

# **2018 All-Cause Hospital Wide Measure Updates and Specifications Report**

## **Hospital-Level 30-Day Risk-Standardized Readmission Measure – Version 7.0**

### **Submitted By:**

Yale New Haven Health Services Corporation – Center for Outcomes Research & Evaluation  
(YNHHSC/CORE)

### **Prepared For:**

Centers for Medicare & Medicaid Services (CMS)

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## Center for Outcomes Research & Evaluation Project Team

Jaymie Simoes, M.P.H. – Annual Updates Team Lead, Reevaluation Division Project Manager

Jacqueline N. Grady, M.S. – Reevaluation Team Lead Analyst

Danielle Purvis, M.P.H. – Research Project Coordinator

Jo DeBuhr, R.N., B.S.N. – Technical Writer

Alexandra Harris, M.P.H. – Research Associate

Leora I. Horwitz, M.D., M.H.S.\* – Measure and Clinical Expert for HWR and EDAC

Huihui Yu, Ph.D.\* – Measure Reevaluation Analyst

Zhenqiu Lin, Ph.D. – Reevaluation Analytic Director

Karen Dorsey, M.D., Ph.D.\*\* – Reevaluation Division Director

Susannah Bernheim, M.D., M.H.S. – Project Director

Harlan M. Krumholz, M.D., S.M.\*\* – Principal Investigator

\*New York University School of Medicine

\*\*Yale School of Medicine

## Measure Reevaluation Team Contributors

Silverberg Aryee, B.S. – Research Assistant

Sarah Auer, B.A. – Research Assistant

Kathryn Cannon, M.P.H., M.S. – Research Associate

Grace Glennon, M.S. – Research Associate

Madeline L. Parisi, B.A. – Research Associate

Kelly Strait, M.S. – Measure Reevaluation Analyst

Elizabeth Triche, Ph.D. – Content Expert for ICD-10

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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 used in the Hospital Inpatient Quality Reporting program and publicly reported on [Hospital Compare](#). The measure reports 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 on [QualityNet](#).

This report provides an overview of the measure methodology, methodology updates for 2018 public reporting, and the national results for 2018 public reporting. The appendices provide detailed specifications for the measure, including tables of the codes used for [cohort](#) derivation and risk adjustment, as well as a history of annual updates.

Specifically, the report includes:

- **[Section 2](#) - An overview of the 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 score
- **[Section 3](#) - 2018 measure updates**
- **[Section 4](#) - 2018 measure results**
- **[Section 5](#) - Glossary**

The appendices contain detailed measure information, consisting of:

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

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

The measure methodology is also described in the peer-reviewed medical literature.<sup>7,8</sup>

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



## 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 Services hospitals) and critical access hospitals. 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 added the HWR measure to the Hospital Inpatient Quality Reporting program and began publicly reporting the measure in 2013.

Results for the measure are posted and updated annually on Hospital Compare.

CMS contracted with the YNHHS/CORE to update the HWR measure for 2018 public reporting through a process of measure reevaluation.

### 2.2. Overview of Measure Methodology

The 2018 risk-adjusted HWR measure uses specifications from the initial measure methodology report with refinements to the measure, as listed in Appendix C and described in the prior measure updates and specifications reports.<sup>1-6</sup> An overview of the methodology is presented in this section.

#### 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;
- Aged 65 or over;
- Discharged alive from a non-federal short-term acute care hospital; and,
- Not transferred to another acute care facility

See Table D.2, Table D.4, Table D.5, Table D.6, and Table D.7 in Appendix D for specific diagnosis and procedure Agency for Healthcare Research and Quality (AHRQ) Clinical Classification Software (CCS) categories used to define the specialty cohorts included in the measure. Table D.2 also includes singular International Classification of Diseases, 10th Revision, Procedure Coding System (ICD-10-PCS) codes used to define additional cases for the surgery/gynecology specialty cohort.

### Index Admissions Excluded from the Measure

This measure excludes index admissions for patients:

- Admitted to Prospective Payment System (PPS)-exempt cancer hospitals;
- Without at least 30 days of post-discharge enrollment in Medicare FFS;
- Discharged against medical advice;
- Admitted for primary psychiatric diagnoses;
- Admitted for rehabilitation; or,
- Admitted for medical treatment of cancer.

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; this does not represent a change from the original measure methodology. 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.

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 include removing claims with stays longer than one year, claims with overlapping dates, claims for patients not listed in the Medicare enrollment database, and records with invalid provider IDs.

See [Table D.1](#) and [Table D.3](#) in [Appendix D](#) for specific AHRQ CCS diagnosis categories excluded from the measure. 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 [Table D.2](#). 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 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). However, if the condition is **different** from the index admission, this is considered a readmission in the measure.

#### 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>9</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>10</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 of whether each admitted patient has any unplanned readmission within 30 days. If the first readmission after discharge is planned, any subsequent unplanned readmission is not considered in the outcome for that index admission because the unplanned readmission could be related to care provided during the intervening planned readmission rather than during the index admission.

### **2.2.3 Planned Readmission Algorithm (Version 4.0 2018 [ICD-10])**

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

The planned readmission algorithm has three fundamental principles:

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

The algorithm was developed in 2011 as part of the 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 procedure categories, discharge diagnosis categories, and singular ICD-10 codes to classify readmissions as planned ([Appendix E](#)). As illustrated in [Figure PR.1](#), readmissions are considered planned if any of the following occurs during the readmission:

1. A procedure is performed that is in one of the procedure categories that are always planned regardless of diagnosis ([Table PR.1](#));
2. The principal diagnosis is in one of the diagnosis categories that are always planned ([Table PR.2](#)); or,
3. A procedure is performed that is one of the potentially planned procedures ([Table PR.3](#)) and the principal diagnosis is not in the list of acute discharge diagnoses ([Table PR.4](#)).

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

In order to account for differences in case mix among hospitals, the measure adjusts for variables (that is, age and comorbid diseases) that 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.

In order 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 ([Table D.4](#), [Table D.5](#), [Table D.6](#), and [Table D.7](#), respectively). 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.

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

The measure does not adjust for socioeconomic status (SES) because the association between SES and health outcomes can be due, in part, to differences in the quality of health care that groups of patients with varying SES receive. The intent is for the measure to adjust for age and clinical characteristics while illuminating important quality differences. The HWR measure was recently re-endorsed by the National Quality Forum (NQF) without adjustment for patient-level SES factors. For more information about this decision, please refer to the [NQF website](#).

Refer to [Table D.8](#) in [Appendix D](#) of this report for the list of comorbidity risk-adjustment variables common to all specialty cohorts and the list of potential

complications that are excluded from risk adjustment if they occur during the index admission. The Condition Categories (CCs) outlined in this table are used to identify risk variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015.

Note that CC mappings to International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes (for discharges on or after October 1, 2015) and International Classification of Diseases, Clinical Modification, 9th Revision (ICD-9-CM) codes (for discharges prior to October 1, 2015) are available on the QualityNet website.

#### **2.2.5 Data Sources**

The data sources for these analyses are Medicare administrative claims and enrollment information for patients with hospitalizations between July 1, 2016 and June 30, 2017. To make it feasible to implement with Medicare data, the HWR risk-adjustment models use only inpatient claims data for the 12 months prior to the index admission and one month subsequent to the index admission for patients admitted in this time period. Refer to the original methodology report for further descriptions of these data sources.<sup>1</sup>

#### **2.2.6 Measure Calculation**

The measure estimates hospital-level 30-day all-cause RSRRs using hierarchical logistic regression models. 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>11</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>11</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, and 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 [Appendix D](#)) 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 log transformed and summed over all patients attributed to a hospital to calculate a predicted value. The “expected” number of readmissions (the denominator) is obtained in the same manner, except that a common effect using all hospitals in our sample is added in place of the hospital-specific effect. The results are log transformed and summed over all patients attributed to a hospital to calculate an expected value. To assess hospital performance for each reporting period, we re-estimate the model coefficients using the 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 composite SRR. The composite SRR is multiplied by the [national observed readmission rate](#) to produce the RSRR. The statistical modeling approach is described fully in [Appendix A](#) and in the original methodology report.<sup>1</sup>

### **2.2.7 Categorizing Hospital Performance**

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

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

If a hospital has fewer than 25 eligible cases for a measure, CMS assigns the hospital to a separate category, “Number of Cases Too Small”. This category is used when the number of cases is too small (fewer than 25) to reliably 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 2018 PUBLIC REPORTING

#### 3.1. Rationale for Measure Updates

Annual measure reevaluation ensures that the risk-standardized readmission model is continually assessed and remains valid, given possible changes in clinical practice and coding standards over time. Modifications made to measure specialty cohorts, the risk model, and outcomes are informed by review of the most recent literature related to measure conditions or outcomes, feedback from various stakeholders, and empirical analyses, including assessment of coding trends that reveal shifts in clinical practice or billing patterns. As this report describes, for 2018 public reporting, we made the following modifications to the measure:

- Updated the ICD-10 code-based specifications used in the measure. Specifically:
  - Incorporated the code changes that occurred in the fiscal year (FY) 2017 version of the ICD-10-CM/PCS (effective with October 1, 2016+ discharges) into the surgery/gynecology cohort definition and planned readmission algorithm;
  - Applied the 2017.1 and 2017.2 versions of the AHRQ CCS to the specialty cohort definitions and planned readmission algorithm for diagnoses and procedures, respectively;
  - Applied the FY 2017 version of the V22 CMS-Hierarchical Condition Categories (HCC) crosswalk maintained by RTI International to the risk models; and,
  - Conducted code surveillance to identify any specification changes warranted due to 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.

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

- Evaluated and validated model performance in the July 2016-June 2017 dataset; and,
- Updated the measure's SAS analytic package (SAS pack) and documentation.

#### 3.2. Detailed Discussion of Measure Updates

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

###### Cohort Definitions and Planned Readmission Algorithm

We studied the 2017.1 and 2017.2 versions of the AHRQ CCS for diagnoses and procedures, respectively, to determine how the newly implemented ICD-10 codes in the 2017 code set were categorized, and to examine any code shifts that may have occurred from the previous version of the AHRQ CCS to the most recent AHRQ CCS. Review of these versions of the AHRQ CCS was extensive, and included:

- Examination of approximately 2,000 ICD-10-CM codes in 73 AHRQ CCS diagnosis categories and over 1,200 ICD-10-PCS codes in 15 AHRQ CCS procedure categories to determine how the newly implemented ICD-10 codes should be incorporated into



the specialty cohort definitions and planned readmission algorithm specifications; and,

- Examination of 38 ICD-10-CM codes that shifted between AHRQ CCS diagnosis categories and over 1,300 ICD-10-PCS codes that shifted between AHRQ CCS procedure categories to investigate where code shifts may affect the specialty cohort definitions and planned readmission algorithm.

We then solicited input from clinical and measure experts to confirm the clinical appropriateness of the AHRQ CCS categorization of the newly implemented ICD-10 codes and any changes warranted due to the code shifts that occurred. The experts also reviewed the newly implemented ICD-10 codes in the FY 2017 version of the ICD-10-CM/PCS 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 any of the specialty cohort definitions (if not appropriately covered in AHRQ CCS categories). The intent was to maintain the clinical integrity of the algorithm and cohort definitions.

These processes led to the following changes:

- Changes to one of the specialty cohort definitions:
  - The addition of singular ICD-10-PCS codes to the surgery/gynecology cohort inclusion list, in addition to the AHRQ CCS-defined inclusions.
- Changes to the planned readmission algorithm:
  - Potentially planned procedures (Table PR.3): The addition of ICD-10-PCS codes that capture certain kidney/ureter release procedures, male perineum procedures, and hip/femur internal fixation device removal procedures.
  - Acute diagnoses (Table PR.4):
    - The addition of ICD-10-CM codes that capture certain intestinal atherosclerosis, artery dissection, pancreatitis, enterocolitis, and nonmalignant breast conditions, as well as lung abscess without pneumonia and select male and female genital disorders; and,
    - The removal of five AHRQ CCS diagnosis categories as whole categories (AHRQ CCS 225, 228, 230, 232, and 237); the subsets of ICD-10-CM initial encounter codes that fell under these categories were retained as acute diagnoses.

New ICD-10 codes were added to the cardiovascular, neurology, and medicine specialty cohort inclusions and the exclusions for all of the specialty cohorts. The additions included new codes in the FY 2017 version of the ICD-10-CM as well as code shifts, but the AHRQ CCS structure did not change.

Note that AHRQ publishes periodic updates to the CCS to ICD-10 code mappings. For our annual reporting, we utilize the most recent mapping available at the time of measure calculation. For 2018 public reporting, we used the 2017.1 and 2017.2 versions of the AHRQ CCS for diagnoses and procedures, respectively.

### Risk Adjustment

The process of updating the risk models to account for differences in case mix among hospitals was similar to the planned readmission algorithm process described above. We studied the FY 2017 version of the V22 CMS-HCC crosswalk maintained by RTI International, to determine how the newly implemented ICD-10 codes in the 2017 code set were classified, and to examine any code shifts that may have occurred from the previous version of the HCC to the most current version. We then solicited input from clinical and measure experts to confirm the clinical appropriateness of the HCC classifications of the newly implemented ICD-10 codes and any changes warranted due to the code shifts that occurred. No changes were made as a result of these processes.

### Additional Notes

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

**All changes made to the ICD-10 code-based specifications are detailed in the supplemental Excel file that accompanies this report on QualityNet.**

Note that ICD-10 code listings in this report and the supplemental Excel file reflect the current (2017) labels or narrative descriptions for each code. Changes in the labels are not noted.

### **3.3. Changes to SAS Pack**

We revised the measure calculation SAS pack to accommodate the ICD-10 code-based specification updates as well as the updates to the HCC and AHRQ CCS mappings. The new SAS pack and documentation are available upon request by emailing [cmsreadmissionmeasures@yale.edu](mailto:cmsreadmissionmeasures@yale.edu). **Do NOT submit patient-identifiable information (for example, date of birth, Social Security number, health insurance claim number) to this address.**

The SAS pack describes 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 RSRR calculation without the data files which contain longitudinal patient data from the entire national sample of acute care hospitals to estimate the individual hospital-specific effects, the average hospital-specific effect, and the risk-adjustment coefficients used in the equations.

## 4. RESULTS FOR 2018 PUBLIC REPORTING

### 4.1. Assessment of Updated Models

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

We evaluated the performance of the models, using the July 1, 2016-June 30, 2017 data for the 2017 reporting period. We examined the differences in the frequencies of patient risk factors and the model variable 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, 2016-June 30, 2017 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 2018 Model Results

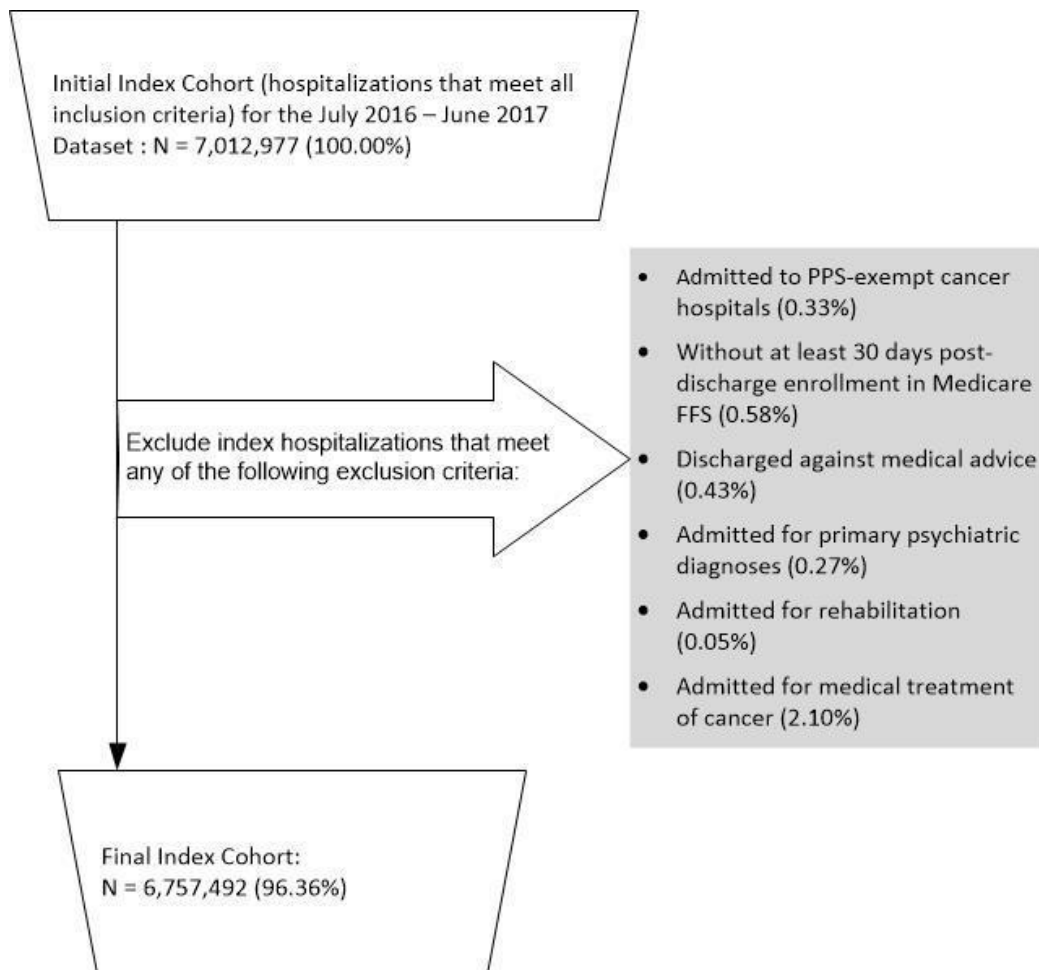
### 4.2.1 Index Cohort Exclusions

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 2016-June 2017 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;
- Who were not transferred to another acute care facility; and,
- Were alive at discharge.

**Figure 4.2.1 – Cohort Exclusions in the July 2016-June 2017 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 variable coefficients and standard errors (SEs) for the July 1, 2016-June 30, 2017 data sample. Table 4.2.6 presents the 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 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 national *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. The median hospital RSRR in the dataset was 15.3% (interquartile range [IQR]: 14.9% - 15.7%). Figure 4.2.2 shows the overall distribution of the hospital RSRRs for the combined dataset.

#### 4.2.4 Distribution of Hospitals by Performance Category

Of 4,687 hospitals in the study cohort, 184 performed “Better than the National Rate,” 4,060 performed “No Different than the National Rate,” and 265 performed “Worse than the National Rate.” 178 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 2016-June 2017)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	N/A	1.00 (1.00 - 1.00)	-0.001 (0.000)
Severe infection (CC 1, 3-6)	1.69	1.12 (1.10 - 1.14)	0.114 (0.011)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	12.25	1.03 (1.02 - 1.04)	0.028 (0.005)
Other infectious diseases and pneumonias (CC 7, 114-116)	31.03	1.10 (1.09 - 1.11)	0.096 (0.004)
Metastatic cancer and acute leukemia (CC 8)	4.25	1.28 (1.26 - 1.30)	0.245 (0.008)
Severe cancer (CC 9-10)	6.59	1.25 (1.23 - 1.26)	0.221 (0.006)
Other cancers (CC 11-14)	9.35	1.09 (1.07 - 1.10)	0.083 (0.005)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	37.53	1.10 (1.09 - 1.11)	0.094 (0.003)
Protein-calorie malnutrition (CC 21)	14.85	1.14 (1.13 - 1.15)	0.132 (0.004)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	34.97	1.16 (1.15 - 1.17)	0.151 (0.004)
End-stage liver disease; cirrhosis of liver (CC 27-28)	3.74	1.28 (1.26 - 1.30)	0.245 (0.008)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	11.82	1.11 (1.10 - 1.12)	0.107 (0.005)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	6.24	1.12 (1.10 - 1.13)	0.110 (0.006)
Severe hematological disorders (CC 46)	1.35	1.36 (1.33 - 1.39)	0.306 (0.012)
Coagulation defects and other specified hematological disorders (CC 48)	8.00	1.08 (1.07 - 1.09)	0.074 (0.005)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	50.54	1.20 (1.19 - 1.20)	0.178 (0.004)
Drug/alcohol psychosis or dependence (CC 54-55)	4.06	1.11 (1.09 - 1.13)	0.103 (0.008)
Psychiatric comorbidity (CC 57-59, 61, 63)	31.71	1.06 (1.06 - 1.07)	0.062 (0.003)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	7.10	1.07 (1.06 - 1.08)	0.065 (0.006)
Seizure disorders and convulsions (CC 79)	5.12	1.07 (1.06 - 1.09)	0.071 (0.007)
Respirator dependence/tracheostomy status (CC 82)	0.51	1.12 (1.08 - 1.16)	0.116 (0.018)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	16.10	1.10 (1.09 - 1.11)	0.091 (0.005)
Congestive heart failure (CC 85)	24.83	1.16 (1.15 - 1.17)	0.152 (0.004)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	51.72	1.12 (1.11 - 1.13)	0.113 (0.004)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	26.08	1.08 (1.07 - 1.09)	0.080 (0.004)
Chronic obstructive pulmonary disease (COPD) (CC 111)	28.01	1.18 (1.17 - 1.18)	0.162 (0.004)
Fibrosis of lung or other chronic lung disorders (CC 112)	3.27	1.09 (1.08 - 1.11)	0.089 (0.008)
Transplants (CC 132, 186)	1.18	1.19 (1.16 - 1.22)	0.175 (0.013)
Dialysis status (CC 134)	3.20	1.27 (1.25 - 1.29)	0.242 (0.008)
Renal failure (CC 135-140)	43.74	1.23 (1.22 - 1.24)	0.205 (0.004)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	7.57	1.12 (1.11 - 1.13)	0.111 (0.006)
Hip fracture/dislocation (CC 170)	2.74	0.92 (0.91 - 0.94)	-0.081 (0.009)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Septicemia (except in labor) (CCS 2)	16.59	0.86 (0.85 - 0.87)	-0.153 (0.006)
Bacterial infection; unspecified site (CCS 3)	0.18	0.82 (0.77 - 0.89)	-0.193 (0.037)
Mycoses (CCS 4)	0.15	1.21 (1.13 - 1.29)	0.188 (0.035)
Hepatitis (CCS 6)	0.07	1.24 (1.12 - 1.37)	0.212 (0.051)
Viral infection (CCS 7)	0.28	0.82 (0.77 - 0.87)	-0.198 (0.031)
Other infections; including parasitic (CCS 8)	0.05	0.44 (0.37 - 0.53)	-0.815 (0.095)
Other and unspecified benign neoplasm (CCS 47)	0.17	0.86 (0.79 - 0.93)	-0.153 (0.041)
Thyroid disorders (CCS 48)	0.09	1.01 (0.91 - 1.11)	0.008 (0.051)
Diabetes mellitus with complications (CCS 50)	2.03	0.89 (0.87 - 0.91)	-0.115 (0.012)
Other endocrine disorders (CCS 51)	0.57	0.99 (0.95 - 1.03)	-0.011 (0.021)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Nutritional deficiencies (CCS 52)	0.09	0.96 (0.87 - 1.06)	-0.043 (0.050)
Gout and other crystal arthropathies (CCS 54)	0.19	0.72 (0.67 - 0.78)	-0.322 (0.039)
Fluid and electrolyte disorders (CCS 55)	3.35	0.92 (0.91 - 0.94)	-0.079 (0.010)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.46	0.95 (0.91 - 0.99)	-0.055 (0.022)
Deficiency and other anemia (CCS 59)	1.45	1.00 (0.97 - 1.02)	-0.003 (0.013)
Acute posthemorrhagic anemia (CCS 60)	0.52	0.93 (0.89 - 0.97)	-0.075 (0.021)
Coagulation and hemorrhagic disorders (CCS 62)	0.36	1.05 (1.00 - 1.10)	0.050 (0.024)
Diseases of white blood cells (CCS 63)	0.32	1.09 (1.04 - 1.15)	0.088 (0.025)
Meningitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 76)	0.06	0.80 (0.70 - 0.92)	-0.223 (0.072)
Encephalitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 77)	0.06	1.04 (0.91 - 1.18)	0.036 (0.064)
Headache; including migraine (CCS 84)	0.15	0.63 (0.57 - 0.69)	-0.467 (0.048)
Blindness and vision defects (CCS 89)	0.04	0.65 (0.54 - 0.77)	-0.438 (0.093)
Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease) (CCS 90)	0.05	0.79 (0.67 - 0.92)	-0.240 (0.079)
Other eye disorders (CCS 91)	0.03	0.57 (0.46 - 0.70)	-0.571 (0.107)
Conditions associated with dizziness or vertigo (CCS 93)	0.46	0.44 (0.41 - 0.47)	-0.819 (0.034)
Essential hypertension (CCS 98)	0.25	0.65 (0.61 - 0.71)	-0.424 (0.039)
Hypertension with complications and secondary hypertension (CCS 99)	9.93	Reference	Reference
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	1.00	0.81 (0.79 - 0.84)	-0.205 (0.017)
Hemorrhoids (CCS 120)	0.24	0.85 (0.80 - 0.91)	-0.158 (0.032)
Other diseases of veins and lymphatics (CCS 121)	0.12	0.91 (0.83 - 0.99)	-0.098 (0.043)
Influenza (CCS 123)	1.27	0.65 (0.63 - 0.67)	-0.433 (0.017)
Other upper respiratory infections (CCS 126)	0.19	0.69 (0.63 - 0.74)	-0.375 (0.041)
Aspiration pneumonitis; food/vomitus (CCS 129)	2.04	0.90 (0.88 - 0.93)	-0.100 (0.012)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.76	1.22 (1.18 - 1.26)	0.200 (0.016)
Lung disease due to external agents (CCS 132)	0.07	1.03 (0.92 - 1.14)	0.025 (0.055)
Other lower respiratory disease (CCS 133)	0.75	0.91 (0.88 - 0.94)	-0.096 (0.018)
Other upper respiratory disease (CCS 134)	0.15	0.83 (0.76 - 0.89)	-0.191 (0.040)
Intestinal infection (CCS 135)	1.87	0.99 (0.97 - 1.01)	-0.011 (0.012)
Disorders of teeth and jaw (CCS 136)	0.04	0.70 (0.59 - 0.83)	-0.358 (0.088)
Diseases of mouth; excluding dental (CCS 137)	0.10	0.65 (0.58 - 0.72)	-0.436 (0.057)
Esophageal disorders (CCS 138)	0.74	0.85 (0.82 - 0.88)	-0.166 (0.019)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.18	0.84 (0.78 - 0.90)	-0.176 (0.039)
Gastritis and duodenitis (CCS 140)	0.52	0.92 (0.88 - 0.96)	-0.087 (0.022)
Other disorders of stomach and duodenum (CCS 141)	0.40	1.07 (1.02 - 1.11)	0.064 (0.022)
Appendicitis and other appendiceal conditions (CCS 142)	0.06	0.88 (0.77 - 1.01)	-0.122 (0.070)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Abdominal hernia (CCS 143)	0.28	0.75 (0.71 - 0.80)	-0.281 (0.033)
Regional enteritis and ulcerative colitis (CCS 144)	0.25	1.16 (1.09 - 1.23)	0.148 (0.030)
Intestinal obstruction without hernia (CCS 145)	2.52	0.86 (0.84 - 0.88)	-0.149 (0.012)
Diverticulosis and diverticulitis (CCS 146)	2.34	0.85 (0.83 - 0.87)	-0.163 (0.012)
Anal and rectal conditions (CCS 147)	0.15	0.93 (0.86 - 1.00)	-0.077 (0.039)
Peritonitis and intestinal abscess (CCS 148)	0.10	1.10 (1.01 - 1.20)	0.097 (0.043)
Biliary tract disease (CCS 149)	0.97	1.00 (0.97 - 1.04)	0.003 (0.016)
Other liver diseases (CCS 151)	0.77	1.28 (1.24 - 1.32)	0.248 (0.017)
Pancreatic disorders (not diabetes) (CCS 152)	1.02	0.87 (0.84 - 0.90)	-0.139 (0.017)
Gastrointestinal hemorrhage (CCS 153)	3.90	0.83 (0.82 - 0.85)	-0.182 (0.009)
Noninfectious gastroenteritis (CCS 154)	0.89	0.82 (0.79 - 0.85)	-0.198 (0.018)
Other gastrointestinal disorders (CCS 155)	1.17	0.97 (0.95 - 1.00)	-0.025 (0.014)
Nephritis; nephrosis; renal sclerosis (CCS 156)	0.04	1.26 (1.10 - 1.45)	0.234 (0.069)
Acute and unspecified renal failure (CCS 157)	6.12	0.96 (0.95 - 0.97)	-0.041 (0.008)
Chronic kidney disease (CCS 158)	0.05	0.92 (0.81 - 1.04)	-0.083 (0.065)
Urinary tract infections (CCS 159)	6.61	0.87 (0.85 - 0.88)	-0.144 (0.008)
Calculus of urinary tract (CCS 160)	0.10	0.72 (0.65 - 0.81)	-0.323 (0.057)
Other diseases of kidney and ureters (CCS 161)	0.42	0.83 (0.79 - 0.88)	-0.182 (0.026)
Other diseases of bladder and urethra (CCS 162)	0.07	0.98 (0.87 - 1.10)	-0.022 (0.059)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.26	0.93 (0.87 - 0.99)	-0.073 (0.031)
Hyperplasia of prostate (CCS 164)	0.10	1.02 (0.93 - 1.13)	0.021 (0.050)
Inflammatory conditions of male genital organs (CCS 165)	0.12	0.60 (0.54 - 0.66)	-0.516 (0.054)
Skin and subcutaneous tissue infections (CCS 197)	3.32	0.77 (0.76 - 0.79)	-0.259 (0.010)
Other inflammatory condition of skin (CCS 198)	0.06	1.13 (1.00 - 1.27)	0.121 (0.061)
Chronic ulcer of skin (CCS 199)	0.21	0.81 (0.75 - 0.86)	-0.214 (0.034)
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease) (CCS 201)	0.23	0.88 (0.82 - 0.93)	-0.133 (0.032)
Rheumatoid arthritis and related disease (CCS 202)	0.05	0.82 (0.72 - 0.95)	-0.193 (0.071)
Osteoarthritis (CCS 203)	0.16	0.68 (0.63 - 0.75)	-0.380 (0.045)
Other non-traumatic joint disorders (CCS 204)	0.21	0.76 (0.70 - 0.81)	-0.281 (0.037)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	1.19	0.77 (0.74 - 0.79)	-0.268 (0.017)
Pathological fracture (CCS 207)	0.33	0.82 (0.77 - 0.86)	-0.203 (0.029)
Systemic lupus erythematosus and connective tissue disorders (CCS 210)	0.09	1.11 (1.01 - 1.22)	0.104 (0.050)
Other connective tissue disease (CCS 211)	0.71	0.73 (0.70 - 0.77)	-0.309 (0.021)
Other bone disease and musculoskeletal deformities (CCS 212)	0.08	0.74 (0.66 - 0.83)	-0.300 (0.059)
Fracture of neck of femur (hip) (CCS 226)	0.29	0.67 (0.62 - 0.71)	-0.404 (0.034)
Skull and face fractures (CCS 228)	0.14	0.76 (0.69 - 0.84)	-0.271 (0.048)
Fracture of upper limb (CCS 229)	0.43	0.83 (0.79 - 0.87)	-0.188 (0.026)
Fracture of lower limb (CCS 230)	0.37	0.75 (0.71 - 0.79)	-0.287 (0.029)
Other fractures (CCS 231)	2.39	0.73 (0.71 - 0.75)	-0.317 (0.013)
Sprains and strains (CCS 232)	0.09	0.69 (0.62 - 0.78)	-0.369 (0.059)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Crushing injury or internal injury (CCS 234)	0.31	0.76 (0.71 - 0.81)	-0.277 (0.032)
Open wounds of head; neck; and trunk (CCS 235)	0.09	0.71 (0.63 - 0.79)	-0.345 (0.057)
Open wounds of extremities (CCS 236)	0.07	0.84 (0.74 - 0.95)	-0.174 (0.064)
Complication of device; implant or graft (CCS 237)	3.10	0.97 (0.95 - 0.99)	-0.031 (0.009)
Complications of surgical procedures or medical care (CCS 238)	2.33	0.88 (0.86 - 0.90)	-0.128 (0.011)
Superficial injury; contusion (CCS 239)	0.38	0.76 (0.72 - 0.80)	-0.277 (0.028)
Burns (CCS 240)	0.03	0.94 (0.79 - 1.11)	-0.064 (0.085)
Poisoning by psychotropic agents (CCS 241)	0.08	0.75 (0.67 - 0.84)	-0.288 (0.060)
Poisoning by other medications and drugs (CCS 242)	0.43	0.80 (0.77 - 0.84)	-0.219 (0.025)
Poisoning by nonmedicinal substances (CCS 243)	0.05	0.49 (0.41 - 0.59)	-0.712 (0.090)
Other injuries and conditions due to external causes (CCS 244)	0.57	0.75 (0.72 - 0.79)	-0.288 (0.023)
Syncope (CCS 245)	1.23	0.63 (0.61 - 0.65)	-0.468 (0.017)
Fever of unknown origin (CCS 246)	0.23	0.87 (0.81 - 0.92)	-0.145 (0.033)
Gangrene (CCS 248)	0.07	1.37 (1.24 - 1.51)	0.314 (0.051)
Shock (CCS 249)	0.07	0.83 (0.75 - 0.93)	-0.181 (0.057)
Nausea and vomiting (CCS 250)	0.21	1.11 (1.04 - 1.18)	0.106 (0.032)
Abdominal pain (CCS 251)	0.35	0.88 (0.83 - 0.93)	-0.130 (0.027)
Malaise and fatigue (CCS 252)	0.40	0.82 (0.78 - 0.86)	-0.203 (0.026)
Allergic reactions (CCS 253)	0.09	0.81 (0.73 - 0.90)	-0.210 (0.056)
Other aftercare (CCS 257)	0.04	0.77 (0.64 - 0.93)	-0.261 (0.094)
Other screening for suspected conditions (not mental disorders or infectious disease) (CCS 258)	0.09	0.85 (0.76 - 0.94)	-0.167 (0.053)
Residual codes; unclassified (CCS 259)	0.55	0.83 (0.79 - 0.87)	-0.189 (0.022)
Delirium, dementia, and amnestic and other cognitive disorders (CCS 653)	0.97	0.79 (0.76 - 0.82)	-0.240 (0.018)
Alcohol-related disorders (CCS 660)	0.58	1.03 (0.99 - 1.07)	0.027 (0.021)
Substance-related disorders (CCS 661)	0.11	0.80 (0.73 - 0.88)	-0.220 (0.049)
Adverse effects of medical drugs (CCS 2617)	0.08	0.90 (0.81 - 1.00)	-0.107 (0.053)
Low Frequency Conditions	0.46	0.83 (0.79 - 0.87)	-0.184 (0.024)

**Table 4.2.2 – Surgery/Gynecology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2016-June 2017)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	N/A	1.01 (1.01 - 1.01)	0.014 (0.000)
Severe infection (CC 1, 3-6)	1.00	1.18 (1.14 - 1.23)	0.169 (0.020)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	5.20	0.95 (0.93 - 0.97)	-0.054 (0.010)
Other infectious diseases and pneumonias (CC 7, 114-116)	12.80	1.10 (1.08 - 1.12)	0.096 (0.007)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Metastatic cancer and acute leukemia (CC 8)	3.25	1.30 (1.27 - 1.34)	0.266 (0.013)
Severe cancer (CC 9-10)	3.80	1.21 (1.18 - 1.23)	0.187 (0.011)
Other cancers (CC 11-14)	6.11	1.06 (1.04 - 1.08)	0.059 (0.009)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	28.76	1.17 (1.16 - 1.18)	0.157 (0.006)
Protein-calorie malnutrition (CC 21)	8.06	1.22 (1.20 - 1.23)	0.195 (0.008)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	17.23	1.10 (1.08 - 1.11)	0.092 (0.007)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.41	1.33 (1.29 - 1.38)	0.287 (0.017)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	5.96	1.03 (1.01 - 1.05)	0.032 (0.009)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.47	1.15 (1.12 - 1.17)	0.137 (0.010)
Severe hematological disorders (CC 46)	0.53	1.37 (1.30 - 1.44)	0.316 (0.026)
Coagulation defects and other specified hematological disorders (CC 48)	3.62	1.01 (0.99 - 1.03)	0.007 (0.011)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	43.56	1.28 (1.27 - 1.29)	0.247 (0.006)
Drug/alcohol psychosis or dependence (CC 54-55)	2.44	1.12 (1.09 - 1.15)	0.112 (0.014)
Psychiatric comorbidity (CC 57-59, 61, 63)	24.18	1.11 (1.10 - 1.12)	0.104 (0.006)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	4.41	1.08 (1.06 - 1.10)	0.077 (0.010)
Seizure disorders and convulsions (CC 79)	2.67	1.13 (1.10 - 1.16)	0.125 (0.013)
Respirator dependence/tracheostomy status (CC 82)	0.22	0.97 (0.90 - 1.05)	-0.028 (0.038)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	6.91	1.03 (1.01 - 1.04)	0.025 (0.009)
Congestive heart failure (CC 85)	10.75	1.14 (1.12 - 1.16)	0.131 (0.008)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	37.12	1.21 (1.19 - 1.22)	0.188 (0.006)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	13.34	1.08 (1.06 - 1.09)	0.074 (0.007)
Chronic obstructive pulmonary disease (COPD) (CC 111)	17.67	1.26 (1.24 - 1.27)	0.231 (0.006)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.61	1.12 (1.09 - 1.16)	0.118 (0.016)
Transplants (CC 132, 186)	0.61	1.35 (1.29 - 1.41)	0.300 (0.024)
Dialysis status (CC 134)	1.63	1.34 (1.30 - 1.37)	0.290 (0.014)
Renal failure (CC 135-140)	23.59	1.28 (1.26 - 1.29)	0.244 (0.006)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	5.10	1.06 (1.04 - 1.09)	0.062 (0.011)
Hip fracture/dislocation (CC 170)	2.08	0.93 (0.91 - 0.96)	-0.068 (0.015)
<b>Condition Specific Indicator (AHRQ CCS)</b>			

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Septicemia (except in labor) (CCS 2)	3.06	0.96 (0.92 - 1.01)	-0.039 (0.026)
Cancer of head and neck (CCS 11)	0.27	0.71 (0.64 - 0.78)	-0.345 (0.051)
Cancer of esophagus (CCS 12)	0.08	1.36 (1.18 - 1.56)	0.307 (0.072)
Cancer of stomach (CCS 13)	0.17	0.90 (0.81 - 1.01)	-0.103 (0.056)
Cancer of colon (CCS 14)	1.39	0.69 (0.65 - 0.73)	-0.371 (0.031)
Cancer of rectum and anus (CCS 15)	0.36	1.15 (1.06 - 1.24)	0.136 (0.041)
Cancer of liver and intrahepatic bile duct (CCS 16)	0.09	1.13 (0.99 - 1.30)	0.124 (0.070)
Cancer of pancreas (CCS 17)	0.22	1.22 (1.11 - 1.34)	0.199 (0.047)
Cancer of other GI organs; peritoneum (CCS 18)	0.18	0.96 (0.86 - 1.07)	-0.042 (0.054)
Cancer of bronchus; lung (CCS 19)	1.05	0.70 (0.65 - 0.74)	-0.362 (0.033)
Cancer of bone and connective tissue (CCS 21)	0.09	0.90 (0.77 - 1.05)	-0.106 (0.077)
Other non-epithelial cancer of skin (CCS 23)	0.08	0.55 (0.46 - 0.66)	-0.605 (0.093)
Cancer of breast (CCS 24)	0.26	0.48 (0.42 - 0.54)	-0.736 (0.062)
Cancer of uterus (CCS 25)	0.27	0.65 (0.58 - 0.72)	-0.437 (0.055)
Cancer of ovary (CCS 27)	0.19	0.69 (0.61 - 0.77)	-0.373 (0.060)
Cancer of other female genital organs (CCS 28)	0.07	0.98 (0.83 - 1.15)	-0.023 (0.082)
Cancer of prostate (CCS 29)	0.89	0.41 (0.38 - 0.45)	-0.882 (0.044)
Cancer of bladder (CCS 32)	0.47	1.28 (1.19 - 1.37)	0.246 (0.036)
Cancer of kidney and renal pelvis (CCS 33)	0.58	0.58 (0.53 - 0.63)	-0.546 (0.042)
Cancer of other urinary organs (CCS 34)	0.08	0.75 (0.64 - 0.89)	-0.285 (0.083)
Cancer of brain and nervous system (CCS 35)	0.15	1.10 (0.98 - 1.23)	0.097 (0.058)
Non-Hodgkin's lymphoma (CCS 38)	0.17	1.80 (1.64 - 1.98)	0.588 (0.048)
Secondary malignancies (CCS 42)	0.79	0.96 (0.90 - 1.03)	-0.040 (0.033)
Heart valve procedures (CCS 43)	0.06	1.02 (0.86 - 1.21)	0.020 (0.089)
Neoplasms of unspecified nature or uncertain behavior (CCS 44)	0.18	0.75 (0.67 - 0.85)	-0.287 (0.062)
Other and unspecified benign neoplasm (CCS 47)	1.02	0.69 (0.65 - 0.74)	-0.370 (0.034)
Diabetes mellitus with complications (CCS 50)	1.63	0.88 (0.83 - 0.93)	-0.127 (0.028)
Fluid and electrolyte disorders (CCS 55)	0.10	0.96 (0.85 - 1.09)	-0.037 (0.062)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.35	0.47 (0.42 - 0.52)	-0.759 (0.058)
Parkinson's disease (CCS 79)	0.08	0.41 (0.32 - 0.52)	-0.900 (0.123)
Other nervous system disorders (CCS 95)	0.49	0.83 (0.77 - 0.90)	-0.183 (0.040)
Heart valve disorders (CCS 96)	3.12	0.73 (0.69 - 0.76)	-0.321 (0.026)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease) (CCS 97)	0.17	0.97 (0.87 - 1.07)	-0.033 (0.052)
Hypertension with complications and secondary hypertension (CCS 99)	0.61	Reference	Reference
Acute myocardial infarction (CCS 100)	1.15	0.89 (0.84 - 0.94)	-0.118 (0.030)
Coronary atherosclerosis and other heart disease (CCS 101)	2.18	0.74 (0.70 - 0.78)	-0.308 (0.028)
Cardiac dysrhythmias (CCS 106)	0.97	0.79 (0.74 - 0.84)	-0.240 (0.032)
Congestive heart failure; nonhypertensive (CCS 108)	0.19	1.04 (0.95 - 1.14)	0.041 (0.046)
Acute cerebrovascular disease (CCS 109)	1.07	0.93 (0.87 - 0.98)	-0.076 (0.031)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Occlusion or stenosis of precerebral arteries (CCS 110)	2.14	0.42 (0.39 - 0.44)	-0.873 (0.031)
Other and ill-defined cerebrovascular disease (CCS 111)	0.16	0.53 (0.46 - 0.62)	-0.629 (0.074)
Peripheral and visceral atherosclerosis (CCS 114)	1.10	0.93 (0.88 - 0.99)	-0.071 (0.030)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	0.38	1.01 (0.93 - 1.09)	0.006 (0.040)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.24	1.19 (1.09 - 1.30)	0.172 (0.045)
Other circulatory disease (CCS 117)	0.11	1.05 (0.93 - 1.18)	0.046 (0.062)
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	0.11	0.82 (0.72 - 0.94)	-0.194 (0.068)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	0.19	0.95 (0.87 - 1.05)	-0.046 (0.049)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	0.18	1.05 (0.96 - 1.16)	0.052 (0.050)
Aspiration pneumonitis; food/vomitus (CCS 129)	0.11	1.00 (0.89 - 1.13)	0.004 (0.059)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.22	0.85 (0.77 - 0.93)	-0.165 (0.049)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	0.23	0.92 (0.84 - 1.00)	-0.088 (0.045)
Other lower respiratory disease (CCS 133)	0.17	0.74 (0.66 - 0.83)	-0.302 (0.061)
Other upper respiratory disease (CCS 134)	0.12	0.86 (0.76 - 0.97)	-0.149 (0.063)
Esophageal disorders (CCS 138)	0.20	0.75 (0.67 - 0.83)	-0.293 (0.057)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.16	0.98 (0.87 - 1.09)	-0.023 (0.058)
Other disorders of stomach and duodenum (CCS 141)	0.18	0.97 (0.87 - 1.07)	-0.036 (0.051)
Appendicitis and other appendiceal conditions (CCS 142)	0.54	0.62 (0.57 - 0.68)	-0.477 (0.044)
Abdominal hernia (CCS 143)	2.16	0.68 (0.64 - 0.72)	-0.392 (0.029)
Regional enteritis and ulcerative colitis (CCS 144)	0.08	1.32 (1.15 - 1.52)	0.276 (0.072)
Intestinal obstruction without hernia (CCS 145)	1.29	0.85 (0.80 - 0.90)	-0.168 (0.030)
Diverticulosis and diverticulitis (CCS 146)	0.87	0.81 (0.76 - 0.86)	-0.212 (0.034)
Anal and rectal conditions (CCS 147)	0.27	0.68 (0.61 - 0.75)	-0.390 (0.052)
Biliary tract disease (CCS 149)	2.43	0.64 (0.61 - 0.68)	-0.445 (0.028)
Other liver diseases (CCS 151)	0.09	1.28 (1.14 - 1.45)	0.251 (0.063)
Pancreatic disorders (not diabetes) (CCS 152)	0.36	0.78 (0.72 - 0.86)	-0.244 (0.045)
Gastrointestinal hemorrhage (CCS 153)	0.37	0.87 (0.81 - 0.94)	-0.138 (0.039)
Other gastrointestinal disorders (CCS 155)	0.85	0.77 (0.72 - 0.82)	-0.265 (0.033)
Acute and unspecified renal failure (CCS 157)	0.41	1.06 (0.99 - 1.14)	0.056 (0.036)
Urinary tract infections (CCS 159)	0.36	1.03 (0.95 - 1.11)	0.030 (0.039)
Calculus of urinary tract (CCS 160)	0.22	0.65 (0.58 - 0.72)	-0.435 (0.058)
Other diseases of kidney and ureters (CCS 161)	0.47	0.67 (0.62 - 0.73)	-0.393 (0.043)
Other diseases of bladder and urethra (CCS 162)	0.18	0.88 (0.79 - 0.98)	-0.125 (0.055)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.14	0.83 (0.74 - 0.93)	-0.186 (0.060)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Hyperplasia of prostate (CCS 164)	0.45	0.60 (0.55 - 0.65)	-0.514 (0.045)
Prolapse of female genital organs (CCS 170)	0.24	0.33 (0.28 - 0.39)	-1.100 (0.081)
Other female genital disorders (CCS 175)	0.11	0.77 (0.67 - 0.89)	-0.259 (0.075)
Skin and subcutaneous tissue infections (CCS 197)	0.46	0.70 (0.65 - 0.76)	-0.355 (0.040)
Chronic ulcer of skin (CCS 199)	0.32	0.76 (0.70 - 0.83)	-0.274 (0.042)
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease (CCS 201)	0.57	0.69 (0.65 - 0.75)	-0.365 (0.037)
Rheumatoid arthritis and related disease (CCS 202)	0.07	0.38 (0.29 - 0.49)	-0.974 (0.133)
Osteoarthritis (CCS 203)	24.03	0.29 (0.28 - 0.30)	-1.238 (0.025)
Other non-traumatic joint disorders (CCS 204)	0.24	0.33 (0.29 - 0.39)	-1.095 (0.076)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	5.13	0.52 (0.50 - 0.55)	-0.650 (0.027)
Pathological fracture (CCS 207)	0.99	0.73 (0.69 - 0.78)	-0.311 (0.032)
Other acquired deformities (CCS 209)	1.26	0.51 (0.47 - 0.54)	-0.680 (0.036)
Other connective tissue disease (CCS 211)	0.57	0.42 (0.39 - 0.46)	-0.860 (0.047)
Other bone disease and musculoskeletal deformities (CCS 212)	0.24	0.47 (0.42 - 0.54)	-0.749 (0.063)
Cardiac and circulatory congenital anomalies (CCS 213)	0.11	0.72 (0.63 - 0.84)	-0.323 (0.074)
Joint disorders and dislocations; trauma-related (CCS 225)	0.15	0.64 (0.56 - 0.74)	-0.444 (0.069)
Fracture of neck of femur (hip) (CCS 226)	8.79	0.63 (0.60 - 0.66)	-0.468 (0.025)
Skull and face fractures (CCS 228)	0.08	0.56 (0.46 - 0.67)	-0.586 (0.095)
Fracture of upper limb (CCS 229)	1.19	0.50 (0.47 - 0.54)	-0.689 (0.034)
Fracture of lower limb (CCS 230)	2.07	0.65 (0.62 - 0.69)	-0.426 (0.029)
Other fractures (CCS 231)	0.94	0.82 (0.77 - 0.87)	-0.204 (0.032)
Sprains and strains (CCS 232)	0.11	0.44 (0.36 - 0.53)	-0.825 (0.097)
Intracranial injury (CCS 233)	0.53	0.98 (0.91 - 1.05)	-0.023 (0.037)
Crushing injury or internal injury (CCS 234)	0.11	0.95 (0.83 - 1.08)	-0.057 (0.068)
Open wounds of head; neck; and trunk (CCS 235)	0.06	0.54 (0.44 - 0.67)	-0.613 (0.107)
Open wounds of extremities (CCS 236)	0.12	0.78 (0.68 - 0.89)	-0.252 (0.068)
Complication of device; implant or graft (CCS 237)	4.63	0.77 (0.73 - 0.81)	-0.259 (0.025)
Complications of surgical procedures or medical care (CCS 238)	2.43	0.83 (0.79 - 0.88)	-0.184 (0.027)
Burns (CCS 240)	0.06	0.88 (0.74 - 1.05)	-0.127 (0.090)
Other injuries and conditions due to external causes (CCS 244)	0.07	0.84 (0.71 - 0.99)	-0.173 (0.084)
Gangrene (CCS 248)	0.38	1.17 (1.08 - 1.25)	0.153 (0.037)
Other aftercare (CCS 257)	0.15	0.54 (0.47 - 0.61)	-0.623 (0.069)
Low Frequency Conditions	1.96	0.85 (0.81 - 0.90)	-0.158 (0.028)

**Table 4.2.3 - Cardiorespiratory Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2016-June 2017)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	N/A	1.00 (1.00 - 1.00)	-0.002 (0.000)
Severe infection (CC 1, 3-6)	1.67	1.10 (1.06 - 1.15)	0.098 (0.020)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	10.25	1.01 (1.00 - 1.03)	0.015 (0.009)
Other infectious diseases and pneumonias (CC 7, 114-116)	40.74	1.06 (1.05 - 1.07)	0.059 (0.007)
Metastatic cancer and acute leukemia (CC 8)	3.21	1.26 (1.22 - 1.30)	0.232 (0.016)
Severe cancer (CC 9-10)	6.88	1.24 (1.21 - 1.27)	0.213 (0.011)
Other cancers (CC 11-14)	5.83	1.06 (1.04 - 1.08)	0.058 (0.012)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	35.87	1.09 (1.08 - 1.11)	0.090 (0.006)
Protein-calorie malnutrition (CC 21)	12.05	1.11 (1.10 - 1.13)	0.107 (0.008)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	33.01	1.14 (1.12 - 1.16)	0.131 (0.007)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.78	1.16 (1.11 - 1.20)	0.145 (0.019)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	8.00	1.09 (1.07 - 1.11)	0.083 (0.010)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	6.09	1.06 (1.04 - 1.08)	0.058 (0.011)
Severe hematological disorders (CC 46)	1.05	1.24 (1.19 - 1.31)	0.219 (0.025)
Coagulation defects and other specified hematological disorders (CC 48)	6.68	1.05 (1.03 - 1.07)	0.046 (0.010)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	44.24	1.20 (1.18 - 1.21)	0.180 (0.006)
Drug/alcohol psychosis or dependence (CC 54-55)	3.68	1.20 (1.17 - 1.24)	0.185 (0.014)
Psychiatric comorbidity (CC 57-59, 61, 63)	34.71	1.10 (1.09 - 1.12)	0.100 (0.006)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	4.73	1.08 (1.06 - 1.11)	0.078 (0.012)
Seizure disorders and convulsions (CC 79)	3.90	1.06 (1.03 - 1.09)	0.060 (0.014)
Respirator dependence/tracheostomy status (CC 82)	0.63	1.09 (1.03 - 1.16)	0.090 (0.030)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	29.43	1.22 (1.20 - 1.23)	0.195 (0.007)
Congestive heart failure (CC 85)	32.65	1.20 (1.18 - 1.22)	0.184 (0.008)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	54.25	1.12 (1.11 - 1.14)	0.116 (0.006)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	28.88	1.11 (1.09 - 1.12)	0.103 (0.007)
Chronic obstructive pulmonary disease (COPD) (CC 111)	53.18	1.20 (1.19 - 1.22)	0.185 (0.007)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Fibrosis of lung or other chronic lung disorders (CC 112)	7.57	1.09 (1.07 - 1.11)	0.087 (0.010)
Transplants (CC 132, 186)	0.67	1.16 (1.09 - 1.23)	0.149 (0.030)
Dialysis status (CC 134)	2.21	1.24 (1.20 - 1.28)	0.212 (0.017)
Renal failure (CC 135-140)	38.60	1.18 (1.17 - 1.20)	0.169 (0.006)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	4.80	1.10 (1.08 - 1.13)	0.098 (0.012)
Hip fracture/dislocation (CC 170)	2.25	0.90 (0.87 - 0.94)	-0.101 (0.018)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Pulmonary heart disease (CCS 103)	6.08	0.81 (0.78 - 0.83)	-0.215 (0.015)
Congestive heart failure; nonhypertensive (CCS 108)	19.88	1.06 (1.04 - 1.08)	0.056 (0.010)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	25.55	0.88 (0.86 - 0.89)	-0.131 (0.010)
Acute bronchitis (CCS 125)	2.06	0.74 (0.71 - 0.78)	-0.297 (0.025)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	29.94	1.00 (0.98 - 1.02)	0.001 (0.009)
Asthma (CCS 128)	1.45	0.77 (0.73 - 0.82)	-0.257 (0.028)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	15.03	Reference	Reference
Low Frequency Conditions	0.01	0.94 (0.44 - 2.02)	-0.063 (0.392)

**Table 4.2.4 - Cardiovascular Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2016-June 2017)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	N/A	1.01 (1.01 - 1.02)	0.015 (0.000)
Severe infection (CC 1, 3-6)	0.78	1.16 (1.08 - 1.24)	0.148 (0.035)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	5.09	0.98 (0.95 - 1.01)	-0.022 (0.015)
Other infectious diseases and pneumonias (CC 7, 114-116)	16.87	1.15 (1.13 - 1.17)	0.140 (0.010)
Metastatic cancer and acute leukemia (CC 8)	1.80	1.36 (1.30 - 1.43)	0.310 (0.025)
Severe cancer (CC 9-10)	3.65	1.30 (1.26 - 1.35)	0.262 (0.018)
Other cancers (CC 11-14)	5.02	1.05 (1.02 - 1.08)	0.049 (0.016)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	34.18	1.14 (1.12 - 1.16)	0.132 (0.008)
Protein-calorie malnutrition (CC 21)	6.29	1.15 (1.12 - 1.19)	0.144 (0.013)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	21.80	1.14 (1.12 - 1.16)	0.131 (0.010)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.40	1.27 (1.21 - 1.34)	0.240 (0.026)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	6.14	1.08 (1.06 - 1.11)	0.081 (0.014)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.05	1.13 (1.10 - 1.17)	0.123 (0.015)
Severe hematological disorders (CC 46)	0.71	1.27 (1.19 - 1.37)	0.242 (0.036)
Coagulation defects and other specified hematological disorders (CC 48)	4.77	1.02 (0.99 - 1.05)	0.021 (0.015)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	33.93	1.31 (1.29 - 1.33)	0.272 (0.009)
Drug/alcohol psychosis or dependence (CC 54-55)	2.49	1.26 (1.21 - 1.31)	0.228 (0.021)
Psychiatric comorbidity (CC 57-59, 61, 63)	24.82	1.13 (1.11 - 1.15)	0.124 (0.008)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	3.88	1.14 (1.11 - 1.18)	0.134 (0.017)
Seizure disorders and convulsions (CC 79)	3.02	1.13 (1.09 - 1.18)	0.125 (0.019)
Respirator dependence/tracheostomy status (CC 82)	0.17	1.02 (0.89 - 1.17)	0.021 (0.069)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	10.76	1.07 (1.05 - 1.10)	0.069 (0.012)
Congestive heart failure (CC 85)	21.66	1.24 (1.21 - 1.27)	0.214 (0.011)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	63.15	1.10 (1.08 - 1.12)	0.093 (0.009)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	26.86	1.06 (1.04 - 1.08)	0.059 (0.010)
Chronic obstructive pulmonary disease (COPD) (CC 111)	25.23	1.32 (1.30 - 1.35)	0.280 (0.008)
Fibrosis of lung or other chronic lung disorders (CC 112)	2.62	1.14 (1.10 - 1.19)	0.133 (0.020)
Transplants (CC 132, 186)	0.62	1.11 (1.03 - 1.20)	0.107 (0.040)
Dialysis status (CC 134)	2.46	1.45 (1.39 - 1.50)	0.370 (0.019)
Renal failure (CC 135-140)	34.45	1.31 (1.29 - 1.33)	0.272 (0.008)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	3.19	1.20 (1.16 - 1.24)	0.179 (0.018)
Hip fracture/dislocation (CC 170)	1.43	0.89 (0.84 - 0.94)	-0.116 (0.027)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Heart valve disorders (CCS 96)	1.43	0.72 (0.67 - 0.78)	-0.326 (0.040)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease) (CCS 97)	1.53	Reference	Reference
Acute myocardial infarction (CCS 100)	25.04	0.84 (0.80 - 0.89)	-0.170 (0.028)
Coronary atherosclerosis and other heart disease (CCS 101)	10.64	0.64 (0.60 - 0.68)	-0.446 (0.029)
Nonspecific chest pain (CCS 102)	6.37	0.59 (0.56 - 0.63)	-0.523 (0.031)
Other and ill-defined heart disease (CCS 104)	0.49	0.73 (0.65 - 0.83)	-0.313 (0.062)
Conduction disorders (CCS 105)	4.10	0.54 (0.51 - 0.58)	-0.608 (0.034)
Cardiac dysrhythmias (CCS 106)	37.05	0.83 (0.78 - 0.87)	-0.190 (0.027)
Cardiac arrest and ventricular fibrillation (CCS 107)	0.41	0.72 (0.64 - 0.81)	-0.334 (0.061)
Peripheral and visceral atherosclerosis (CCS 114)	3.32	0.76 (0.71 - 0.81)	-0.278 (0.033)



Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	3.59	0.70 (0.65 - 0.75)	-0.358 (0.034)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.47	0.83 (0.74 - 0.93)	-0.184 (0.058)
Other circulatory disease (CCS 117)	5.22	0.73 (0.69 - 0.78)	-0.312 (0.031)
Cardiac and circulatory congenital anomalies (CCS 213)	0.34	0.87 (0.77 - 0.98)	-0.143 (0.060)

**Table 4.2.5 - Neurology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2016-June 2017)**

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	N/A	1.00 (1.00 - 1.00)	0.000 (0.001)
Severe infection (CC 1, 3-6)	1.20	1.11 (1.04 - 1.20)	0.109 (0.037)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	5.87	1.00 (0.97 - 1.04)	0.003 (0.019)
Other infectious diseases and pneumonias (CC 7, 114-116)	16.58	1.13 (1.10 - 1.16)	0.118 (0.014)
Metastatic cancer and acute leukemia (CC 8)	3.30	1.34 (1.27 - 1.41)	0.292 (0.026)
Severe cancer (CC 9-10)	4.41	1.26 (1.20 - 1.31)	0.228 (0.022)
Other cancers (CC 11-14)	6.33	1.09 (1.05 - 1.13)	0.083 (0.019)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	34.51	1.17 (1.15 - 1.19)	0.156 (0.010)
Protein-calorie malnutrition (CC 21)	9.03	1.11 (1.08 - 1.14)	0.103 (0.015)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	23.88	1.11 (1.09 - 1.14)	0.108 (0.013)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.44	1.37 (1.29 - 1.46)	0.317 (0.033)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	5.77	1.04 (1.00 - 1.08)	0.038 (0.018)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	4.68	1.10 (1.06 - 1.15)	0.098 (0.021)
Severe hematological disorders (CC 46)	0.64	1.31 (1.19 - 1.44)	0.271 (0.049)
Coagulation defects and other specified hematological disorders (CC 48)	4.73	1.06 (1.02 - 1.10)	0.054 (0.020)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	31.12	1.22 (1.19 - 1.24)	0.195 (0.011)
Drug/alcohol psychosis or dependence (CC 54-55)	3.87	1.07 (1.02 - 1.12)	0.064 (0.023)
Psychiatric comorbidity (CC 57-59, 61, 63)	29.45	1.01 (0.99 - 1.03)	0.013 (0.011)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	9.14	1.08 (1.05 - 1.11)	0.077 (0.016)
Seizure disorders and convulsions (CC 79)	10.73	1.14 (1.10 - 1.17)	0.127 (0.015)

Risk Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Respirator dependence/tracheostomy status (CC 82)	0.21	0.95 (0.81 - 1.12)	-0.048 (0.084)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	8.76	1.08 (1.05 - 1.12)	0.079 (0.017)
Congestive heart failure (CC 85)	14.47	1.12 (1.09 - 1.15)	0.113 (0.015)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	55.72	1.14 (1.12 - 1.16)	0.130 (0.011)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	19.08	1.10 (1.07 - 1.12)	0.091 (0.013)
Chronic obstructive pulmonary disease (COPD) (CC 111)	17.98	1.17 (1.14 - 1.20)	0.159 (0.012)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.64	1.07 (1.00 - 1.14)	0.066 (0.033)
Transplants (CC 132, 186)	0.55	1.18 (1.07 - 1.31)	0.168 (0.052)
Dialysis status (CC 134)	1.99	1.43 (1.35 - 1.50)	0.356 (0.027)
Renal failure (CC 135-140)	28.90	1.24 (1.21 - 1.27)	0.214 (0.011)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	3.22	1.15 (1.10 - 1.21)	0.144 (0.023)
Hip fracture/dislocation (CC 170)	2.14	0.82 (0.77 - 0.87)	-0.197 (0.031)
<b>Condition Specific Indicator (AHRQ CCS)</b>			
Parkinson's disease (CCS 79)	1.55	0.87 (0.80 - 0.94)	-0.138 (0.041)
Multiple sclerosis (CCS 80)	0.32	1.15 (0.98 - 1.34)	0.137 (0.081)
Other hereditary and degenerative nervous system conditions (CCS 81)	1.18	0.88 (0.80 - 0.95)	-0.133 (0.044)
Paralysis (CCS 82)	0.29	0.85 (0.72 - 1.00)	-0.166 (0.086)
Epilepsy; convulsions (CCS 83)	8.38	0.84 (0.81 - 0.87)	-0.176 (0.020)
Other nervous system disorders (CCS 95)	16.64	Reference	Reference
Acute cerebrovascular disease (CCS 109)	47.06	0.84 (0.81 - 0.86)	-0.180 (0.013)
Occlusion or stenosis of precerebral arteries (CCS 110)	0.82	0.75 (0.67 - 0.84)	-0.288 (0.056)
Other and ill-defined cerebrovascular disease (CCS 111)	0.49	0.80 (0.70 - 0.92)	-0.221 (0.069)
Transient cerebral ischemia (CCS 112)	10.53	0.66 (0.64 - 0.69)	-0.411 (0.020)
Late effects of cerebrovascular disease (CCS 113)	1.34	0.77 (0.71 - 0.84)	-0.262 (0.042)
Intracranial injury (CCS 233)	10.88	1.10 (1.06 - 1.14)	0.097 (0.017)
Low Frequency Conditions	0.52	1.12 (0.99 - 1.25)	0.110 (0.059)

**Table 4.2.6 – Model Performance by Specialty Cohort (July 2016-June 2017)**

Specialty Cohort	Predictive Ability, % (lowest decile-highest decile)	c-statistic
Medicine	7.7 - 32.8	0.65
Surgery/Gynecology	2.4 - 26.7	0.71
Cardiorespiratory	8.4 - 34.6	0.64

Specialty Cohort	Predictive Ability, % (lowest decile-highest decile)	c-statistic
Cardiovascular	5.2 - 29.5	0.67
Neurology	6.4 - 25.4	0.63

**Table 4.2.7 - Index Hospitalizations and Observed Readmission Rates by Specialty Cohort (July 2016-June 2017)**

Specialty Cohort	Index Hospitalizations	Observed Readmission Rate
Medicine	3,064,545	17.3%
Surgery/Gynecology	1,756,819	11.1%
Cardiorespiratory	879,670	18.7%
Cardiovascular	644,861	14.3%
Neurology	411,597	13.0%
HWR	6,757,492	15.3%

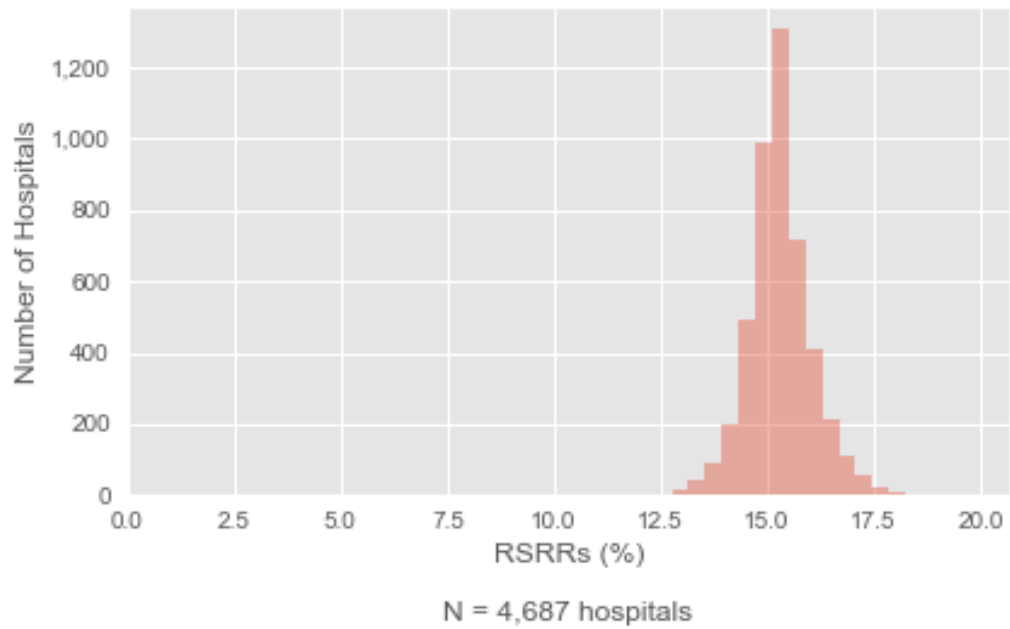
**Table 4.2.8 - Hospital-Level Observed Readmission Rates and SRRs (July 2016-June 2017)**

Variable	Number of Hospitals	Mean Observed Readmission Rate (standard deviation [SD])	Median Observed Readmission Rate (IQR)	Mean SRR (SD)	Median SRR (IQR)
Medicine	4,644	15.3 (5.6)	15.9 (12.9 - 18.3)	1.001 (0.065)	0.997 (0.963 - 1.035)
Surgery/Gynecology	3,932	10.6 (8.8)	10.2 (6.7 - 13.3)	1.001 (0.060)	0.998 (0.971 - 1.028)
Cardiorespiratory	4,508	17.2 (7.2)	17.5 (13.9 - 20.8)	1.001 (0.058)	0.996 (0.966 - 1.031)
Cardiovascular	4,307	14.4 (11.7)	13.8 (9.7 - 17.6)	1.001 (0.044)	0.998 (0.983 - 1.018)
Neurology	4,284	11.9 (12.0)	11.5 (4.7 - 15.3)	1.001 (0.041)	0.997 (0.983 - 1.015)
HWR	4,687	14.2 (4.8)	14.6 (12.0 - 16.8)	1.000 (0.050)	0.997 (0.972 - 1.026)

**Table 4.2.9 - Distribution of Hospital-Level Observed Readmission Rates and RSRRs (July 2016-June 2017)**

Composite Readmission Rate	Mean	SD	Min	10th Percentile	Lower Quartile	Median	Upper Quartile	90th Percentile	Max
Observed	14.2	4.8	0.0	8.7	12.0	14.6	16.8	19.1	100.0
RSRR	15.3	0.8	10.6	14.4	14.9	15.3	15.7	16.3	20.3

**Figure 4.2.2 – Distribution of Hospital 30-Day HWR RSRRs between July 2016 and June 2017**



## 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.

**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 standard deviation of the replications.

**C-statistic:** An indicator of the model's discriminant ability or ability to correctly classify those who have and have not been readmitted within 30 days of discharge. Potential values range from 0.5, meaning no better than chance, to 1.0, an indication of perfect prediction. Perfect prediction implies that patients' outcomes can be predicted completely by their risk factors, and physicians and hospitals play no role in their patients' outcomes.

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

**Clinical Classification Software (CCS):** Software maintained by the AHRQ that groups thousands of individual procedure and diagnosis codes into clinically coherent, mutually exclusive procedure and diagnosis categories. AHRQ CCS 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 are available on the [AHRQ website](#).

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

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

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

**Condition Categories (CCs):** Groupings of ICD-9-CM/ICD-10-CM diagnosis codes in clinically relevant categories, from the HCCs system.<sup>12,13</sup> CMS uses the grouping but not the hierarchical logic of the system to create risk factor variables. Mappings which show the assignment of ICD-9 and ICD-10 codes to the CCs are available on the [QualityNet](#) website.

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

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

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

**Hierarchical model:** A widely accepted statistical method that enables evaluation of relative hospital performance by accounting for patient risk factors. This statistical model accounts for the hierarchical structure of the data (patients clustered within hospitals are assumed to be correlated) and accommodates modeling of the association between outcomes and patient characteristics. Based on the hierarchical model, we can evaluate (1) how much variation in hospital readmission rates overall is accounted for by patients’ individual risk factors (such as age and other medical conditions), and (2) how much variation is accounted for by hospital contribution to readmission risk.

**Hospital-specific effect:** A measure of the hospital quality of care that is calculated through hierarchical logistic regression, taking into consideration how many patients were eligible for the cohort, these patients’ risk factors, and how many were readmitted. The hospital-specific effect is the calculated random effect for each hospital. The hospital-specific effect will be negative for a better-than-average hospital, positive for a worse-than-average hospital, and close to zero for an average hospital. The hospital-specific effect is used in the numerator to calculate “predicted” readmissions.

**Index admission:** Any admission included in the measure calculation as the initial admission for 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 could change from year to year.

**Medicare Fee-For-Service (FFS):** Original Medicare plan in which providers receive a fee or payment for each individual service provided directly from Medicare. Only beneficiaries in Medicare FFS, not in managed care (Medicare Advantage), are included in the 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 variable present relative to those without the risk variable present. The model coefficient for each risk variable is the log (odds) for that variable.

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

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## 7. APPENDICES

### Appendix A. Statistical Approach for Medicare HWR

The Medicare 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 Medicare 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 composite 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 composite 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, 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>14</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  $\hat{\mu}$ ,  $\{\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_l\}$ ,  $\hat{\boldsymbol{\beta}}$ , and  $\hat{\tau}^2$ . We calculate an SRR,  $\hat{s}_i$ , for each hospital by computing the number of the predicted readmissions to the number of expected readmissions. Specifically, we calculate:

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

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

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

### Composite 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 composite SRR,  $\hat{t}_i$ . The composite SRR is the volume-weighted geometric mean of the specialty cohort SRRs where  $k=1, \dots, 5$  indicates the  $k$ -th specialty cohort:

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

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 confidence interval falls below the national observed readmission rate,  $\bar{y}$ , and considered worse if the lower bound of their confidence interval falls above  $\bar{y}$ . A hospital is considered no different than expected if the confidence interval overlaps  $\bar{y}$ .

More specifically, we use bootstrapping procedures to compute confidence intervals. 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 hierarchical logistic regression model 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,  $\{\hat{\alpha}_i^{(b)}, v\hat{\sigma}_i^2(\alpha_i^{(b)}); i = 1, 2, \dots, I\}$
3. We generate a hospital random effect by sampling from the distribution of the hospital-specific distribution obtained in Step 2c. We approximate the distribution for each random effect by a normal distribution. Thus, we draw  $\alpha_i^{(b*)} \sim N(\hat{\alpha}_i^{(b)}, v\hat{\sigma}_i^2(\alpha_i^{(b)}))$  for the unique set of hospitals sampled in Step 1.
  4. Within each unique hospital  $i$  sampled in Step 1, and for each case  $j$  in that hospital, we calculate  $\hat{p}_{ij}^{(b)}$ ,  $\hat{e}_{ij}^{(b)}$ , and  $\hat{s}_i^{(b)}$  where  $\hat{\beta}^{(b)}$  and  $\hat{\mu}^{(b)}$  are obtained from Step 2 and  $\alpha_i^{(b*)}$  is obtained from Step 3.
  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>15</sup>

## **Appendix B. Data QA**

This production year required revision of all SAS packs to account for updates in ICD-10 codes and associated mappings of clinical groupers. To assure the quality of measure output, we utilized a multi-phase approach to QA of the HWR measure.

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

### **Phase I**

The first step in this year's QA process was to review changes in the cohort and outcomes definitions as determined by the measure-specific code set files that were updated to account for changes in ICD-10 coding. This included updates to the AHRQ CCS software and the HCC clinical category maps.

In general, we used 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 updated 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 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.

### 2018

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

1. Updated the ICD-10 code-based specifications used in the measure. Specifically:
  - Applied the 2017.1 and 2017.2 versions of the AHRQ 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,
  - Conducted code surveillance to identify any specification changes warranted due to 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 CCS, and CMS-HCC crosswalk were released. Revisions to the measure specifications were warranted to accommodate these updates.
2. 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](#), 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 two 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 critical access hospitals, hospitals that are not part of the Inpatient Prospective Payment System. 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).
3. 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, Tables PR.1 and PR.2, 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 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)

1. Revised the measure specifications to accommodate the implementation of ICD-10 coding:
  - Updated the specialty cohort definitions, by using the most recent (2016) version of the AHRQ ICD-10 CCS for discharges on or after October 1, 2015.
  - Updated the planned readmission algorithm, by using the most recent (2016) version of the ICD-10-based AHRQ CCS and ICD-10 codes for certain “potentially planned procedures” and “acute diagnoses” to the algorithm specifications, for discharges on or after October 1, 2015.
  - Re-specified the risk model, updating the CC-based risk variables to the ICD-10-compatible Hierarchical Condition Categories (HCC) system version 22 to the model.
    - Rationale: The ICD-9 code sets used to report medical diagnoses and inpatient procedures were replaced by ICD-10 code sets on October 1, 2015. The U.S. Department of Health and Human Services (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.
2. Updated the methodologies used to identify transfers to psychiatric and rehabilitation units, to ensure these transfers are not captured as readmissions for any hospital (as described in the 2013 update below and the 2010 AMI, HF, and pneumonia readmission measures maintenance report):
  - Psychiatric admissions – Criterion (2) and (3) from the 2013 update apply. However, criterion (1) was modified slightly to:
    - (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with ‘29’, ‘30’ or ‘31’, for discharges prior to October 1, 2015, or ICD-10-CM codes beginning with ‘F’, for discharges on or after October 1, 2015).
  - Rehabilitation admissions – For discharges on or after October 1, 2015, the previous approach is replaced with:
    - (1) the index admission has a discharge disposition code to a rehabilitation hospital or rehabilitation unit from the index admission; and,
    - (2) the admission being evaluated as a potential readmission occurred on the same day as or the day following the index discharge.
      - Rationale: With the implementation of ICD-10 coding effective with 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.

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## 2016

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### 2016 Measure Updates and Specifications Report HWR (Version 5.0)

1. 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.
2. Applied the 2015 version of the AHRQ CCS to the planned readmission algorithm, risk-adjustment models, and specialty cohort definitions.
  - Rationale: A 2015 version of the AHRQ CCS was released.

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## 2015

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

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

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## 2014

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

1. 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.
2. Applied updated AHRQ CCS version to the planned readmission algorithm, risk adjustment-models, and specialty cohort definitions.
  - Rationale: An updated version of the AHRQ CCS was released in 2013.

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## 2013

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

1. 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.
2. Updated CC map.
  - Rationale: The ICD-9-CM CC map is updated annually to capture all relevant comorbidities coded in patient administrative claims data.
3. 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.



4. Updated the methodology used to determine readmission outcome in cases of admission to psychiatric and rehabilitation hospital units.
- Rationale: Psychiatric and rehabilitation units within short-term acute care hospitals in Maryland have the same type of provider ID number (or CCN) as the acute care hospital in which they are housed. Transfers to these units can therefore look like readmissions. In order to accurately assess readmissions in Maryland and allow for public reporting of Maryland readmission rates, methodologies to identify these cases were needed, to ensure these transfers are not captured as readmissions for any hospital. Rehabilitation admissions are identified by ICD-9-CM principal discharge diagnosis code (codes beginning with 'V57' indicate admission to a rehabilitation unit). A psychiatric admission is identified if all three of the following criteria are met:
    - (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with '29', '30', or '31');
    - (2) the index admission has a discharge disposition code to a psychiatric hospital or psychiatric unit from the index admission; and,
    - (3) the admission being evaluated as a potential readmission occurred during the same day as or the day following the index discharge.Psychiatric/rehabilitation admissions identified as described above are not 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.

## Appendix D. Measure Specifications

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

#### Cohort

##### Inclusion Criteria for HWR Measure

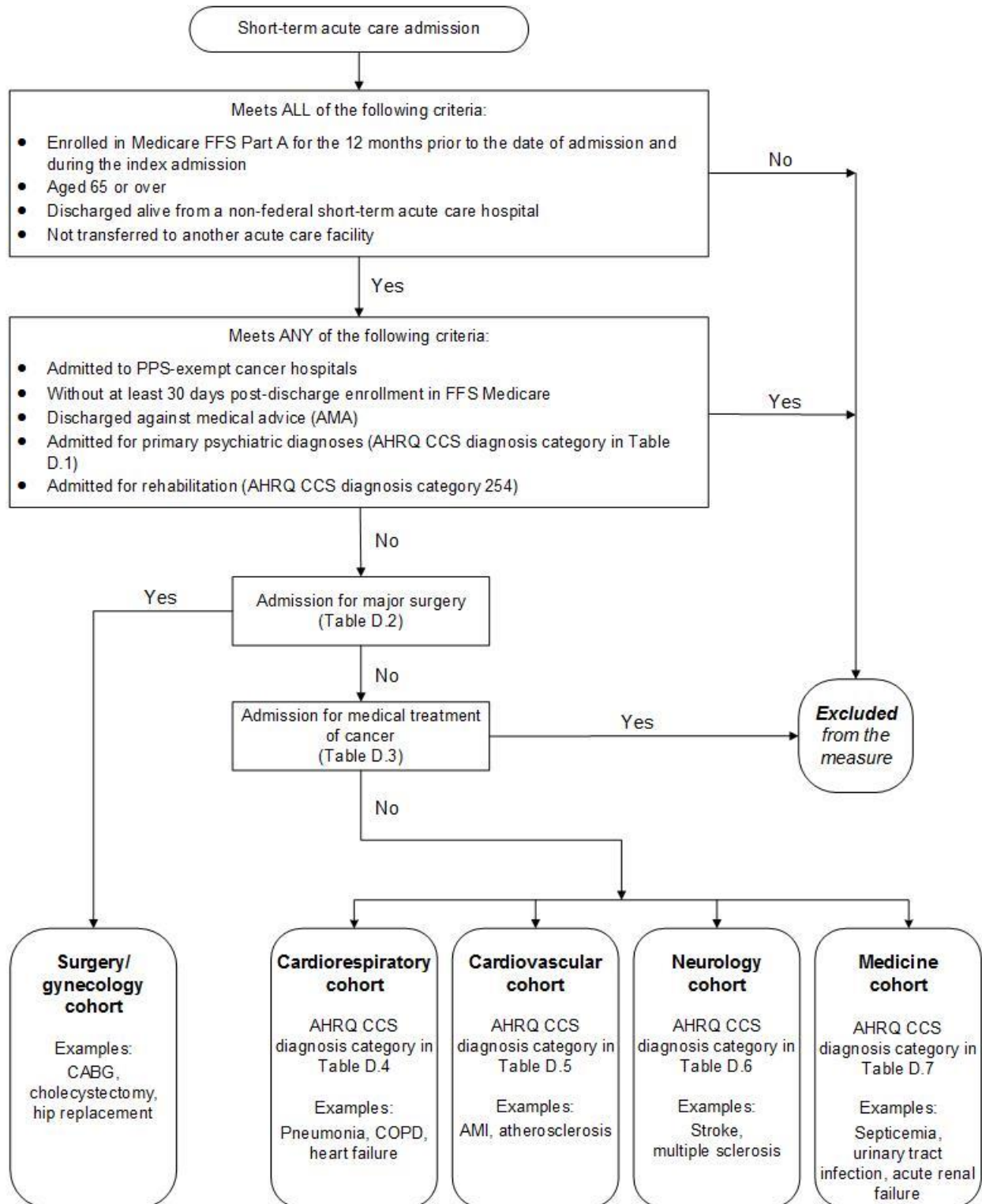
- 1. Enrolled in Medicare FFS Part A for the 12 months prior to the date of admission and during the index admission**  
Rationale: Claims data are consistently available only for Medicare FFS beneficiaries. The 12-month prior enrollment ensures a full year of administrative data is available for risk adjustment. Medicare Part A is required at the time of admission to ensure no Medicare Advantage patients are included in the measure.
- 2. Aged 65 or over**  
Rationale: Medicare patients younger than 65 usually qualify for the program due to severe disability. They are not included in the measure because Medicare patients younger than 65 are considered to be too clinically distinct from Medicare patients 65 and over.
- 3. Discharged alive from a non-federal short-term acute care hospital**  
Rationale: It is only possible for patients to be readmitted if they are discharged alive.
- 4. 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

- 1. Admitted to PPS-exempt cancer hospitals**  
Rationale: These hospitals care for a unique population of patients that cannot reasonably be compared to patients admitted to other hospitals.
- 2. Without at least 30 days of post-discharge enrollment in Medicare FFS**  
Rationale: The 30-day readmission outcome cannot be assessed in this group since claims data are used to determine whether a patient was readmitted.
- 3. Discharged against medical advice**  
Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- 4. 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 ([Table D.1](#)).
- 5. Admitted for rehabilitation**  
Rationale: These admissions are not typically to a short-term acute care hospital and are not for acute care.
- 6. Admitted for medical treatment of cancer**  
Rationale: These admissions have a different mortality and readmission profile than the rest of the Medicare population, 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 (Table D.3).

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



**Table D.1 - Psychiatric Discharge Diagnosis Categories Excluded from the Measure**

AHRQ CCS Diagnosis	Description
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit conduct and disruptive behavior disorders
654	Developmental disorders
655	Disorders usually diagnosed in infancy childhood or adolescence
656	Impulse control disorders NEC
657	Mood disorders
658	Personality disorders
659	Schizophrenia and other psychotic disorders
662	Suicide and intentional self-inflicted injury
670	Miscellaneous mental health disorders

**Table D.2 – Procedures Defining the Surgery/Gynecology Cohort**

Procedure Category/ICD-10-PCS Codes	Description
<b>AHRQ CCS Procedure Categories</b>	
1	Incision and excision of CNS
2	Insertion; replacement; or removal of extracranial ventricular shunt
3	Excision destruction or resection of intervertebral disc
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Therapeutic endocrine procedures
13	Corneal transplant
14	Procedures typically performed for glaucoma
15	Lens and cataract procedures
16	Repair of retina
17	Destruction of lesion of retina and choroid
20	Other intraocular therapeutic procedures
21	Other extraocular muscle and orbit therapeutic procedures
22	Tympanoplasty
23	Myringotomy
24	Mastoidectomy
26	Other therapeutic procedures on the ear nose and sinus
28	Plastic procedures on nose
30	Tonsillectomy and/or adenoidectomy
33	Other OR procedures on mouth and throat
36	Lobectomy or pneumonectomy
42	Other OR Rx procedures on respiratory system and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
55	Peripheral vascular bypass
56	Other vascular bypass and shunt; not heart

Procedure Category/ICD-10-PCS Codes	Description
59	Other OR procedures on vessels of head and neck
60	Embolectomy and endarterectomy of lower limbs
66	Procedures on spleen
67	Other procedures; hemic and lymphatic systems
72	Colostomy; temporary and permanent
73	Ileostomy and other enterostomy
74	Gastrectomy; partial and total
75	Small bowel resection
78	Colorectal resection
79	Excision (partial) of large intestine (not endoscopic)
80	Appendectomy
84	Cholecystectomy and common duct exploration
85	Inguinal and femoral hernia repair
86	Other hernia repair
89	Exploratory laparotomy
90	Excision; lysis peritoneal adhesions
94	Other OR upper GI therapeutic procedures
96	Other OR lower GI therapeutic procedures
99	Other OR gastrointestinal therapeutic procedures
101	Transurethral excision; drainage; or removal urinary obstruction
103	Nephrotomy and nephrostomy
104	Nephrectomy; partial or complete
105	Kidney transplant
106	Genitourinary incontinence procedures
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
118	Other OR therapeutic procedures; male genital
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
121	Ligation or occlusion of fallopian tubes
123	Other operations on fallopian tubes
124	Hysterectomy; abdominal and vaginal
125	Other excision of cervix and uterus
129	Repair of cystocele and rectocele; obliteration of vaginal vault
131	Other non-OR therapeutic procedures; female organs
132	Other OR therapeutic procedures; female organs
133	Episiotomy
141	Other therapeutic obstetrical procedures
142	Partial excision bone
144	Fracture treatment including reposition with or without fixation; facial fracture or dislocation
145	Fracture treatment including reposition with or without fixation; radius or ulna fracture or dislocation
146	Fracture treatment including reposition with or without fixation; hip or femur fracture or dislocation
147	Fracture treatment including reposition with or without fixation; lower extremity fracture or dislocation (other than hip or femur)

Procedure Category/ICD-10-PCS Codes	Description
148	Fracture treatment including reposition with or without fixation of other fracture or dislocation
150	Division or release of joint capsule; ligament or cartilage
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
157	Amputation of lower extremity
158	Spinal fusion
160	Other therapeutic procedures on muscles and tendons
161	Other OR therapeutic procedures on bone
162	Other OR therapeutic procedures on joints
164	Other OR therapeutic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
172	Skin graft
175	Other OR therapeutic procedures on skin subcutaneous tissue fascia and breast
176	Organ transplantation (other than bone marrow corneal or kidney)
<b>ICD-10-PCS Codes</b>	
0C9030Z	Drainage of Upper Lip with Drainage Device, Percutaneous Approach
0C903ZZ	Drainage of Upper Lip, Percutaneous Approach
0C9130Z	Drainage of Lower Lip with Drainage Device, Percutaneous Approach
0C913ZZ	Drainage of Lower Lip, Percutaneous Approach
0C9230Z	Drainage of Hard Palate with Drainage Device, Percutaneous Approach
0C923ZZ	Drainage of Hard Palate, Percutaneous Approach
0C9330Z	Drainage of Soft Palate with Drainage Device, Percutaneous Approach
0C933ZZ	Drainage of Soft Palate, Percutaneous Approach
0C9430Z	Drainage of Buccal Mucosa with Drainage Device, Percutaneous Approach
0C943ZZ	Drainage of Buccal Mucosa, Percutaneous Approach
0C9730Z	Drainage of Tongue with Drainage Device, Percutaneous Approach
0C973ZZ	Drainage of Tongue, Percutaneous Approach
0C9M30Z	Drainage of Pharynx with Drainage Device, Percutaneous Approach
0C9M3ZZ	Drainage of Pharynx, Percutaneous Approach
0C9N30Z	Drainage of Uvula with Drainage Device, Percutaneous Approach
0C9N3ZZ	Drainage of Uvula, Percutaneous Approach
0C9P30Z	Drainage of Tonsils with Drainage Device, Percutaneous Approach
0C9P3ZZ	Drainage of Tonsils, Percutaneous Approach
0C9Q30Z	Drainage of Adenoids with Drainage Device, Percutaneous Approach
0C9Q3ZZ	Drainage of Adenoids, Percutaneous Approach
0C9R30Z	Drainage of Epiglottis with Drainage Device, Percutaneous Approach
0C9R3ZZ	Drainage of Epiglottis, Percutaneous Approach
0C9S30Z	Drainage of Larynx with Drainage Device, Percutaneous Approach
0C9S3ZZ	Drainage of Larynx, Percutaneous Approach
0C9T30Z	Drainage of Right Vocal Cord with Drainage Device, Percutaneous Approach
0C9T3ZZ	Drainage of Right Vocal Cord, Percutaneous Approach
0C9V30Z	Drainage of Left Vocal Cord with Drainage Device, Percutaneous Approach
0C9V3ZZ	Drainage of Left Vocal Cord, Percutaneous Approach
0CPS70Z	Removal of Drainage Device from Larynx, Via Natural or Artificial Opening
0CPS7DZ	Removal of Intraluminal Device from Larynx, Via Natural or Artificial Opening
0CPS80Z	Removal of Drainage Device from Larynx, Via Natural or Artificial Opening Endoscopic

Procedure Category/ICD-10-PCS Codes	Description
0CPS8DZ	Removal of Intraluminal Device from Larynx, Via Natural or Artificial Opening Endoscopic
0MPX30Z	Removal of Drainage Device from Upper Bursa and Ligament, Percutaneous Approach
0MPY30Z	Removal of Drainage Device from Lower Bursa and Ligament, Percutaneous Approach
0N9030Z	Drainage of Skull with Drainage Device, Percutaneous Approach
0N903ZZ	Drainage of Skull, Percutaneous Approach
0N9130Z	Drainage of Right Frontal Bone with Drainage Device, Percutaneous Approach
0N913ZZ	Drainage of Right Frontal Bone, Percutaneous Approach
0N9230Z	Drainage of Left Frontal Bone with Drainage Device, Percutaneous Approach
0N923ZZ	Drainage of Left Frontal Bone, Percutaneous Approach
0N9330Z	Drainage of Right Parietal Bone with Drainage Device, Percutaneous Approach
0N933ZZ	Drainage of Right Parietal Bone, Percutaneous Approach
0N9430Z	Drainage of Left Parietal Bone with Drainage Device, Percutaneous Approach
0N943ZZ	Drainage of Left Parietal Bone, Percutaneous Approach
0N9530Z	Drainage of Right Temporal Bone with Drainage Device, Percutaneous Approach
0N953ZZ	Drainage of Right Temporal Bone, Percutaneous Approach
0N9630Z	Drainage of Left Temporal Bone with Drainage Device, Percutaneous Approach
0N963ZZ	Drainage of Left Temporal Bone, Percutaneous Approach
0N9730Z	Drainage of Right Occipital Bone with Drainage Device, Percutaneous Approach
0N973ZZ	Drainage of Right Occipital Bone, Percutaneous Approach
0N9830Z	Drainage of Left Occipital Bone with Drainage Device, Percutaneous Approach
0N983ZZ	Drainage of Left Occipital Bone, Percutaneous Approach
0N9C30Z	Drainage of Right Sphenoid Bone with Drainage Device, Percutaneous Approach
0N9C3ZZ	Drainage of Right Sphenoid Bone, Percutaneous Approach
0N9D30Z	Drainage of Left Sphenoid Bone with Drainage Device, Percutaneous Approach
0N9D3ZZ	Drainage of Left Sphenoid Bone, Percutaneous Approach
0N9F30Z	Drainage of Right Ethmoid Bone with Drainage Device, Percutaneous Approach
0N9F3ZZ	Drainage of Right Ethmoid Bone, Percutaneous Approach
0N9G30Z	Drainage of Left Ethmoid Bone with Drainage Device, Percutaneous Approach
0N9G3ZZ	Drainage of Left Ethmoid Bone, Percutaneous Approach
0N9H30Z	Drainage of Right Lacrimal Bone with Drainage Device, Percutaneous Approach
0N9H3ZZ	Drainage of Right Lacrimal Bone, Percutaneous Approach
0N9J30Z	Drainage of Left Lacrimal Bone with Drainage Device, Percutaneous Approach
0N9J3ZZ	Drainage of Left Lacrimal Bone, Percutaneous Approach
0N9K30Z	Drainage of Right Palatine Bone with Drainage Device, Percutaneous Approach
0N9K3ZZ	Drainage of Right Palatine Bone, Percutaneous Approach
0N9L30Z	Drainage of Left Palatine Bone with Drainage Device, Percutaneous Approach
0N9L3ZZ	Drainage of Left Palatine Bone, Percutaneous Approach
0N9M30Z	Drainage of Right Zygomatic Bone with Drainage Device, Percutaneous Approach
0N9M3ZZ	Drainage of Right Zygomatic Bone, Percutaneous Approach
0N9N30Z	Drainage of Left Zygomatic Bone with Drainage Device, Percutaneous Approach
0N9N3ZZ	Drainage of Left Zygomatic Bone, Percutaneous Approach
0N9P30Z	Drainage of Right Orbit with Drainage Device, Percutaneous Approach
0N9P3ZZ	Drainage of Right Orbit, Percutaneous Approach
0N9Q30Z	Drainage of Left Orbit with Drainage Device, Percutaneous Approach
0N9Q3ZZ	Drainage of Left Orbit, Percutaneous Approach
0N9X30Z	Drainage of Hyoid Bone with Drainage Device, Percutaneous Approach
0N9X3ZZ	Drainage of Hyoid Bone, Percutaneous Approach
0NH005Z	Insertion of External Fixation Device into Skull, Open Approach



Procedure Category/ICD-10-PCS Codes	Description
ONH035Z	Insertion of External Fixation Device into Skull, Percutaneous Approach
ONH045Z	Insertion of External Fixation Device into Skull, Percutaneous Endoscopic Approach
OP9030Z	Drainage of Sternum with Drainage Device, Percutaneous Approach
OP903ZZ	Drainage of Sternum, Percutaneous Approach
OP9130Z	Drainage of Right Rib with Drainage Device, Percutaneous Approach
OP913ZZ	Drainage of Right Rib, Percutaneous Approach
OP9230Z	Drainage of Left Rib with Drainage Device, Percutaneous Approach
OP923ZZ	Drainage of Left Rib, Percutaneous Approach
OP9330Z	Drainage of Cervical Vertebra with Drainage Device, Percutaneous Approach
OP933ZZ	Drainage of Cervical Vertebra, Percutaneous Approach
OP9430Z	Drainage of Thoracic Vertebra with Drainage Device, Percutaneous Approach
OP943ZZ	Drainage of Thoracic Vertebra, Percutaneous Approach
OP9530Z	Drainage of Right Scapula with Drainage Device, Percutaneous Approach
OP953ZZ	Drainage of Right Scapula, Percutaneous Approach
OP9630Z	Drainage of Left Scapula with Drainage Device, Percutaneous Approach
OP963ZZ	Drainage of Left Scapula, Percutaneous Approach
OP9730Z	Drainage of Right Glenoid Cavity with Drainage Device, Percutaneous Approach
OP973ZZ	Drainage of Right Glenoid Cavity, Percutaneous Approach
OP9830Z	Drainage of Left Glenoid Cavity with Drainage Device, Percutaneous Approach
OP983ZZ	Drainage of Left Glenoid Cavity, Percutaneous Approach
OP9930Z	Drainage of Right Clavicle with Drainage Device, Percutaneous Approach
OP993ZZ	Drainage of Right Clavicle, Percutaneous Approach
OP9B30Z	Drainage of Left Clavicle with Drainage Device, Percutaneous Approach
OP9B3ZZ	Drainage of Left Clavicle, Percutaneous Approach
OP9C30Z	Drainage of Right Humeral Head with Drainage Device, Percutaneous Approach
OP9C3ZZ	Drainage of Right Humeral Head, Percutaneous Approach
OP9D30Z	Drainage of Left Humeral Head with Drainage Device, Percutaneous Approach
OP9D3ZZ	Drainage of Left Humeral Head, Percutaneous Approach
OP9F30Z	Drainage of Right Humeral Shaft with Drainage Device, Percutaneous Approach
OP9F3ZZ	Drainage of Right Humeral Shaft, Percutaneous Approach
OP9G30Z	Drainage of Left Humeral Shaft with Drainage Device, Percutaneous Approach
OP9G3ZZ	Drainage of Left Humeral Shaft, Percutaneous Approach
OP9H30Z	Drainage of Right Radius with Drainage Device, Percutaneous Approach
OP9H3ZZ	Drainage of Right Radius, Percutaneous Approach
OP9J30Z	Drainage of Left Radius with Drainage Device, Percutaneous Approach
OP9J3ZZ	Drainage of Left Radius, Percutaneous Approach
OP9K30Z	Drainage of Right Ulna with Drainage Device, Percutaneous Approach
OP9K3ZZ	Drainage of Right Ulna, Percutaneous Approach
OP9L30Z	Drainage of Left Ulna with Drainage Device, Percutaneous Approach
OP9L3ZZ	Drainage of Left Ulna, Percutaneous Approach
OP9M30Z	Drainage of Right Carpal with Drainage Device, Percutaneous Approach
OP9M3ZZ	Drainage of Right Carpal, Percutaneous Approach
OP9N30Z	Drainage of Left Carpal with Drainage Device, Percutaneous Approach
OP9N3ZZ	Drainage of Left Carpal, Percutaneous Approach
OP9P30Z	Drainage of Right Metacarpal with Drainage Device, Percutaneous Approach
OP9P3ZZ	Drainage of Right Metacarpal, Percutaneous Approach
OP9Q30Z	Drainage of Left Metacarpal with Drainage Device, Percutaneous Approach
OP9Q3ZZ	Drainage of Left Metacarpal, Percutaneous Approach



Procedure Category/ICD-10-PCS Codes	Description
0P9R30Z	Drainage of Right Thumb Phalanx with Drainage Device, Percutaneous Approach
0P9R3ZZ	Drainage of Right Thumb Phalanx, Percutaneous Approach
0P9S30Z	Drainage of Left Thumb Phalanx with Drainage Device, Percutaneous Approach
0P9S3ZZ	Drainage of Left Thumb Phalanx, Percutaneous Approach
0P9T30Z	Drainage of Right Finger Phalanx with Drainage Device, Percutaneous Approach
0P9T3ZZ	Drainage of Right Finger Phalanx, Percutaneous Approach
0P9V30Z	Drainage of Left Finger Phalanx with Drainage Device, Percutaneous Approach
0P9V3ZZ	Drainage of Left Finger Phalanx, Percutaneous Approach
0PPY30Z	Removal of Drainage Device from Upper Bone, Percutaneous Approach
0Q9030Z	Drainage of Lumbar Vertebra with Drainage Device, Percutaneous Approach
0Q903ZZ	Drainage of Lumbar Vertebra, Percutaneous Approach
0Q9130Z	Drainage of Sacrum with Drainage Device, Percutaneous Approach
0Q913ZZ	Drainage of Sacrum, Percutaneous Approach
0Q9230Z	Drainage of Right Pelvic Bone with Drainage Device, Percutaneous Approach
0Q923ZZ	Drainage of Right Pelvic Bone, Percutaneous Approach
0Q9330Z	Drainage of Left Pelvic Bone with Drainage Device, Percutaneous Approach
0Q933ZZ	Drainage of Left Pelvic Bone, Percutaneous Approach
0Q9430Z	Drainage of Right Acetabulum with Drainage Device, Percutaneous Approach
0Q943ZZ	Drainage of Right Acetabulum, Percutaneous Approach
0Q9530Z	Drainage of Left Acetabulum with Drainage Device, Percutaneous Approach
0Q953ZZ	Drainage of Left Acetabulum, Percutaneous Approach
0Q9630Z	Drainage of Right Upper Femur with Drainage Device, Percutaneous Approach
0Q963ZZ	Drainage of Right Upper Femur, Percutaneous Approach
0Q9730Z	Drainage of Left Upper Femur with Drainage Device, Percutaneous Approach
0Q973ZZ	Drainage of Left Upper Femur, Percutaneous Approach
0Q9830Z	Drainage of Right Femoral Shaft with Drainage Device, Percutaneous Approach
0Q983ZZ	Drainage of Right Femoral Shaft, Percutaneous Approach
0Q9930Z	Drainage of Left Femoral Shaft with Drainage Device, Percutaneous Approach
0Q993ZZ	Drainage of Left Femoral Shaft, Percutaneous Approach
0Q9B30Z	Drainage of Right Lower Femur with Drainage Device, Percutaneous Approach
0Q9B3ZZ	Drainage of Right Lower Femur, Percutaneous Approach
0Q9C30Z	Drainage of Left Lower Femur with Drainage Device, Percutaneous Approach
0Q9C3ZZ	Drainage of Left Lower Femur, Percutaneous Approach
0Q9D30Z	Drainage of Right Patella with Drainage Device, Percutaneous Approach
0Q9D3ZZ	Drainage of Right Patella, Percutaneous Approach
0Q9F30Z	Drainage of Left Patella with Drainage Device, Percutaneous Approach
0Q9F3ZZ	Drainage of Left Patella, Percutaneous Approach
0Q9G30Z	Drainage of Right Tibia with Drainage Device, Percutaneous Approach
0Q9G3ZZ	Drainage of Right Tibia, Percutaneous Approach
0Q9H30Z	Drainage of Left Tibia with Drainage Device, Percutaneous Approach
0Q9H3ZZ	Drainage of Left Tibia, Percutaneous Approach
0Q9J30Z	Drainage of Right Fibula with Drainage Device, Percutaneous Approach
0Q9J3ZZ	Drainage of Right Fibula, Percutaneous Approach
0Q9K30Z	Drainage of Left Fibula with Drainage Device, Percutaneous Approach
0Q9K3ZZ	Drainage of Left Fibula, Percutaneous Approach
0Q9L30Z	Drainage of Right Tarsal with Drainage Device, Percutaneous Approach
0Q9L3ZZ	Drainage of Right Tarsal, Percutaneous Approach
0Q9M30Z	Drainage of Left Tarsal with Drainage Device, Percutaneous Approach

Procedure Category/ICD-10-PCS Codes	Description
0Q9M3ZZ	Drainage of Left Tarsal, Percutaneous Approach
0Q9N30Z	Drainage of Right Metatarsal with Drainage Device, Percutaneous Approach
0Q9N3ZZ	Drainage of Right Metatarsal, Percutaneous Approach
0Q9P30Z	Drainage of Left Metatarsal with Drainage Device, Percutaneous Approach
0Q9P3ZZ	Drainage of Left Metatarsal, Percutaneous Approach
0Q9Q30Z	Drainage of Right Toe Phalanx with Drainage Device, Percutaneous Approach
0Q9Q3ZZ	Drainage of Right Toe Phalanx, Percutaneous Approach
0Q9R30Z	Drainage of Left Toe Phalanx with Drainage Device, Percutaneous Approach
0Q9R3ZZ	Drainage of Left Toe Phalanx, Percutaneous Approach
0Q9S30Z	Drainage of Coccyx with Drainage Device, Percutaneous Approach
0Q9S3ZZ	Drainage of Coccyx, Percutaneous Approach
0QPY30Z	Removal of Drainage Device from Lower Bone, Percutaneous Approach
0W9230Z	Drainage of Face with Drainage Device, Percutaneous Approach
0W923ZZ	Drainage of Face, Percutaneous Approach
0W9330Z	Drainage of Oral Cavity and Throat with Drainage Device, Percutaneous Approach
0W933ZZ	Drainage of Oral Cavity and Throat, Percutaneous Approach
0W9430Z	Drainage of Upper Jaw with Drainage Device, Percutaneous Approach
0W943ZZ	Drainage of Upper Jaw, Percutaneous Approach
0W9530Z	Drainage of Lower Jaw with Drainage Device, Percutaneous Approach
0W953ZZ	Drainage of Lower Jaw, Percutaneous Approach
0W9630Z	Drainage of Neck with Drainage Device, Percutaneous Approach
0W963ZZ	Drainage of Neck, Percutaneous Approach

**Table D.3 - Cancer Discharge Diagnosis Categories Excluded from the Measure for Admissions Not Included in the Surgical Cohort**

AHRQ CCS Diagnosis	Description
11	Cancer of head and neck
12	Cancer of esophagus
13	Cancer of stomach
14	Cancer of colon
15	Cancer of rectum and anus
16	Cancer of liver and intrahepatic bile duct
17	Cancer of pancreas
18	Cancer of other GI organs; peritoneum
19	Cancer of bronchus; lung
20	Cancer; other respiratory and intrathoracic
21	Cancer of bone and connective tissue
22	Melanomas of skin
23	Other non-epithelial cancer of skin
24	Cancer of breast
25	Cancer of uterus
26	Cancer of cervix
27	Cancer of ovary
28	Cancer of other female genital organs
29	Cancer of prostate
30	Cancer of testis

AHRQ CCS Diagnosis	Description
31	Cancer of other male genital organs
32	Cancer of bladder
33	Cancer of kidney and renal pelvis
34	Cancer of other urinary organs
35	Cancer of brain and nervous system
36	Cancer of thyroid
37	Hodgkin's disease
38	Non-Hodgkin's lymphoma
39	Leukemias
40	Multiple myeloma
41	Cancer; other and unspecified primary
42	Secondary malignancies
43	Malignant neoplasm without specification of site
44	Neoplasms of unspecified nature or uncertain behavior
45	Maintenance chemotherapy; radiotherapy

**Table D.4 – Diagnosis Categories Defining the Cardiorespiratory Cohort**

AHRQ CCS Diagnosis	Description
56	Cystic fibrosis
103	Pulmonary heart disease
108	Congestive heart failure; nonhypertensive
122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
125	Acute bronchitis
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
131	Respiratory failure; insufficiency; arrest (adult)

**Table D.5 – Diagnosis Categories Defining the Cardiovascular Cohort**

AHRQ CCS Diagnosis	Description
96	Heart valve disorders
97	Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease)
100	Acute myocardial infarction
101	Coronary atherosclerosis and other heart disease
102	Nonspecific chest pain
104	Other and ill-defined heart disease
105	Conduction disorders
106	Cardiac dysrhythmias
107	Cardiac arrest and ventricular fibrillation
114	Peripheral and visceral atherosclerosis
115	Aortic; peripheral; and visceral artery aneurysms
116	Aortic and peripheral arterial embolism or thrombosis
117	Other circulatory disease
213	Cardiac and circulatory congenital anomalies

**Table D.6 – Diagnosis Categories Defining the Neurology Cohort**

AHRQ CCS Diagnosis	Description
78	Other CNS infection and poliomyelitis
79	Parkinson's disease
80	Multiple sclerosis
81	Other hereditary and degenerative nervous system conditions
82	Paralysis
83	Epilepsy; convulsions
85	Coma; stupor; and brain damage
95	Other nervous system disorders
109	Acute cerebrovascular disease
110	Occlusion or stenosis of precerebral arteries
111	Other and ill-defined cerebrovascular disease
112	Transient cerebral ischemia
113	Late effects of cerebrovascular disease
216	Nervous system congenital anomalies
227	Spinal cord injury
233	Intracranial injury

**Table D.7 – Diagnosis Categories Defining the Medicine Cohort**

AHRQ CCS Diagnosis	Description
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
6	Hepatitis
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
10	Immunizations and screening for infectious disease
46	Benign neoplasm of uterus
47	Other and unspecified benign neoplasm
48	Thyroid disorders
49	Diabetes mellitus without complication
50	Diabetes mellitus with complications
51	Other endocrine disorders
52	Nutritional deficiencies
53	Disorders of lipid metabolism
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
57	Immunity disorders
58	Other nutritional; endocrine; and metabolic disorders
59	Deficiency and other anemia
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
62	Coagulation and hemorrhagic disorders

AHRQ CCS Diagnosis	Description
63	Diseases of white blood cells
64	Other hematologic conditions
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
84	Headache; including migraine
86	Cataract
87	Retinal detachments; defects; vascular occlusion; and retinopathy
88	Glaucoma
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
94	Other ear and sense organ disorders
98	Essential hypertension
99	Hypertension with complications and secondary hypertension
118	Phlebitis; thrombophlebitis and thromboembolism
119	Varicose veins of lower extremity
120	Hemorrhoids
121	Other diseases of veins and lymphatics
123	Influenza
124	Acute and chronic tonsillitis
126	Other upper respiratory infections
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
132	Lung disease due to external agents
133	Other lower respiratory disease
134	Other upper respiratory disease
135	Intestinal infection
136	Disorders of teeth and jaw
137	Diseases of mouth; excluding dental
138	Esophageal disorders
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
141	Other disorders of stomach and duodenum
142	Appendicitis and other appendiceal conditions
143	Abdominal hernia
144	Regional enteritis and ulcerative colitis
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
147	Anal and rectal conditions
148	Peritonitis and intestinal abscess
149	Biliary tract disease
151	Other liver diseases
152	Pancreatic disorders (not diabetes)
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
155	Other gastrointestinal disorders

AHRQ CCS Diagnosis	Description
156	Nephritis; nephrosis; renal sclerosis
157	Acute and unspecified renal failure
158	Chronic kidney disease
159	Urinary tract infections
160	Calculus of urinary tract
161	Other diseases of kidney and ureters
162	Other diseases of bladder and urethra
163	Genitourinary symptoms and ill-defined conditions
164	Hyperplasia of prostate
165	Inflammatory conditions of male genital organs
166	Other male genital disorders
167	Nonmalignant breast conditions
168	Inflammatory diseases of female pelvic organs
169	Endometriosis
170	Prolapse of female genital organs
171	Menstrual disorders
172	Ovarian cyst
173	Menopausal disorders
175	Other female genital disorders
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
199	Chronic ulcer of skin
200	Other skin disorders
201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease)
202	Rheumatoid arthritis and related disease
203	Osteoarthritis
204	Other non-traumatic joint disorders
205	Spondylosis; intervertebral disc disorders; other back problems
206	Osteoporosis
207	Pathological fracture
208	Acquired foot deformities
209	Other acquired deformities
210	Systemic lupus erythematosus and connective tissue disorders
211	Other connective tissue disease
212	Other bone disease and musculoskeletal deformities
214	Digestive congenital anomalies
215	Genitourinary congenital anomalies
217	Other congenital anomalies
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
231	Other fractures
232	Sprains and strains
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
236	Open wounds of extremities

AHRQ CCS Diagnosis	Description
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
248	Gangrene
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
255	Administrative/social admission
256	Medical examination/evaluation
257	Other aftercare
258	Other screening for suspected conditions (not mental disorders or infectious disease)
259	Residual codes; unclassified
653	Delirium dementia and amnestic and other cognitive disorders
660	Alcohol-related disorders
661	Substance-related disorders
663	Screening and history of mental health and substance abuse codes
2617	Adverse effects of medical drugs

## **Risk Adjustment**

The CCs outlined in [Table D.8](#) below are used to identify risk variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015.

**Table D.8 – Comorbidity Risk Variables Common to All HWR Specialty Cohorts**

Description of Risk Variable	CCs and/or ICD Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by “X”)
Age minus 65 (years above 65, continuous)	n/a	
Severe infection (CC 1, 3-6)	HIV/AIDS (CC 1)	
	Bacterial, fungal, and parasitic central nervous system infections (CC 3)	
	Viral and late effects central nervous system infections (CC 4)	
	Tuberculosis (CC 5)	
	Opportunistic infections (CC 6)	
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	X
Other infectious diseases and pneumonias (CC 7, 114-116)	Other infectious diseases (CC 7)	X
	Aspiration and specified bacterial pneumonias (CC 114)	X
	Pneumococcal pneumonia, empyema, lung abscess (CC 115)	X
	Viral and unspecified pneumonia, pleurisy (CC 116)	
Metastatic cancer and acute leukemia (CC 8)	Metastatic cancer and acute leukemia (CC 8)	
Severe cancer (CC 9-10)	Lung and other severe cancers (CC 9)	
	Lymphoma and other cancers (CC 10)	
Other cancers (CC 11-14)	Colorectal, bladder, and other cancers (CC 11)	
	Breast, prostate, and other cancers and tumors (CC 12)	
	Other respiratory and heart neoplasms (CC 13)	
	Other digestive and urinary neoplasms (CC 14)	
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	Diabetes with acute complications (CC 17)	X
	Diabetes with chronic complications (CC 18)	
	Diabetes without complications (CC 19)	
	Proliferative diabetic retinopathy and vitreous hemorrhage (CC 122)	
	Diabetic and other vascular retinopathies (CC 123)	
Protein-calorie malnutrition (CC 21)	Protein-calorie malnutrition (CC 21)	
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	Other significant endocrine and metabolic disorders (CC 23)	
	Disorders of fluid/electrolyte/acid-base balance (CC 24)	X
End-stage liver disease; cirrhosis of liver (CC 27-28)	End-stage liver disease (CC 27)	
	Cirrhosis of liver (CC 28)	
Pancreatic disease; peptic ulcer, hemorrhage, other specified	Chronic pancreatitis (CC 34)	
	Peptic ulcer, hemorrhage, other specified	X



Description of Risk Variable	CCs and/or ICD Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by "X")
gastrointestinal disorders (CC 34, 36)	gastrointestinal disorders (CC 36)	
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	
Severe hematological disorders (CC 46)	Severe hematological disorders (CC 46)	
Coagulation defects and other specified hematological disorders (CC 48)	Coagulation defects and other specified hematological disorders (CC 48)	X
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	Iron deficiency or other/unspecified anemias and blood disease (CC 49)	
Drug/alcohol psychosis or dependence (CC 54-55)	Drug/alcohol psychosis (CC 54)	
	Drug/alcohol dependence (CC 55)	
Psychiatric comorbidity (CC 57-59, 61, 63)	Schizophrenia (CC 57)	
	Major depressive, bipolar, and paranoid disorders (CC 58)	
	Reactive and unspecified psychosis (CC 59)	
	Depression (CC 61)	
	Other psychiatric disorders (CC 63)	
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	Quadriplegia (CC 70)	
	Paraplegia (CC 71)	
	Spinal cord disorders/injuries (CC 72)	
	Amyotrophic lateral sclerosis and other motor neuron disease (CC 73)	
	Cerebral palsy (CC 74)	
	Hemiplegia/hemiparesis (CC 103)	X
	Monoplegia, other paralytic syndromes (CC 104)	X
	Amputation status, lower limb/amputation complications (CC 189)	X
	Amputation status, upper limb (CC 190)	X
Seizure disorders and convulsions (CC 79)	Seizure disorders and convulsions (CC 79)	
Respirator dependence/tracheostomy status (CC 82)	Respirator dependence/tracheostomy status (CC 82)	X
Cardio-respiratory failure and shock	Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM codes 799.01 and 799.02, for discharges prior to October 1, 2015)	X
Congestive heart failure (CC 85)	Congestive heart failure (CC 85)	X
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	Acute myocardial infarction (CC 86)	X
	Unstable angina and other acute ischemic heart disease (CC 87)	X
	Angina pectoris (CC 88)	
	Coronary atherosclerosis/other chronic ischemic heart disease (CC 89)	
	Cerebrovascular atherosclerosis, aneurysm, and other disease (CC 102)	

Description of Risk Variable	CCs and/or ICD Codes Included	Variables Not Used in Risk Adjustment if Occurred Only during Index Admission (indicated by "X")
	Late effects of cerebrovascular disease, except paralysis (CC 105)	
	Atherosclerosis of the extremities with ulceration or gangrene (CC 106)	X
	Vascular disease with complications (CC 107)	X
	Vascular disease (CC 108)	X
	Other circulatory disease (CC 109)	X
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	Specified heart arrhythmias (CC 96)	X
	Other heart rhythm and conduction disorders (CC 97)	X
Chronic obstructive pulmonary disease (COPD) (CC 111)	Chronic obstructive pulmonary disease (COPD) (CC 111)	
Fibrosis of lung or other chronic lung disorders (CC 112)	Fibrosis of lung or other chronic lung disorders (CC 112)	
Transplants (CC 132, 186)	Kidney transplant status (CC 132)	
	Major organ transplant or replacement status (CC 186)	X
Dialysis status (CC 134)	Dialysis status (CC 134)	X
Renal failure (CC 135-140)	Acute renal failure (CC 135)	X
	Chronic kidney disease, stage 5 (CC 136)	
	Chronic kidney disease, severe (stage 4) (CC 137)	
	Chronic kidney disease, moderate (stage 3) (CC 138)	
	Chronic kidney disease, mild or unspecified (stages 1-2 or unspecified) (CC 139)	
	Unspecified renal failure (CC 140)	X
Decubitus ulcer or chronic skin ulcer (CC 157-161)	Pressure ulcer of skin with necrosis through to muscle, tendon, or bone (CC 157)	X
	Pressure ulcer of skin with full thickness skin loss (CC 158)	X
	Pressure ulcer of skin with partial thickness skin loss (CC 159)	X
	Pressure pre-ulcer skin changes or unspecified stage (CC 160)	X
	Chronic ulcer of skin, except pressure (CC 161)	
Hip fracture/dislocation (CC 170)	Hip fracture/dislocation (CC 170)	X

## **Outcome**

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

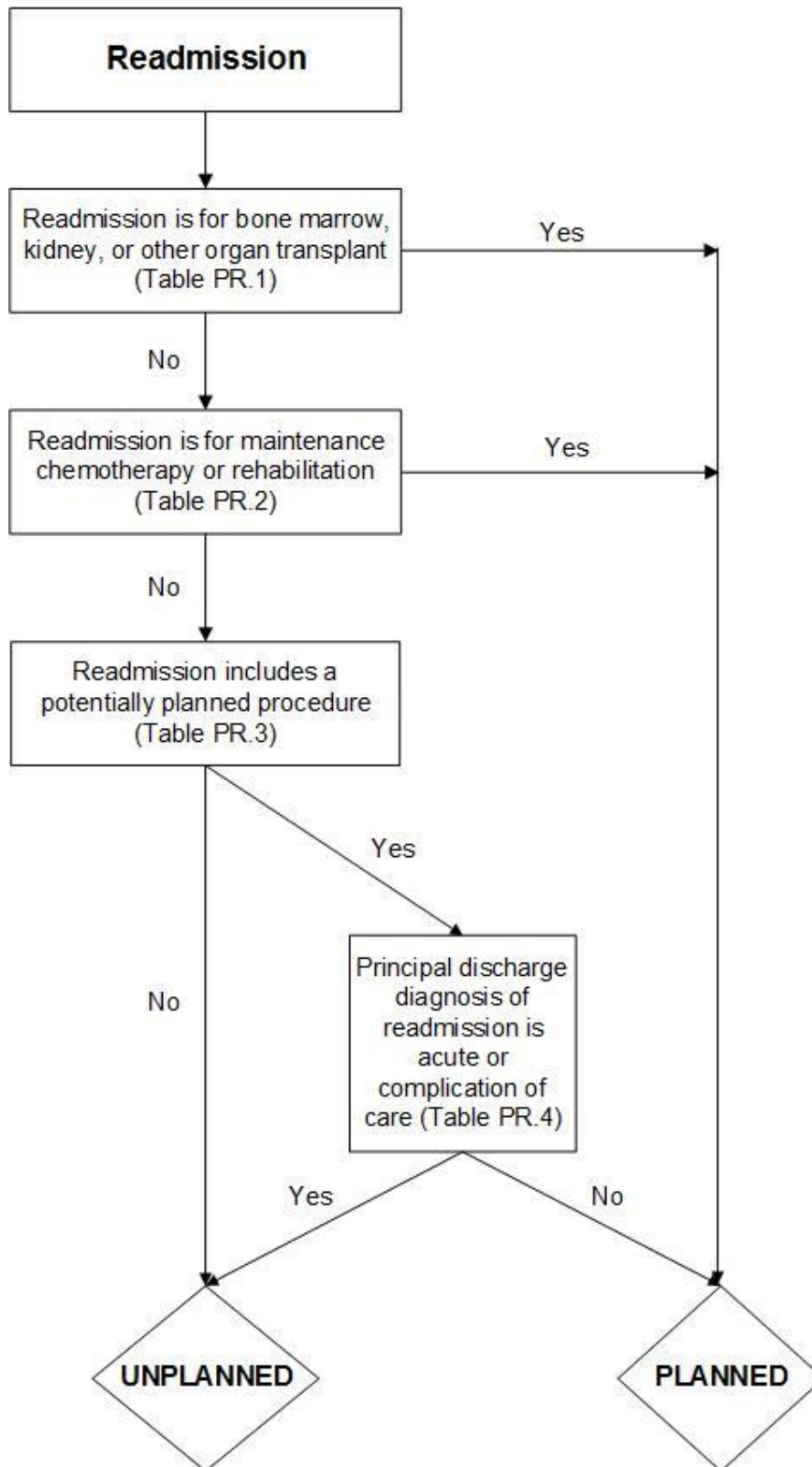
**Unplanned readmission, from any cause, within 30 days from the date of discharge from an index admission.**

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.

## Appendix E. Planned Readmission Algorithm

Figure PR.1 - Planned Readmission Algorithm Version 4.0 2018 (ICD-10) Flowchart



## Planned Readmission Algorithm Version 4.0 2018 (ICD-10) Tables – HWR Measure

Note that the singular ICD-10 codes described in [Tables PR.3](#) and [PR.4](#) are listed in the supplemental Excel file on [QualityNet](#); hyperlinks to these lists are provided in the tables.

**Table PR.1 - Procedure Categories That Are Always Planned (Version 4.0 2018 [ICD-10])**

AHRQ CCS Procedure	Description
64	Bone marrow transplant
105	Kidney transplant
176	Other organ transplantation (other than bone marrow corneal or kidney)

**Table PR.2 – Diagnosis Categories That Are Always Planned (Version 4.0 2018 [ICD-10])**

AHRQ CCS Diagnosis	Description
45	Maintenance chemotherapy; radiotherapy
254	Rehabilitation care; fitting of prostheses; and adjustment of devices

**Table PR.3 – Potentially Planned Procedures (Version 4.0 2018 [ICD-10])**

Procedure Category/ICD-10-PCS Codes	Description
<b>AHRQ CCS Procedure Categories</b>	
1	Incision and excision of CNS
3	Excision destruction or resection of intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal canal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Therapeutic endocrine procedures
33	Other OR procedures on mouth and throat
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures on the respiratory system and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA) with or without stent placement
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
55	Peripheral vascular bypass
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
66	Procedures on spleen
67	Other procedures; hemic and lymphatic systems
74	Gastrectomy; partial and total
78	Colorectal resection
79	Excision (partial) of large intestine (not endoscopic)
84	Cholecystectomy and common duct exploration

Procedure Category/ICD-10-PCS Codes	Description
85	Inguinal and femoral hernia repair
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault
132	Other OR therapeutic procedures; female organs
142	Partial excision bone
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
172	Skin graft
175	Other OR therapeutic procedures on skin subcutaneous tissue fascia and breast
ICD-10-PCS Codes - <a href="#">ICD-10-PCS code list</a> posted on <i>QualityNet</i>	

**Table PR.4 – Acute Diagnoses (Version 4.0 2018 [ICD-10])**

Diagnosis Category/ICD-10-CM Codes	Description
<b>AHRQ CCS Diagnosis Categories</b>	
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis

Diagnosis Category/ICD-10-CM Codes	Description
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
99	Hypertension with complications and secondary hypertension
102	Nonspecific chest pain
104	Other and ill-defined heart disease
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
226	Fracture of neck of femur (hip)
227	Spinal cord injury
229	Fracture of upper limb

Diagnosis Category/ICD-10-CM Codes	Description
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit conduct and disruptive behavior disorders
653	Delirium dementia and amnestic and other cognitive disorders
656	Impulse control disorders NEC
658	Personality disorders
660	Alcohol-related disorders
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous mental health disorders
ICD-10-CM Codes - <a href="#">ICD-10-CM code list</a> posted on <i>QualityNet</i>	