b>	<b>OR (95% CI)</b>	<b>Model Coefficients (SE)</b>
Protein-calorie malnutrition (CC 21)	16.03	1.16 (1.15 – 1.17)	0.151 (0.005)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	59.66	1.19 (1.18 – 1.20)	0.174 (0.004)
End-stage liver disease; cirrhosis of liver (CC 27 – 28)	5.08	1.26 (1.24 – 1.27)	0.227 (0.008)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	17.35	1.14 (1.13 – 1.15)	0.133 (0.005)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	6.37	1.10 (1.08 – 1.11)	0.092 (0.007)
Severe hematological disorders (CC 46)	1.28	1.34 (1.30 – 1.38)	0.292 (0.014)
Coagulation defects and other specified hematological disorders (CC 48)	14.60	1.06 (1.05 – 1.07)	0.061 (0.005)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	51.68	1.21 (1.20 – 1.22)	0.189 (0.004)
Drug/alcohol psychosis or dependence (CC 54 – 55)	4.46	1.10 (1.09 – 1.12)	0.098 (0.008)
Psychiatric comorbidity (CC 57 – 59, 61, 63)	32.63	1.09 (1.09 – 1.10)	0.089 (0.004)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	8.63	1.08 (1.07 – 1.09)	0.077 (0.006)
Seizure disorders and convulsions (CC 79)	5.01	1.12 (1.10 – 1.13)	0.109 (0.008)
Respirator dependence/tracheostomy status (CC 82)	0.65	1.17 (1.12 – 1.21)	0.153 (0.019)
Cardio-respiratory failure and shock (CC 84), plus ICD-10-CM codes R09.01 and R09.02	29.69	1.09 (1.08 – 1.10)	0.088 (0.004)
Congestive heart failure (CC 85)	42.84	1.19 (1.18 – 1.20)	0.176 (0.004)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86 – 89, 102, 105 – 109)	61.39	1.11 (1.11 – 1.12)	0.108 (0.004)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	45.89	1.11 (1.10 – 1.12)	0.102 (0.004)
Chronic obstructive pulmonary disease (COPD) (CC 111)	25.15	1.15 (1.14 – 1.16)	0.139 (0.004)
Fibrosis of lung or other chronic lung disorders (CC 112)	3.44	1.11 (1.09 – 1.13)	0.102 (0.009)
Transplants (CC 132, 186)	1.71	1.14 (1.11 – 1.17)	0.132 (0.012)
Dialysis status (CC 134)	4.34	1.28 (1.26 – 1.30)	0.248 (0.008)
Renal failure (CC 135 – 140)	55.44	1.20 (1.19 – 1.21)	0.183 (0.004)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	10.88	1.15 (1.14 – 1.16)	0.138 (0.005)
Hip fracture/dislocation (CC 170)	3.28	0.92 (0.90 – 0.94)	-0.083 (0.010)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Septicemia (except in labor) (CCS 2)	16.90	0.86 (0.84 – 0.87)	-0.156 (0.007)
Bacterial infection; unspecified site (CCS 3)	0.24	0.82 (0.77 – 0.89)	-0.193 (0.037)
Mycoses (CCS 4)	0.13	1.28 (1.18 – 1.39)	0.246 (0.043)
Hepatitis (CCS 6)	0.07	1.26 (1.12 – 1.41)	0.228 (0.058)
Viral infection (CCS 7)	0.19	0.80 (0.74 – 0.88)	-0.219 (0.044)
Other infections; including parasitic (CCS 8)	0.06	0.50 (0.41 – 0.61)	-0.690 (0.097)
Other and unspecified benign neoplasm (CCS 47)	0.17	0.74 (0.67 – 0.81)	-0.301 (0.049)
Thyroid disorders (CCS 48)	0.10	0.98 (0.88 – 1.09)	-0.020 (0.055)
Diabetes mellitus with complications (CCS 50)	2.23	0.99 (0.96 – 1.01)	-0.013 (0.012)
Other endocrine disorders (CCS 51)	0.83	1.01 (0.97 – 1.05)	0.007 (0.020)
Nutritional deficiencies (CCS 52)	0.13	0.98 (0.89 – 1.07)	-0.025 (0.048)
Gout and other crystal arthropathies (CCS 54)	0.16	0.76 (0.69 – 0.84)	-0.271 (0.048)
Fluid and electrolyte disorders (CCS 55)	3.44	0.97 (0.95 – 0.99)	-0.031 (0.011)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.71	0.96 (0.92 – 1.00)	-0.040 (0.021)
Deficiency and other anemia (CCS 59)	1.43	1.02 (0.99 – 1.05)	0.024 (0.015)
Acute posthemorrhagic anemia (CCS 60)	0.63	1.01 (0.97 – 1.05)	0.008 (0.021)
Coagulation and hemorrhagic disorders (CCS 62)	0.49	0.97 (0.92 – 1.02)	-0.032 (0.025)
Diseases of white blood cells (CCS 63)	0.24	1.16 (1.08 – 1.23)	0.146 (0.033)
Other hematologic conditions (CCS 64)	0.06	0.99 (0.85 – 1.15)	-0.012 (0.076)
Meningitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 76)	0.05	0.87 (0.74 – 1.03)	-0.136 (0.086)
Encephalitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 77)	0.07	0.98 (0.85 – 1.12)	-0.021 (0.070)
Headache; including migraine (CCS 84)	0.15	0.73 (0.65 – 0.81)	-0.316 (0.056)
Retinal detachments; defects; vascular occlusion; and retinopathy (CCS 87)	0.05	0.51 (0.41 – 0.64)	-0.677 (0.114)
Blindness and vision defects (CCS 89)	0.06	0.66 (0.56 – 0.79)	-0.411 (0.090)
Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease) (CCS 90)	0.05	0.75 (0.63 – 0.89)	-0.288 (0.088)
Other eye disorders (CCS 91)	0.05	0.70 (0.58 – 0.84)	-0.357 (0.094)
Conditions associated with dizziness or vertigo (CCS 93)	0.47	0.51 (0.47 – 0.55)	-0.678 (0.037)
Essential hypertension (CCS 98)	0.06	0.61 (0.50 – 0.75)	-0.489 (0.100)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Hypertension with complications and secondary hypertension (CCS 99)	15.08	Reference	Reference
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	0.68	0.90 (0.86 – 0.95)	-0.101 (0.023)
Hemorrhoids (CCS 120)	0.24	0.82 (0.76 – 0.88)	-0.198 (0.037)
Other diseases of veins and lymphatics (CCS 121)	0.14	0.97 (0.88 – 1.06)	-0.035 (0.045)
Influenza (CCS 123)	0.33	0.63 (0.59 – 0.68)	-0.460 (0.037)
Other upper respiratory infections (CCS 126)	0.10	0.65 (0.57 – 0.74)	-0.429 (0.068)
Other upper respiratory disease (CCS 134)	0.13	0.91 (0.83 – 1.00)	-0.094 (0.050)
Intestinal infection (CCS 135)	1.28	0.94 (0.91 – 0.97)	-0.059 (0.016)
Diseases of mouth; excluding dental (CCS 137)	0.09	0.67 (0.58 – 0.76)	-0.405 (0.068)
Esophageal disorders (CCS 138)	0.45	0.90 (0.85 – 0.95)	-0.110 (0.028)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.13	0.87 (0.78 – 0.96)	-0.142 (0.052)
Gastritis and duodenitis (CCS 140)	0.58	0.89 (0.85 – 0.93)	-0.118 (0.023)
Other disorders of stomach and duodenum (CCS 141)	0.19	1.04 (0.96 – 1.12)	0.038 (0.038)
Appendicitis and other appendiceal conditions (CCS 142)	0.10	0.96 (0.85 – 1.09)	-0.036 (0.064)
Abdominal hernia (CCS 143)	0.29	0.76 (0.71 – 0.82)	-0.271 (0.038)
Regional enteritis and ulcerative colitis (CCS 144)	0.21	1.07 (0.99 – 1.15)	0.066 (0.039)
Intestinal obstruction without hernia (CCS 145)	2.41	0.89 (0.87 – 0.92)	-0.114 (0.014)
Diverticulosis and diverticulitis (CCS 146)	2.24	0.92 (0.90 – 0.95)	-0.081 (0.014)
Anal and rectal conditions (CCS 147)	0.18	0.94 (0.87 – 1.02)	-0.060 (0.041)
Peritonitis and intestinal abscess (CCS 148)	0.12	1.11 (1.02 – 1.22)	0.107 (0.046)
Biliary tract disease (CCS 149)	1.08	1.10 (1.06 – 1.14)	0.094 (0.018)
Other liver diseases (CCS 151)	0.97	1.37 (1.33 – 1.42)	0.318 (0.017)
Pancreatic disorders (not diabetes) (CCS 152)	0.89	1.01 (0.97 – 1.05)	0.011 (0.020)
Gastrointestinal hemorrhage (CCS 153)	3.99	0.94 (0.92 – 0.96)	-0.063 (0.010)
Noninfectious gastroenteritis (CCS 154)	0.79	0.91 (0.88 – 0.95)	-0.091 (0.021)
Other gastrointestinal disorders (CCS 155)	1.26	1.04 (1.01 – 1.07)	0.039 (0.016)
Nephritis; nephrosis; renal sclerosis (CCS 156)	0.06	1.15 (1.01 – 1.32)	0.141 (0.068)
Acute and unspecified renal failure (CCS 157)	5.51	0.98 (0.96 – 0.99)	-0.023 (0.009)
Urinary tract infections (CCS 159)	6.04	0.93 (0.91 – 0.95)	-0.071 (0.009)
Calculus of urinary tract (CCS 160)	0.10	0.88 (0.78 – 1.00)	-0.123 (0.063)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Other diseases of kidney and ureters (CCS 161)	0.42	0.86 (0.81 – 0.91)	-0.150 (0.030)
Other diseases of bladder and urethra (CCS 162)	0.09	0.97 (0.86 – 1.10)	-0.026 (0.061)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.24	1.03 (0.96 – 1.10)	0.029 (0.036)
Hyperplasia of prostate (CCS 164)	0.13	0.97 (0.88 – 1.08)	-0.029 (0.052)
Inflammatory conditions of male genital organs (CCS 165)	0.12	0.71 (0.63 – 0.80)	-0.346 (0.060)
Skin and subcutaneous tissue infections (CCS 197)	2.58	0.83 (0.81 – 0.85)	-0.189 (0.013)
Other inflammatory condition of skin (CCS 198)	0.06	1.19 (1.04 – 1.36)	0.170 (0.069)
Chronic ulcer of skin (CCS 199)	0.20	0.93 (0.86 – 1.00)	-0.076 (0.038)
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 201)	0.26	0.86 (0.81 – 0.93)	-0.147 (0.035)
Rheumatoid arthritis and related disease (CCS 202)	0.05	0.79 (0.66 – 0.94)	-0.238 (0.088)
Osteoarthritis (CCS 203)	0.22	0.72 (0.66 – 0.79)	-0.331 (0.047)
Other non-traumatic joint disorders (CCS 204)	0.21	0.86 (0.79 – 0.93)	-0.152 (0.043)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	1.14	0.90 (0.86 – 0.93)	-0.111 (0.019)
Pathological fracture (CCS 207)	0.37	0.77 (0.72 – 0.82)	-0.264 (0.033)
Systemic lupus erythematosus and connective tissue disorders (CCS 210)	0.10	1.13 (1.02 – 1.26)	0.124 (0.054)
Other connective tissue disease (CCS 211)	0.75	0.82 (0.78 – 0.86)	-0.201 (0.023)
Other bone disease and musculoskeletal deformities (CCS 212)	0.07	0.86 (0.75 – 0.98)	-0.156 (0.070)
Fracture of neck of femur (hip) (CCS 226)	0.31	0.65 (0.60 – 0.70)	-0.428 (0.040)
Skull and face fractures (CCS 228)	0.13	0.67 (0.60 – 0.76)	-0.397 (0.062)
Fracture of upper limb (CCS 229)	0.44	0.86 (0.81 – 0.91)	-0.156 (0.030)
Fracture of lower limb (CCS 230)	0.40	0.78 (0.73 – 0.83)	-0.254 (0.033)
Other fractures (CCS 231)	2.54	0.76 (0.74 – 0.78)	-0.273 (0.014)
Sprains and strains (CCS 232)	0.09	0.77 (0.67 – 0.88)	-0.264 (0.069)
Crushing injury or internal injury (CCS 234)	0.46	0.86 (0.81 – 0.91)	-0.156 (0.031)
Open wounds of head; neck; and trunk (CCS 235)	0.10	0.77 (0.68 – 0.87)	-0.267 (0.063)
Open wounds of extremities (CCS 236)	0.08	0.98 (0.86 – 1.12)	-0.018 (0.067)
Complication of device; implant or graft (CCS 237)	4.14	1.03 (1.02 – 1.05)	0.034 (0.009)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Complications of surgical procedures or medical care (CCS 238)	2.58	0.90 (0.88 – 0.92)	-0.107 (0.012)
Superficial injury; contusion (CCS 239)	0.40	0.84 (0.79 – 0.89)	-0.175 (0.031)
Poisoning by psychotropic agents (CCS 241)	0.06	0.82 (0.71 – 0.95)	-0.197 (0.076)
Poisoning by other medications and drugs (CCS 242)	0.33	0.82 (0.77 – 0.87)	-0.200 (0.032)
Poisoning by nonmedicinal substances (CCS 243)	0.04	0.66 (0.54 – 0.81)	-0.416 (0.103)
Other injuries and conditions due to external causes (CCS 244)	0.56	0.73 (0.69 – 0.77)	-0.321 (0.028)
Syncope (CCS 245)	0.97	0.73 (0.70 – 0.76)	-0.316 (0.021)
Fever of unknown origin (CCS 246)	0.16	0.95 (0.87 – 1.03)	-0.056 (0.045)
Gangrene (CCS 248)	0.07	1.25 (1.12 – 1.40)	0.225 (0.058)
Shock (CCS 249)	0.06	0.79 (0.69 – 0.91)	-0.238 (0.071)
Nausea and vomiting (CCS 250)	0.17	1.28 (1.18 – 1.38)	0.245 (0.039)
Abdominal pain (CCS 251)	0.23	1.16 (1.09 – 1.25)	0.152 (0.036)
Malaise and fatigue (CCS 252)	0.47	0.97 (0.92 – 1.02)	-0.033 (0.026)
Allergic reactions (CCS 253)	0.08	0.78 (0.68 – 0.89)	-0.253 (0.070)
Other aftercare (CCS 257)	0.11	0.39 (0.33 – 0.45)	-0.951 (0.076)
Other screening for suspected conditions (not mental disorders or infectious disease) (CCS 258)	0.06	0.93 (0.81 – 1.08)	-0.068 (0.074)
Residual codes; unclassified (CCS 259)	0.35	1.04 (0.98 – 1.10)	0.038 (0.030)
Delirium dementia and amnestic and other cognitive disorders (CCS 653)	1.22	0.87 (0.84 – 0.90)	-0.144 (0.018)
Alcohol-related disorders (CCS 660)	0.86	1.12 (1.08 – 1.16)	0.111 (0.019)
Substance-related disorders (CCS 661)	0.12	0.92 (0.83 – 1.02)	-0.086 (0.052)
Low Frequency Conditions	0.53	0.87 (0.83 – 0.91)	-0.140 (0.026)

**Table 4.2.2 — Surgery/Gynecology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2021 through June 2022)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Intercept	N/A	N/A	-2.486 (0.028)
Years over 65 (continuous)	N/A	1.01 (1.01 – 1.01)	0.011 (0.000)
History of COVID-19	5.88	0.96 (0.94-0.99)	-0.038 (0.012)
Severe infection (CC 1, 3 – 6)	1.08	1.09 (1.04 – 1.15)	0.090 (0.024)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	8.88	1.02 (1.00 – 1.04)	0.016 (0.010)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Other infectious diseases and pneumonias (CC 7, 114 – 116)	17.89	1.08 (1.06 – 1.10)	0.079 (0.008)
Metastatic cancer and acute leukemia (CC 8)	4.18	1.32 (1.29 – 1.36)	0.281 (0.015)
Severe cancer (CC 9 – 10)	4.70	1.20 (1.17 – 1.23)	0.179 (0.013)
Other cancers (CC 11 – 14)	7.66	1.04 (1.01 – 1.06)	0.036 (0.011)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	32.00	1.15 (1.14 – 1.17)	0.143 (0.007)
Protein-calorie malnutrition (CC 21)	9.21	1.19 (1.17 – 1.21)	0.172 (0.009)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	30.97	1.18 (1.16 – 1.19)	0.162 (0.007)
End-stage liver disease; cirrhosis of liver (CC 27 – 28)	1.99	1.26 (1.22 – 1.31)	0.235 (0.018)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	11.49	1.10 (1.08 – 1.12)	0.091 (0.009)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.81	1.11 (1.09 – 1.14)	0.107 (0.012)
Severe hematological disorders (CC 46)	0.56	1.29 (1.21 – 1.38)	0.257 (0.032)
Coagulation defects and other specified hematological disorders (CC 48)	8.70	1.06 (1.04 – 1.09)	0.063 (0.010)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	32.38	1.17 (1.15 – 1.19)	0.158 (0.007)
Drug/alcohol psychosis or dependence (CC 54 – 55)	2.58	1.10 (1.07 – 1.14)	0.099 (0.017)
Psychiatric comorbidity (CC 57 – 59, 61, 63)	26.27	1.09 (1.08 – 1.11)	0.090 (0.007)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	7.73	1.12 (1.10 – 1.14)	0.114 (0.011)
Seizure disorders and convulsions (CC 79)	2.83	1.14 (1.10 – 1.17)	0.128 (0.016)
Respirator dependence/tracheostomy status (CC 82)	0.50	1.13 (1.06 – 1.21)	0.122 (0.034)
Cardio-respiratory failure and shock (CC 84), plus ICD-10-CM codes R09.01 and R09.02	12.52	1.08 (1.06 – 1.10)	0.075 (0.009)
Congestive heart failure (CC 85)	23.42	1.17 (1.15 – 1.19)	0.159 (0.008)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86 – 89, 102, 105 – 109)	47.67	1.18 (1.17 – 1.20)	0.167 (0.007)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	30.80	1.14 (1.12 – 1.16)	0.131 (0.007)
Chronic obstructive pulmonary disease (COPD) (CC 111)	16.79	1.19 (1.17 – 1.21)	0.173 (0.008)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.91	1.13 (1.09 – 1.17)	0.122 (0.019)
Transplants (CC 132, 186)	0.96	1.17 (1.11 – 1.23)	0.158 (0.025)
Dialysis status (CC 134)	2.41	1.43 (1.38 – 1.47)	0.354 (0.015)
Renal failure (CC 135 – 140)	32.32	1.24 (1.22 – 1.26)	0.215 (0.007)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	7.99	1.11 (1.09 – 1.14)	0.106 (0.011)
Hip fracture/dislocation (CC 170)	4.17	1.03 (1.00 – 1.05)	0.025 (0.014)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Septicemia (except in labor) (CCS 2)	4.06	0.85 (0.80 – 0.90)	-0.161 (0.030)
Cancer of head and neck (CCS 11)	0.42	0.81 (0.73 – 0.90)	-0.206 (0.053)
Cancer of esophagus (CCS 12)	0.12	1.39 (1.20 – 1.61)	0.331 (0.074)
Cancer of stomach (CCS 13)	0.23	0.81 (0.71 – 0.92)	-0.211 (0.064)
Cancer of colon (CCS 14)	1.66	0.66 (0.62 – 0.71)	-0.409 (0.036)
Cancer of rectum and anus (CCS 15)	0.43	1.12 (1.02 – 1.24)	0.117 (0.048)
Cancer of liver and intrahepatic bile duct (CCS 16)	0.13	1.07 (0.92 – 1.24)	0.066 (0.075)
Cancer of pancreas (CCS 17)	0.30	1.16 (1.05 – 1.28)	0.147 (0.052)
Cancer of other GI organs; peritoneum (CCS 18)	0.22	0.98 (0.87 – 1.11)	-0.017 (0.062)
Cancer of bronchus; lung (CCS 19)	1.22	0.60 (0.56 – 0.65)	-0.506 (0.041)
Cancer of bone and connective tissue (CCS 21)	0.13	0.84 (0.72 – 1.00)	-0.169 (0.085)
Other non-epithelial cancer of skin (CCS 23)	0.12	0.58 (0.48 – 0.69)	-0.552 (0.095)
Cancer of breast (CCS 24)	0.18	0.48 (0.40 – 0.58)	-0.734 (0.094)
Cancer of uterus (CCS 25)	0.25	0.66 (0.58 – 0.76)	-0.410 (0.071)
Cancer of ovary (CCS 27)	0.23	0.63 (0.55 – 0.72)	-0.466 (0.071)
Cancer of other female genital organs (CCS 28)	0.09	0.77 (0.63 – 0.94)	-0.264 (0.103)
Cancer of prostate (CCS 29)	0.46	0.63 (0.56 – 0.70)	-0.467 (0.059)
Cancer of bladder (CCS 32)	0.60	1.30 (1.20 – 1.41)	0.264 (0.041)
Cancer of kidney and renal pelvis (CCS 33)	0.71	0.55 (0.50 – 0.60)	-0.603 (0.049)
Cancer of other urinary organs (CCS 34)	0.11	0.80 (0.67 – 0.96)	-0.220 (0.089)
Cancer of brain and nervous system (CCS 35)	0.23	1.08 (0.96 – 1.22)	0.077 (0.063)
Non-Hodgkin's lymphoma (CCS 38)	0.13	1.29 (1.12 – 1.48)	0.253 (0.072)
Secondary malignancies (CCS 42)	0.90	0.82 (0.75 – 0.88)	-0.203 (0.040)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Malignant neoplasm without specification of site (CCS 43)	0.11	0.93 (0.79 – 1.11)	-0.069 (0.088)
Neoplasms of unspecified nature or uncertain behavior (CCS 44)	0.24	0.75 (0.66 – 0.86)	-0.283 (0.069)
Other and unspecified benign neoplasm (CCS 47)	1.24	0.71 (0.66 – 0.77)	-0.339 (0.040)
Diabetes mellitus with complications (CCS 50)	2.79	0.81 (0.76 – 0.86)	-0.209 (0.031)
Fluid and electrolyte disorders (CCS 55)	0.10	0.97 (0.84 – 1.13)	-0.026 (0.076)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.36	0.45 (0.39 – 0.52)	-0.799 (0.072)
Parkinson`s disease (CCS 79)	0.13	0.43 (0.34 – 0.55)	-0.842 (0.123)
Other nervous system disorders (CCS 95)	0.65	0.65 (0.59 – 0.71)	-0.437 (0.048)
Heart valve disorders (CCS 96)	5.21	0.59 (0.56 – 0.63)	-0.527 (0.030)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease) (CCS 97)	0.20	1.00 (0.89 – 1.13)	0.003 (0.060)
Hypertension with complications and secondary hypertension (CCS 99)	0.70	Reference	Reference
Acute myocardial infarction (CCS 100)	1.10	0.79 (0.73 – 0.85)	-0.241 (0.038)
Coronary atherosclerosis and other heart disease (CCS 101)	2.61	0.70 (0.66 – 0.75)	-0.357 (0.033)
Cardiac dysrhythmias (CCS 106)	0.21	0.92 (0.82 – 1.04)	-0.078 (0.060)
Acute cerebrovascular disease (CCS 109)	1.65	0.76 (0.71 – 0.82)	-0.271 (0.035)
Occlusion or stenosis of precerebral arteries (CCS 110)	2.59	0.41 (0.39 – 0.44)	-0.883 (0.036)
Other and ill-defined cerebrovascular disease (CCS 111)	0.23	0.48 (0.40 – 0.56)	-0.741 (0.083)
Peripheral and visceral atherosclerosis (CCS 114)	1.07	0.92 (0.86 – 0.99)	-0.081 (0.037)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	0.46	1.09 (0.99 – 1.19)	0.084 (0.047)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.16	1.01 (0.88 – 1.16)	0.010 (0.069)
Other circulatory disease (CCS 117)	0.09	0.86 (0.72 – 1.03)	-0.152 (0.091)
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	0.18	0.82 (0.72 – 0.94)	-0.195 (0.069)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	0.15	0.93 (0.82 – 1.06)	-0.072 (0.065)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	0.09	1.14 (0.97 – 1.34)	0.130 (0.081)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.25	0.72 (0.64 – 0.81)	-0.332 (0.060)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	0.13	0.79 (0.69 – 0.91)	-0.235 (0.073)
Other lower respiratory disease (CCS 133)	0.22	0.76 (0.66 – 0.87)	-0.274 (0.070)
Other upper respiratory disease (CCS 134)	0.13	0.57 (0.48 – 0.67)	-0.567 (0.086)
Esophageal disorders (CCS 138)	0.17	0.74 (0.64 – 0.87)	-0.296 (0.078)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.17	0.94 (0.82 – 1.07)	-0.065 (0.070)
Other disorders of stomach and duodenum (CCS 141)	0.12	0.94 (0.81 – 1.10)	-0.059 (0.078)
Appendicitis and other appendiceal conditions (CCS 142)	0.64	0.65 (0.59 – 0.72)	-0.432 (0.050)
Abdominal hernia (CCS 143)	2.29	0.64 (0.60 – 0.68)	-0.447 (0.034)
Regional enteritis and ulcerative colitis (CCS 144)	0.10	1.27 (1.07 – 1.49)	0.235 (0.084)
Intestinal obstruction without hernia (CCS 145)	1.68	0.81 (0.76 – 0.87)	-0.206 (0.035)
Diverticulosis and diverticulitis (CCS 146)	1.03	0.78 (0.72 – 0.84)	-0.254 (0.040)
Anal and rectal conditions (CCS 147)	0.36	0.58 (0.52 – 0.66)	-0.537 (0.061)
Biliary tract disease (CCS 149)	2.68	0.62 (0.58 – 0.66)	-0.475 (0.033)
Other liver diseases (CCS 151)	0.11	1.33 (1.15 – 1.53)	0.283 (0.073)
Pancreatic disorders (not diabetes) (CCS 152)	0.38	0.65 (0.58 – 0.73)	-0.432 (0.057)
Gastrointestinal hemorrhage (CCS 153)	0.22	0.94 (0.84 – 1.05)	-0.064 (0.056)
Other gastrointestinal disorders (CCS 155)	1.02	0.74 (0.68 – 0.79)	-0.307 (0.039)
Acute and unspecified renal failure (CCS 157)	0.27	1.02 (0.92 – 1.13)	0.022 (0.051)
Urinary tract infections (CCS 159)	0.58	0.99 (0.91 – 1.08)	-0.009 (0.042)
Calculus of urinary tract (CCS 160)	0.25	0.63 (0.56 – 0.72)	-0.455 (0.068)
Other diseases of kidney and ureters (CCS 161)	0.54	0.65 (0.59 – 0.72)	-0.430 (0.050)
Other diseases of bladder and urethra (CCS 162)	0.24	0.91 (0.81 – 1.02)	-0.096 (0.060)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.17	0.88 (0.76 – 1.00)	-0.133 (0.069)
Hyperplasia of prostate (CCS 164)	0.58	0.63 (0.57 – 0.70)	-0.455 (0.051)
Prolapse of female genital organs (CCS 170)	0.17	0.34 (0.27 – 0.43)	-1.079 (0.121)
Other female genital disorders (CCS 175)	0.13	0.77 (0.65 – 0.92)	-0.258 (0.089)
Skin and subcutaneous tissue infections (CCS 197)	0.55	0.62 (0.56 – 0.68)	-0.483 (0.047)
Chronic ulcer of skin (CCS 199)	0.31	0.70 (0.63 – 0.77)	-0.361 (0.053)

<b>Risk Variable</b>	<b>% of Hospitalizations with This Risk Variable</b>	<b>OR (95% CI)</b>	<b>Model Coefficients (SE)</b>
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 201)	0.70	0.66 (0.60 – 0.71)	-0.423 (0.043)
Osteoarthritis (CCS 203)	9.44	0.35 (0.33 – 0.37)	-1.048 (0.031)
Other non-traumatic joint disorders (CCS 204)	0.12	0.42 (0.33 – 0.53)	-0.875 (0.119)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	6.12	0.56 (0.53 – 0.60)	-0.576 (0.031)
Pathological fracture (CCS 207)	1.72	0.63 (0.59 – 0.68)	-0.457 (0.035)
Other acquired deformities (CCS 209)	1.13	0.53 (0.48 – 0.58)	-0.638 (0.046)
Other connective tissue disease (CCS 211)	0.39	0.50 (0.45 – 0.57)	-0.687 (0.062)
Other bone disease and musculoskeletal deformities (CCS 212)	0.15	0.54 (0.45 – 0.65)	-0.615 (0.093)
Cardiac and circulatory congenital anomalies (CCS 213)	0.20	0.59 (0.50 – 0.69)	-0.528 (0.081)
Joint disorders and dislocations; trauma-related (CCS 225)	0.14	0.71 (0.60 – 0.84)	-0.340 (0.085)
Fracture of neck of femur (hip) (CCS 226)	11.09	0.61 (0.57 – 0.64)	-0.498 (0.029)
Spinal cord injury (CCS 227)	0.11	0.91 (0.77 – 1.07)	-0.095 (0.085)
Skull and face fractures (CCS 228)	0.09	0.59 (0.47 – 0.74)	-0.523 (0.114)
Fracture of upper limb (CCS 229)	1.24	0.53 (0.49 – 0.58)	-0.628 (0.041)
Fracture of lower limb (CCS 230)	2.83	0.64 (0.60 – 0.68)	-0.447 (0.033)
Other fractures (CCS 231)	1.15	0.71 (0.66 – 0.77)	-0.338 (0.038)
Sprains and strains (CCS 232)	0.10	0.48 (0.37 – 0.60)	-0.743 (0.122)
Intracranial injury (CCS 233)	0.75	1.04 (0.96 – 1.12)	0.038 (0.040)
Crushing injury or internal injury (CCS 234)	0.18	0.67 (0.58 – 0.78)	-0.393 (0.076)
Open wounds of extremities (CCS 236)	0.14	0.59 (0.49 – 0.70)	-0.534 (0.088)
Complication of device; implant or graft (CCS 237)	5.46	0.79 (0.75 – 0.84)	-0.232 (0.029)
Complications of surgical procedures or medical care (CCS 238)	2.97	0.83 (0.79 – 0.89)	-0.181 (0.031)
Superficial injury; contusion (CCS 239)	0.09	0.82 (0.69 – 0.97)	-0.203 (0.088)
Other injuries and conditions due to external causes (CCS 244)	0.09	0.76 (0.63 – 0.92)	-0.273 (0.096)
Gangrene (CCS 248)	0.36	1.12 (1.03 – 1.23)	0.118 (0.046)
Other aftercare (CCS 257)	0.17	0.54 (0.45 – 0.63)	-0.625 (0.084)
Low Frequency Conditions	2.34	0.80 (0.75 – 0.85)	-0.226 (0.032)

**Table 4.2.3 — Cardiorespiratory Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2021 through June 2022)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Intercept	N/A	N/A	-2.443 (0.024)
Years over 65 (continuous)	N/A	1.00 (0.99 – 1.00)	-0.004 (0.001)
History of COVID-19	11.87	1.01 (0.98-1.03)	0.006 (0.012)
Severe infection (CC 1, 3 – 6)	1.85	1.11 (1.05 – 1.17)	0.102 (0.026)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	12.74	1.09 (1.07 – 1.12)	0.087 (0.012)
Other infectious diseases and pneumonias (CC 7, 114 – 116)	41.24	1.12 (1.10 – 1.14)	0.117 (0.009)
Metastatic cancer and acute leukemia (CC 8)	4.88	1.32 (1.27 – 1.37)	0.280 (0.019)
Severe cancer (CC 9 – 10)	9.28	1.20 (1.17 – 1.23)	0.183 (0.014)
Other cancers (CC 11 – 14)	7.66	1.09 (1.06 – 1.12)	0.088 (0.015)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	34.85	1.11 (1.10 – 1.13)	0.108 (0.009)
Protein-calorie malnutrition (CC 21)	15.81	1.13 (1.10 – 1.15)	0.120 (0.011)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	52.59	1.17 (1.15 – 1.19)	0.153 (0.009)
End-stage liver disease; cirrhosis of liver (CC 27 – 28)	2.65	1.17 (1.12 – 1.22)	0.159 (0.022)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	9.68	1.14 (1.11 – 1.17)	0.132 (0.013)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	6.69	1.05 (1.02 – 1.08)	0.049 (0.015)
Severe hematological disorders (CC 46)	0.97	1.20 (1.12 – 1.29)	0.186 (0.036)
Coagulation defects and other specified hematological disorders (CC 48)	11.46	1.04 (1.01 – 1.06)	0.038 (0.012)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	44.24	1.21 (1.19 – 1.23)	0.187 (0.009)
Drug/alcohol psychosis or dependence (CC 54 – 55)	4.18	1.18 (1.14 – 1.22)	0.163 (0.018)
Psychiatric comorbidity (CC 57 – 59, 61, 63)	35.94	1.11 (1.09 – 1.13)	0.103 (0.008)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	6.67	1.13 (1.09 – 1.16)	0.118 (0.015)
Seizure disorders and convulsions (CC 79)	4.61	1.12 (1.09 – 1.16)	0.117 (0.018)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Respirator dependence/tracheostomy status (CC 82)	1.03	1.10 (1.03 – 1.18)	0.097 (0.034)
Cardio-respiratory failure and shock (CC 84), plus ICD-10-CM codes R09.01 and R09.02	63.44	1.12 (1.10 – 1.14)	0.112 (0.009)
Congestive heart failure (CC 85)	48.43	1.22 (1.19 – 1.24)	0.195 (0.009)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86 – 89, 102, 105 – 109)	60.84	1.10 (1.08 – 1.12)	0.092 (0.009)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	44.22	1.15 (1.14 – 1.17)	0.144 (0.009)
Chronic obstructive pulmonary disease (COPD) (CC 111)	48.28	1.25 (1.23 – 1.27)	0.226 (0.009)
Fibrosis of lung or other chronic lung disorders (CC 112)	9.59	1.11 (1.08 – 1.14)	0.105 (0.013)
Transplants (CC 132, 186)	1.12	1.04 (0.98 – 1.12)	0.043 (0.035)
Dialysis status (CC 134)	2.83	1.25 (1.20 – 1.30)	0.219 (0.021)
Renal failure (CC 135 – 140)	43.21	1.16 (1.14 – 1.18)	0.152 (0.009)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	7.23	1.16 (1.12 – 1.19)	0.145 (0.014)
Hip fracture/dislocation (CC 170)	2.40	0.92 (0.88 – 0.97)	-0.081 (0.025)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Pulmonary heart disease (CCS 103)	10.00	0.75 (0.72 – 0.79)	-0.284 (0.025)
Congestive heart failure; nonhypertensive (CCS 108)	5.56	1.06 (1.00 – 1.11)	0.056 (0.026)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	31.06	0.90 (0.86 – 0.94)	-0.108 (0.021)
Acute bronchitis (CCS 125)	1.25	0.73 (0.67 – 0.80)	-0.312 (0.046)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	17.59	1.04 (0.99 – 1.08)	0.035 (0.022)
Asthma (CCS 128)	1.32	0.73 (0.67 – 0.80)	-0.316 (0.046)
Aspiration pneumonitis; food/vomitus (CCS 129)	9.10	0.93 (0.88 – 0.97)	-0.077 (0.024)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	3.90	1.24 (1.18 – 1.31)	0.218 (0.027)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	15.80	0.96 (0.92 – 1.01)	-0.036 (0.022)
Lung disease due to external agents (CCS 132)	0.50	0.91 (0.81 – 1.02)	-0.093 (0.058)
Other lower respiratory disease (CCS 133)	3.90	Reference	Reference
Low Frequency Conditions	0.02	0.82 (0.45 – 1.50)	-0.196 (0.306)

**Table 4.2.4— Cardiovascular Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2021 through June 2022)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Intercept	N/A	N/A	-2.662 (0.030)
Years over 65 (continuous)	N/A	1.01 (1.01 – 1.01)	0.013 (0.001)
History of COVID-19	6.94	0.96 (0.93-0.99)	-0.038 (0.016)
Severe infection (CC 1, 3 – 6)	0.75	1.09 (1.00-1.18)	0.086 (0.043)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	6.26	0.99 (0.96 – 1.02)	-0.009 (0.016)
Other infectious diseases and pneumonias (CC 7, 114 – 116)	17.27	1.15 (1.13 – 1.18)	0.142 (0.012)
Metastatic cancer and acute leukemia (CC 8)	2.12	1.36 (1.29-1.43)	0.306 (0.027)
Severe cancer (CC 9 – 10)	4.21	1.26 (1.21 – 1.31)	0.230 (0.020)
Other cancers (CC 11 – 14)	6.05	1.08 (1.04 – 1.12)	0.076 (0.017)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	36.48	1.15 (1.13 – 1.17)	0.140 (0.009)
Protein-calorie malnutrition (CC 21)	6.69	1.20 (1.17 – 1.24)	0.184 (0.015)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	37.01	1.23 (1.21 – 1.26)	0.209 (0.010)
End-stage liver disease; cirrhosis of liver (CC 27 – 28)	1.96	1.23 (1.16 – 1.29)	0.203 (0.026)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	8.26	1.11 (1.08 – 1.14)	0.107 (0.014)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.35	1.16 (1.12 – 1.20)	0.147 (0.018)
Severe hematological disorders (CC 46)	0.66	1.24 (1.13 – 1.35)	0.213 (0.044)
Coagulation defects and other specified hematological disorders (CC 48)	9.48	1.02 (0.99 – 1.05)	0.020 (0.014)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	33.54	1.25 (1.22 – 1.27)	0.221 (0.010)
Drug/alcohol psychosis or dependence (CC 54 – 55)	2.57	1.27 (1.21 – 1.33)	0.241 (0.024)
Psychiatric comorbidity (CC 57 – 59, 61, 63)	25.60	1.15 (1.13 – 1.17)	0.140 (0.010)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	4.74	1.18 (1.14 – 1.22)	0.162 (0.018)
Seizure disorders and convulsions (CC 79)	3.02	1.18 (1.13 – 1.24)	0.169 (0.022)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Respirator dependence/tracheostomy status (CC 82)	0.23	0.96 (0.83 – 1.11)	-0.043 (0.075)
Cardio-respiratory failure and shock (CC 84), plus ICD-10-CM codes R09.01 and R09.02	19.42	1.18 (1.16 – 1.21)	0.168 (0.011)
Congestive heart failure (CC 85)	46.57	1.32 (1.29 – 1.34)	0.275 (0.010)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86 – 89, 102, 105 – 109)	71.52	1.11 (1.09 – 1.14)	0.108 (0.011)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	55.33	1.05 (1.03 – 1.07)	0.048 (0.010)
Chronic obstructive pulmonary disease (COPD) (CC 111)	21.74	1.24 (1.21 – 1.26)	0.214 (0.010)
Fibrosis of lung or other chronic lung disorders (CC 112)	2.85	1.13 (1.08 – 1.18)	0.125 (0.023)
Transplants (CC 132, 186)	0.94	1.20 (1.11 – 1.29)	0.183 (0.038)
Dialysis status (CC 134)	3.01	1.46 (1.40 – 1.52)	0.376 (0.020)
Renal failure (CC 135 – 140)	41.32	1.24 (1.22 – 1.27)	0.216 (0.010)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	3.85	1.22 (1.18 – 1.27)	0.199 (0.019)
Hip fracture/dislocation (CC 170)	1.42	0.93 (0.87 – 0.99)	-0.070 (0.033)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Heart valve disorders (CCS 96)	1.59	0.68 (0.62 – 0.74)	-0.389 (0.042)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease) (CCS 97)	2.03	Reference	Reference
Acute myocardial infarction (CCS 100)	22.00	0.81 (0.76 – 0.85)	-0.216 (0.028)
Coronary atherosclerosis and other heart disease (CCS 101)	9.05	0.75 (0.70 – 0.79)	-0.294 (0.030)
Nonspecific chest pain (CCS 102)	4.74	0.71 (0.66 – 0.76)	-0.346 (0.033)
Other and ill-defined heart disease (CCS 104)	0.68	0.60 (0.53 – 0.68)	-0.514 (0.064)
Conduction disorders (CCS 105)	4.91	0.52 (0.48 – 0.55)	-0.662 (0.035)
Cardiac dysrhythmias (CCS 106)	41.15	0.72 (0.69 – 0.76)	-0.325 (0.027)
Cardiac arrest and ventricular fibrillation (CCS 107)	0.46	0.62 (0.54 – 0.70)	-0.482 (0.067)
Peripheral and visceral atherosclerosis (CCS 114)	2.67	0.78 (0.72 – 0.84)	-0.252 (0.037)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	3.70	0.71 (0.66 – 0.76)	-0.345 (0.037)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.32	0.86 (0.74 – 1.00)	-0.150 (0.078)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Other circulatory disease (CCS 117)	6.55	0.70 (0.66 – 0.74)	-0.356 (0.031)
Low Frequency Conditions	0.16	0.74 (0.60 – 0.91)	-0.299 (0.106)

**Table 4.2.5 — Neurology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2021 through June 2022)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Intercept	N/A	N/A	-2.524 (0.019)
Years over 65 (continuous)	N/A	1.00 (1.00 – 1.00)	-0.000 (0.001)
History of COVID-19	6.56	0.98 (0.94-1.02)	-0.025 (0.020)
Severe infection (CC 1, 3 – 6)	1.37	1.13 (1.04 – 1.22)	0.121 (0.040)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	7.92	1.03 (1.00 – 1.07)	0.033 (0.019)
Other infectious diseases and pneumonias (CC 7, 114 – 116)	21.48	1.17 (1.13 – 1.20)	0.153 (0.014)
Metastatic cancer and acute leukemia (CC 8)	3.93	1.27 (1.20 – 1.34)	0.237 (0.027)
Severe cancer (CC 9 – 10)	5.20	1.23 (1.18 – 1.29)	0.210 (0.023)
Other cancers (CC 11 – 14)	7.52	1.09 (1.05 – 1.13)	0.088 (0.020)
Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123)	36.90	1.17 (1.15 – 1.20)	0.161 (0.011)
Protein-calorie malnutrition (CC 21)	11.27	1.14 (1.11 – 1.18)	0.135 (0.016)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24)	42.84	1.20 (1.17 – 1.23)	0.181 (0.012)
End-stage liver disease; cirrhosis of liver (CC 27 – 28)	2.08	1.31 (1.23 – 1.39)	0.271 (0.031)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	7.09	1.11 (1.07 – 1.15)	0.103 (0.019)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	4.99	1.06 (1.01 – 1.11)	0.057 (0.023)
Severe hematological disorders (CC 46)	0.62	1.22 (1.09 – 1.36)	0.199 (0.056)
Coagulation defects and other specified hematological disorders (CC 48)	10.85	1.12 (1.08 – 1.15)	0.109 (0.016)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	33.05	1.19 (1.17 – 1.22)	0.178 (0.012)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Drug/alcohol psychosis or dependence (CC 54 – 55)	4.13	1.07 (1.02 – 1.13)	0.070 (0.025)
Psychiatric comorbidity (CC 57 – 59, 61, 63)	31.05	1.05 (1.03 – 1.08)	0.052 (0.012)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190)	30.90	1.06 (1.03 – 1.08)	0.054 (0.013)
Seizure disorders and convulsions (CC 79)	10.78	1.14 (1.10 – 1.17)	0.127 (0.017)
Respirator dependence/tracheostomy status (CC 82)	0.40	1.13 (0.98 – 1.30)	0.122 (0.070)
Cardio-respiratory failure and shock (CC 84), plus ICD-10-CM codes R09.01 and R09.02	15.69	1.00 (0.97 – 1.03)	0.001 (0.015)
Congestive heart failure (CC 85)	25.49	1.18 (1.15 – 1.21)	0.169 (0.013)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86 – 89, 102, 105 – 109)	62.35	1.12 (1.09 – 1.14)	0.110 (0.012)
Specified arrhythmias and other heart rhythm disorders (CC 96 – 97)	40.38	1.09 (1.07 – 1.12)	0.089 (0.012)
Chronic obstructive pulmonary disease (COPD) (CC 111)	16.42	1.12 (1.09 – 1.16)	0.117 (0.014)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.96	1.00 (0.93 – 1.07)	0.001 (0.035)
Transplants (CC 132, 186)	0.85	1.13 (1.03 – 1.24)	0.123 (0.048)
Dialysis status (CC 134)	2.58	1.40 (1.32 – 1.47)	0.334 (0.027)
Renal failure (CC 135 – 140)	37.27	1.19 (1.16 – 1.21)	0.171 (0.012)
Decubitus ulcer or chronic skin ulcer (CC 157 – 161)	5.21	1.15 (1.10 – 1.19)	0.136 (0.021)
Hip fracture/dislocation (CC 170)	2.60	0.84 (0.79 – 0.90)	-0.170 (0.032)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Parkinson's disease (CCS 79)	2.16	1.03 (0.95 – 1.10)	0.026 (0.037)
Multiple sclerosis (CCS 80)	0.32	1.12 (0.94 – 1.34)	0.115 (0.092)
Other hereditary and degenerative nervous system conditions (CCS 81)	1.37	1.03 (0.94 – 1.12)	0.026 (0.044)
Paralysis (CCS 82)	0.35	0.92 (0.78 – 1.10)	-0.078 (0.087)
Epilepsy; convulsions (CCS 83)	8.32	0.85 (0.82 – 0.89)	-0.157 (0.022)
Other nervous system disorders (CCS 95)	19.78	Reference	Reference
Acute cerebrovascular disease (CCS 109)	44.30	0.82 (0.79 – 0.84)	-0.200 (0.015)
Occlusion or stenosis of precerebral arteries (CCS 110)	1.15	0.71 (0.64 – 0.79)	-0.343 (0.056)
Other and ill-defined cerebrovascular disease (CCS 111)	0.56	0.75 (0.65 – 0.87)	-0.286 (0.075)
Transient cerebral ischemia (CCS 112)	7.40	0.67 (0.64 – 0.71)	-0.398 (0.025)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Late effects of cerebrovascular disease (CCS 113)	1.47	0.88 (0.81 – 0.96)	-0.126 (0.043)
Intracranial injury (CCS 233)	12.20	1.11 (1.07 – 1.16)	0.109 (0.019)
Low Frequency Conditions	0.61	0.95 (0.84 – 1.08)	-0.051 (0.065)

**Table 4.2.6 — Model Performance by Specialty Cohort (July 2021 through June 2022)**

Specialty Cohort	Predictive Ability% (lowest decile – -highest decile)	c-statistic
Medicine	7.2 – 30.7	0.64
Surgery/Gynecology	3.2 – 24.6	0.68
Cardiorespiratory	7.2 – 31.9	0.64
Cardiovascular	4.4 – 26.4	0.67
Neurology	5.6 – 24.0	0.64

**Table 4.2.7 — Index Hospitalizations and Observed Readmission Rates by Specialty Cohort (July 2021 through June 2022)**

Specialty Cohort	Index Hospitalizations	Observed Readmission Rate
Medicine	2,475,940	16.51%
Surgery/Gynecology	1,179,131	11.02%
Cardiorespiratory	478,017	16.98%
Cardiovascular	509,314	12.58%
Neurology	341,775	12.27%
HWR	4,984,177	14.57%

**Table 4.2.8 — Hospital-Level Observed Readmission Rates and SRRs (July 2021 through June 2022)**

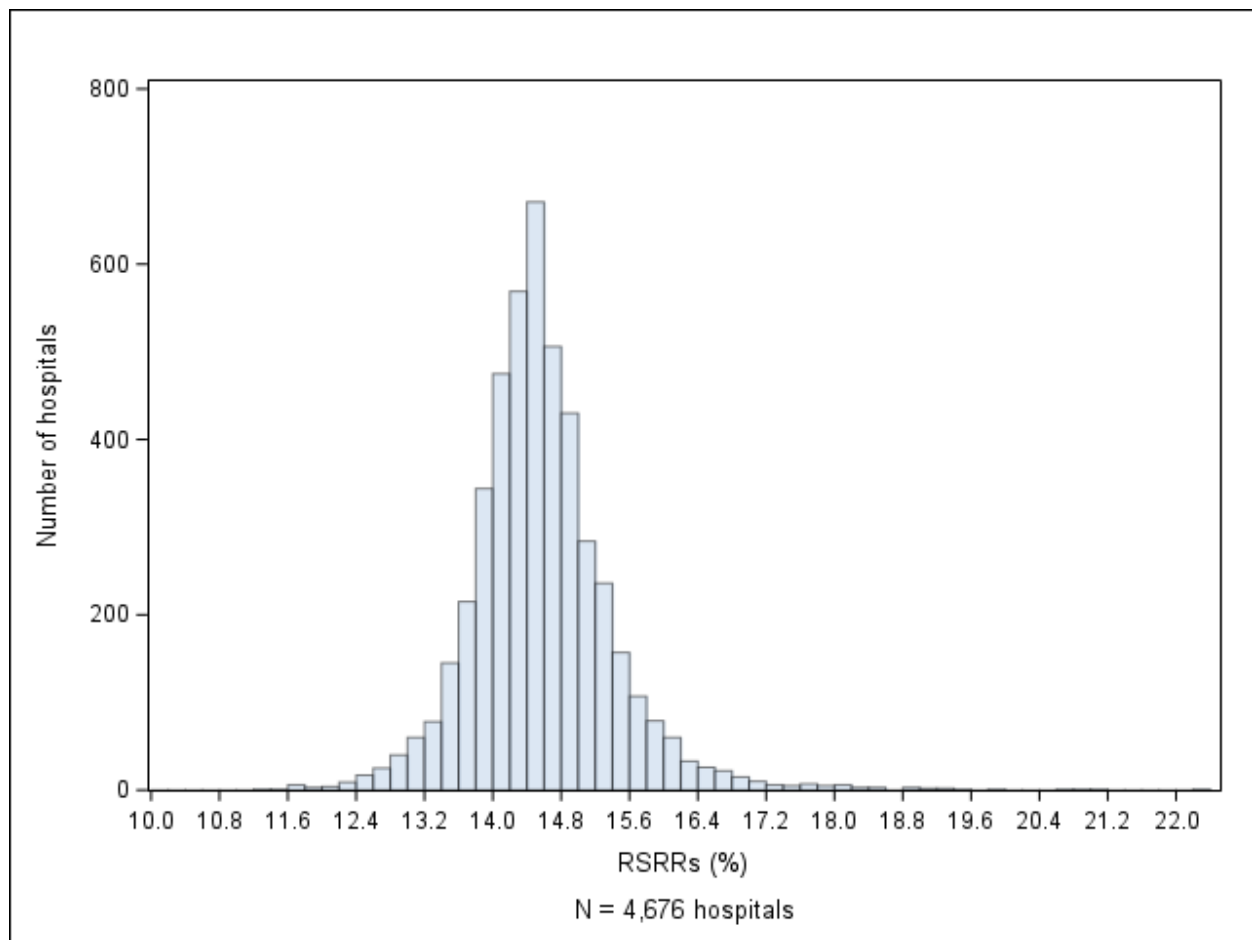
Specialty Cohort	Number of Hospitals	Mean Observed Readmission Rate (standard deviation [SD])	Median Observed Readmission Rate Interquartile Range (IQR)	Mean SRR (SD)	Median SRR (IQR)
Medicine	4,649	14.6 (6.8)	15.1 (11.8 – 17.6)	1.002 (0.080)	0.995 (0.958 – 1.039)
Surgery/ Gynecology	3,880	10.4 (9.2)	10.3 (6.6 – 12.9)	1.001 (0.051)	0.998 (0.976 – 1.022)
Cardiorespiratory	4,496	15.3 (8.4)	15.6 (11.1 – 19.6)	1.001 (0.063)	0.995 (0.966 – 1.030)

Specialty Cohort	Number of Hospitals	Mean Observed Readmission Rate (standard deviation [SD])	Median Observed Readmission Rate Interquartile Range (IQR)	Mean SRR (SD)	Median SRR (IQR)
Cardiovascular	4,210	12.8 (12.3)	12.0 (7.1 – 16.2)	1.002 (0.071)	0.996 (0.975 – 1.028)
Neurology	4,172	10.9 (11.9)	10.5 (0.0 – 14.4)	1.001 (0.054)	0.996 (0.979 – 1.019)
HWR	4,676	13.5 (5.3)	13.7 (11.1 – 16.0)	1.000 (0.058)	0.996 (0.969 – 1.026)

**Table 4.2.9 — Distribution of Hospital-Level Observed Readmission Rates and RSRRs (July 2021 through June 2022)**

HWR Readmission Rate	Mean	SD	Min	10th Percentile	Lower Quartile	Median	Upper Quartile	90th Percentile	Max
Observed	12.8	4.7	0.0	7.5	10.5	13.1	15.2	17.2	100.0
RSRR	14.4	0.5	11.5	13.8	14.1	14.4	14.7	15.0	18.7

**Figure 4.2.2 — Distribution of Hospital 30-Day HWR RSRRs between July 2021 and June 2022**



## 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 procedure and diagnosis categories are used to define specialty cohorts and risk adjust. Additionally, 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 2023 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 that 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 in clinically relevant categories, from the HCC system.<sup>13,14</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 the *QualityNet* website.

**Confidence interval (CI):** A CI is a range of values that describes the uncertainty surrounding an estimate. It is indicated by its endpoints; for example, a 95% CI for the OR associated with 'Protein-

calorie malnutrition' noted as "1.09 – 1.15" would indicate that there is 95% confidence that the OR lies between 1.09 and 1.15.

**Expected readmissions:** The number of readmissions expected based on average hospital performance with a given hospital's case mix and service 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. 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 an episode of care 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.

**Low Frequency Conditions:** Compilation of all AHRQ CCS categories with fewer than 1,000 admits/year. Included AHRQ CCS categories classified as "Low Frequency Conditions" could change from year to year.

**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 measure.

**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 this readmission measure, 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 outcome of this measure.

**Predicted readmissions:** The number of readmissions within 30 days predicted based on the hospital's performance with its observed case mix and service mix.

**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 and service mix across hospitals.

**Service mix:** The particular conditions and procedures of the patients with index admissions at a given hospital.

**Specialty cohort:** A group of index admissions for patients with related AHRQ CCS diagnosis or procedure categories (or related ICD-10-PCS codes, in the case of the surgery/gynecology cohort) that are likely treated by similar care teams. This measure includes five cohorts, each with its own risk model.

**Unplanned readmissions:** Acute clinical events a patient experiences that require urgent rehospitalization. Unplanned readmissions are the outcomes of the measure.

**VA beneficiary:** For the purposes of our 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 HWR

The HWR measure uses hierarchical generalized linear models (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.

For each of the five specialty cohorts in the HWR measure, a separate HGLM model is estimated. Then for each hospital, an SRR is calculated for each of the specialty cohorts with at least one index admission. Finally, a combined SRR for each hospital is created by calculating a volume weighted geometric mean of the specialty cohort SRRs for that hospital. The RSRR is calculated by multiplying the combined SRR for each hospital by the national observed readmission rate.

#### Hierarchical Generalized Linear Model

For each specialty cohort, 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:

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

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

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

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 in the specialty cohort at the  $i$ -th hospital;  $\mathbf{Z}_{ij} = (Z_{ij1}, Z_{ij2}, \dots, Z_{ijp})^T$  is a set of  $p$  patient-specific covariates derived from the data; and  $l$  denotes the total number of hospitals and  $n_i$  denotes the number of index admissions at hospital  $i$  in each specialty cohort. 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>15</sup>

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

### Standardized Risk Ratio for Each Specialty Cohort

For each specialty cohort, we use the HGLM defined by Equation (1), to obtain the parameter estimates  $\hat{\mu}$ ,  $\{\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_I\}$ ,  $\hat{\beta}$ , 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:

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

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

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

### Combined Standardized Risk Ratio and Risk-Standardized Readmission Rate

For each hospital, we obtain the parameter estimate  $\hat{s}_i$  from Equation (4). To report a single readmission score, the specialty cohort SRRs are combined into a combined SRR,  $\hat{t}_i$ . The combined SRR is the volume-weighted geometric mean of the specialty cohort SRRs where  $k=1, \dots, 5$  indicates the  $k$ -th specialty cohort:

$$\text{Combined Standardized Risk Ratio: } \hat{t}_i = \left( \prod_{k=1}^5 \hat{s}_{ik}^{n_{ik}} \right)^{\frac{1}{\sum_{k=1}^5 n_{ik}}} = \exp \left( \frac{\sum_{k=1}^5 n_{ik} \log \hat{s}_{ik}}{\sum_{k=1}^5 n_{ik}} \right) \quad (5)$$

We calculate an RSRR,  $\widehat{RSRR}_i$ , for each hospital by using the estimate from Equation (5) and multiplying by the national observed readmission rate, denoted by  $\bar{y}$ . Specifically, we calculate:

$$\text{Risk-Standardized Readmission Rate: } \widehat{RSRR}_i = \hat{t}_i \times \bar{y} \quad (6)$$

### 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. For each specialty cohort, 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,  $\{\hat{\alpha}_i^{(b)}, \hat{var}(\alpha_i^{(b)})\}; i = 1, 2, \dots, I\}$ .
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  $\alpha_i^{(b*)} \sim N(\hat{\alpha}_i^{(b)}, \hat{var}(\alpha_i^{(b)}))$  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.
5. After Step 4, results from all specialty cohorts are combined to derive  $\hat{t}_i^{(b)}$  for each hospital.

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>16</sup>

## **Appendix B. Data QA**

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

This section represents QA for the subset of the work YNNHSC/CORE conducted to maintain and report the HWR measure. 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 HWR measure.

### **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 pack to accommodate the new codes and updates to the measure. To assure accuracy in SAS pack coding, two analysts independently write SAS code for any major changes made in calculating the HWR measure: 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 pack, 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 pack. Anything that seems outside of normal coding fluctuation is further reviewed in more detail.

## Appendix C. Annual Updates

Prior annual updates for the measure 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 reports are considered Version 1.0 for a measure. The measure receives a new version number for each subsequent year of public reporting.

### 2023

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#### 2023 Measure Updates and Specifications Report (Version 12.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — 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 surgery/gynecology cohort definition and risk models;
  - applied a YNNHSC/CORE-modified v3.0 of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS to the specialty cohort definitions and 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 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.

### 2022

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#### 2022 Measure Updates and Specifications Report (Version 11.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — 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 surgery/gynecology cohort definition and risk models;
  - applied a YNNHSC/CORE-modified v2.0 of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS to the specialty cohort definitions and 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 specifications and methodology for the measure in response to the COVID-19 PHE — Specifically, we:
  - removed COVID-19 index admissions from the specialty 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;
  - reverted the measurement period for 2022 public reporting to one year, similar to 2020 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 methodology for 2022 help to ensure the intent of the measure is maintained. The 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 Extraordinary Circumstances Exception (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>17</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 Measure Updates and Specifications Report (Version 10.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — Specifically, we:
  - incorporated the code changes that occurred in the FY 2020 version of the ICD-10-PCS (effective with October 1, 2019+ discharges) into the surgery/gynecology cohort definition;
  - applied a YNHHSC/CORE-modified version of the AHRQ HCUP's beta version 2019.1 CCS for ICD-10-CM/PCS to the specialty cohort definitions and 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 5 months (from the typical one-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.

## 2020

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### 2020 Measure Updates and Specifications Report (Version 9.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — Specifically, we:
  - incorporated the code changes that occurred in the FY 2019 version of the ICD-10-PCS (effective with October 1, 2018+ discharges) into the surgery/gynecology cohort definition;
  - applied version 2019.1 (beta version) of the AHRQ HCUP CCS for ICD-10-CM/PCS to the specialty cohort definitions and 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 the following types of cases in non-VA hospital claims (Refer to the [2018 updates](#) below):
  - Transfers to rehabilitation units, to ensure these transfers are not captured as readmissions for any hospital
  - Rehabilitation admissions, for exclusion from the cohort
    - Rationale: Revenue center codes 0138 and 0158 are appropriate codes for identifying rehabilitation claims.
- Added admission data from VA hospitals to the measure
  - Rationale: Creates a more inclusive perspective of the relative quality of U.S. hospitals

## 2019

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### 2019 Measure Updates and Specifications Report (Version 8.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — 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 surgery/gynecology cohort definition and planned readmission algorithm;
  - applied version 2018.1 of the AHRQ HCUP CCS for ICD-10-CM/PCS to the specialty cohort definitions and 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 02WA0RS, Revision of Biventricular Short-term External Heart Assist System in Heart, Open Approach, was identified through a “neighboring code search” (found near existing code 02WA0RZ, Revision of Short-term External Heart Assist System in Heart, Open Approach) and determined through clinical review to be a code which meets measure intent. As a result, it was added to the surgery/gynecology cohort inclusion 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.

## 2018

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### 2018 Measure Updates and Specifications Report (Version 7.0 — HWR)

- Updated the ICD-10 code-based specifications used in the measure — Specifically, we:
  - applied the 2017.1 and 2017.2 versions of the AHRQ HCUP CCS to the specialty cohort definitions and planned readmission algorithm for diagnoses and procedures, respectively;
  - incorporated the code changes that occurred in the FY 2017 version of the ICD-10-CM/PCS into the surgery/gynecology cohort definition and planned readmission algorithm;
  - 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 and 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 ICD-10 code-based claims. Specifically:
  - 0024: Inpatient Rehabilitation Facility services paid under PPS submitted as Type of Bill 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).
- Added the use of rehabilitation revenue center codes (as outlined above) to the methodology used to identify rehabilitation admissions for exclusion from the cohort
  - Rationale: The inability to use principal discharge diagnosis codes to identify rehabilitation stays (due to ICD-10 coding guidance) warranted a need to add to our methodology for identifying and excluding admissions to rehabilitation beds in hospitals, which had previously relied solely on AHRQ CCS diagnosis category 254.
- 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. Similarly, the obstetric AHRQ CCS procedure categories 134, 135, and 139 were deleted from the surgery/gynecology specialty cohort list. They remain in the SAS packs but are commented out.
  - Rationale: The obstetric codes were incorporated into the initial measure 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 Measure Updates and Specifications Report HWR (Version 6.0)

- Revised the measure specifications to accommodate the implementation of ICD-10 coding — Specifically, we:
  - updated the specialty cohort definitions, by using the most recent (2016) version of the ICD-10-based AHRQ HCUP CCS, 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 to the models.
    - Rationale: The International Classification of Diseases, Ninth Revision (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 (HHS) 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 methodology 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 — Criterion (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 Measure Updates and Specifications Report HWR (Version 5.0)

- Re-specified the measure 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 removing five procedure categories and adding one procedure category.
- Applied the 2015 version of the AHRQ HCUP CCS to the planned readmission algorithm, risk-adjustment models, and specialty cohort definition
  - Rationale: A 2015 version of the AHRQ HCUP CCS was released.

## 2015

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## **2015 Measure Updates and Specifications Report HWR (Version 4.0)**

- Applied updated AHRQ HCUP CCS version to the planned readmission algorithm, risk adjustment-models, and specialty cohort definitions
  - Rationale: An updated version of the AHRQ HCUP CCS was released in 2014.

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## **2014**

### **2014 Measure Updates and Specifications Report HWR (Version 3.0)**

- Re-specified the measure by updating to 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.
- Applied updated AHRQ HCUP CCS version to the planned readmission algorithm, risk adjustment-models, and specialty cohort definitions
  - Rationale: An updated version of the AHRQ HCUP CCS was released in 2013.

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## **2013**

### **2013 Measure Updates and Specifications Report HWR (Version 2.0)**

- Re-specified the measure by updating to CMS planned readmission algorithm version 2.1
  - Rationale: Version 2.1 incorporated improvements to the original algorithm made following an extensive review by clinical experts and stakeholder feedback submitted during the HWR measure's public comment period and 2012 dry run.
- Updated CC map
  - Rationale: The ICD-9-CM CC map is updated annually to capture all relevant comorbidities coded in patient administrative claims data.
- Removed AHRQ CCS procedure category 61 from the list of procedures qualifying an admission for the surgery cohort
  - Rationale: This procedure category was removed from the surgical cohort because patients undergoing this procedure are typically admitted primarily for cardiovascular or medical care.
- 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, methodology to identify these cases were needed, to ensure these transfers are not captured as readmissions for any hospital.

## Appendix D. Measure Specifications

### Hospital-Wide All-Cause Unplanned Readmission (CBE #1789)

#### Cohort

##### Inclusion Criteria for HWR Measure

- **Enrolled in Medicare FFS Part A for the 12 months prior to the date of admission and during the index admission**
  - For VA beneficiaries hospitalized in VA hospitals, there are no Medicare FFS enrollment requirements.
  - For VA beneficiaries hospitalized in non-VA hospitals, they must be concurrently enrolled in Medicare FFS Part A at the time of the index admission, to be eligible for cohort inclusion (but the 12-month Part A enrollment prior to admission is not required).
    - Rationale: For patients who are not VA beneficiaries, the 12-month Part A prior enrollment criterion ensures that the comorbidity data used in risk adjustment can be captured from inpatient claims data in the 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.
- **Not transferred to another acute care facility**
  - Rationale: Hospitalizations that result in a transfer to another acute care facility are not included in the measure because the measure's focus is on admissions that result in discharge to a non-acute care setting (for example, to home or a skilled nursing facility).

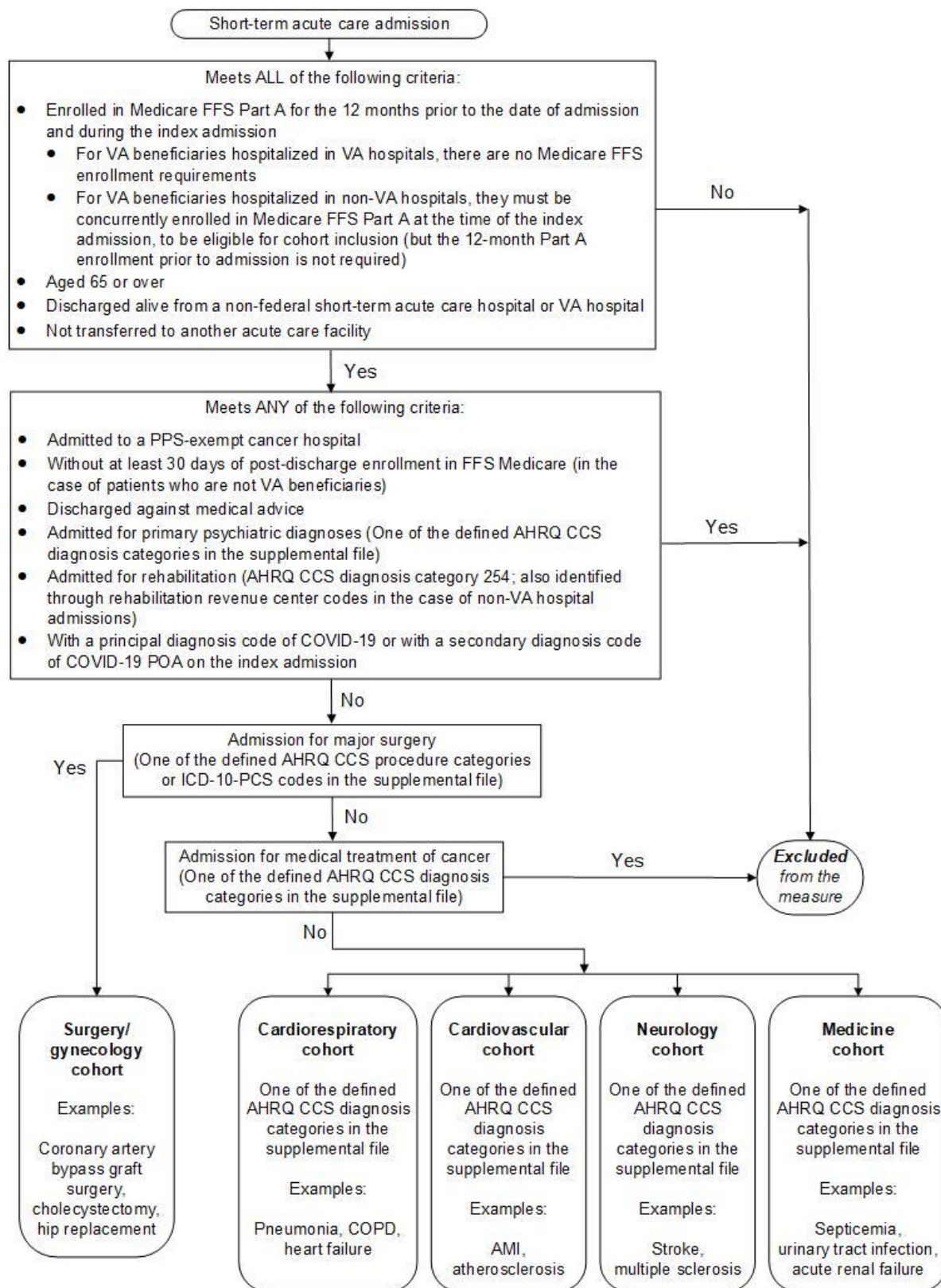
##### Exclusion Criteria for HWR Measure

- **Admitted to a PPS-exempt cancer hospital**
  - Rationale: These hospitals care for a unique population of patients that cannot reasonably be compared to patients admitted to other hospitals.
- **Without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries)**
  - 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 primary psychiatric diagnoses**
  - Rationale: Patients admitted for psychiatric treatment are typically cared for in separate psychiatric or rehabilitation centers that are not comparable to short-term acute care hospitals.
- **Admitted for rehabilitation**

- Rationale: These admissions are not typically to a short-term acute care hospital and are not for acute care.
- **Admitted for medical treatment of cancer**
  - Rationale: These admissions have a different mortality and readmission profile than the rest of the Medicare and VA populations, and outcomes for these admissions do not correlate well with outcomes for other admissions. Patients with cancer admitted for other diagnoses or for surgical treatment of their cancer remain in the measure.
- **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 HWR cohort in response to the COVID-19 PHE.

The AHRQ CCS diagnosis and procedure categories and ICD-10 codes used to define the specialty cohorts are outlined in the 2023 HWR Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

**Figure D.1 — HWR Flow Diagram of Inclusion and Exclusion Criteria and Specialty Cohort Assignment for the Index Admission**





## Outcome

### **Outcome Criteria for HWR Measure**

- **Unplanned readmission, from any cause, within 30 days from the date of discharge from an index admission**
  - Rationale: Planned readmissions are generally not a signal of quality of care. Including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients who are scheduled for elective or necessary procedures within 30 days of discharge. From a patient perspective, an unplanned readmission from any cause is an adverse event. Outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce readmissions.
- **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.



## Appendix E. Planned Readmission Algorithm

Figure PR.1 — Planned Readmission Algorithm Version 4.0 2023 Flowchart

