2017 All-Cause Hospital-Wide Measure Updates and Specifications Report

Hospital-Level 30-Day Risk-Standardized Readmission Measure – Version 6.0

Submitted By:

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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*. 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 2017 public reporting, and the national results for 2017 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 - 2017 measure updates**

- **Section 4 - 2017 measure results**

- **Section 5 - Glossary**

The Appendices contain detailed measure information, consisting of:

- Appendix A: Statistical approach to calculating risk-standardized readmission rates (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.

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 of *QualityNet*.[1-5]

The measure methodology is also described in the peer-reviewed medical literature.[6,7]

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

2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

2.1 Background on 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 on *Hospital Compare*, which CMS updates annually.

CMS contracted with the Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE) to update the HWR measure for 2017 public reporting through a process of measure reevaluation. Measures are reevaluated annually in order to improve them by responding to stakeholder input and incorporating advances in science or changes in coding.

2.2 Overview of Measure Methodology

The 2017 risk-adjusted 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.[1-5] 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 for discharges on or after October 1, 2015. AHRQ CCS diagnosis and procedure category lists for discharges prior to October 1, 2015 can be found in the 2016 hospital-wide readmission measures updates and specifications report posted on *QualityNet*.

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 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.

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.

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 count a readmission as a new index admission within the same measure.

See Table D.1 and Table D.3 in Appendix D for specific AHRQ CCS diagnosis categories excluded from the measure in claims for discharges on or after October 1, 2015. AHRQ CCS diagnosis category lists for discharges prior to October 1, 2015 can be found in the 2016 hospital-wide readmission measures updates and specifications report posted on *QualityNet*. The percentage of admissions excluded based on each criterion is shown in Section 4 in Figure 4.2.1.

Patients Transferred between Hospitals

The measure considers multiple contiguous hospitalizations as a single acute episode of care. Transfer patients are identified by tracking claims for inpatient short-term acute care hospitalizations over time. Admissions to a hospital within one day of discharge from another hospital are considered transfers regardless of whether or not the first institution indicates intent to transfer the patient in the discharge disposition code, and regardless of principal discharge diagnosis.

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 transfer chain 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. Admissions with an eligible surgical procedure category 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 issues 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 as unrelated to the care 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 condition 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.[8] 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.[9]

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

Multiple Readmissions

If a patient has more than one unplanned admission within 30 days of discharge from the index admission, only the first is considered a readmission. The 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 [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 and discharge diagnosis categories to classify readmissions as planned (Appendix E). As illustrated in Figure PR.1, readmissions are considered planned if any of the following occurs during the readmission:

1. A procedure is performed that is in one of the procedure categories that are always planned regardless of diagnosis (Table PR.1);
2. The principal diagnosis is in one of the diagnosis categories that are always planned (Table PR.2); or,

3. A procedure is performed that is one of the potentially planned procedures (Table PR.3) and the principal diagnosis is not in the list of acute discharge diagnoses (Table PR.4).

Note that the ICD-10-based AHRQ CCS categories and the singular ICD-10 codes listed in Tables PR.1 through PR.4 are used to identify planned readmissions in claims for discharges on or after October 1, 2015. ICD-9-based AHRQ CCS categories and singular ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 hospital-wide readmission measures updates and specifications report posted on *QualityNet*.

2.2.4 Risk-Adjustment Variables

In order to account for differences in case mix among hospitals, the 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 that time or in the 12 months prior, and not complications that arise during the course of the hospitalization, are included in the risk adjustment.

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, 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, and including, the index admission.

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. As part of the NQF's endorsement process for this measure, we completed analyses for the two-year Sociodemographic Trial Period. Although univariate analyses found that the patient-level observed (unadjusted) readmission rate is higher for dual-eligible patients (for patients living in lower AHRQ SES Index census block groups) and African-American patients compared with all other patients, analyses in the context of a multivariable model demonstrated that the effect size of these variables was small, and that the c-statistics for the model are similar with and without the addition of these variables.

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 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 ICD-10-CM codes (for discharges on or after October 1, 2015) and ICD-9 codes (for discharges prior to October 1, 2015) are available on the *QualityNet* website.

2.2.5 Data Sources

The data sources for these analyses are Medicare administrative claims and enrollment information for patients with hospitalizations between July 1, 2015 and June 30, 2016. 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.[1]

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.[10] 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.[10] 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 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.[1]

2.2.7 Categorizing Hospital Performance

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

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

If a hospital has fewer than 25 eligible cases for a measure, CMS assigns the hospital to a separate category, "Number of Cases Too Small". This category is used when the number of cases is too small (fewer than 25) to reliably tell how well the hospital is performing. If a hospital has fewer than 25 eligible cases, the hospital's readmission rates and interval estimates will not be publicly reported for the measure.

Section 4.2.4 describes the distribution of hospitals by performance category in the U.S. for this reporting period.

3. UPDATES TO MEASURE FOR 2017 PUBLIC REPORTING

3.1 Rationale for Measure Updates

Annual measure reevaluation ensures that the risk-standardized readmission models are continually assessed and remain valid, given possible changes in clinical practice and coding standards over time. Modifications made to measure specialty cohorts, risk models, and outcomes are informed by review of the most recent literature related to measure conditions or outcomes, feedback from various stakeholders, and empirical analyses including assessment of coding trends that reveal shifts in clinical practice or billing patterns. As this report describes, for 2017 public reporting, we made the following modifications to the measure:

- 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 AHRQ ICD-10 CCS and ICD-10 codes for certain "potentially planned procedures" and "acute diagnoses" to the algorithm specifications, for discharges on or after October 1, 2015.
  - Re-specified the risk model, updating the CC-based risk variables to the ICD-10-compatible Hierarchical Condition Categories (HCC) system version 22 to the model.

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

- Evaluated and validated model performance in the July 2015-June 2016 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-Based Measure Specifications

Measure Re-specification

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

- We expanded the specialty cohort definitions to include ICD-10-based AHRQ CCS categories for use with discharges on or after October 1, 2015. (Previously-specified ICD-9-based AHRQ CCS categories continue to be used for discharges before October 1, 2015.)
- We updated the planned readmission algorithm for use with readmission claims for discharges on or after October 1, 2015:
  - The 2016 version of the AHRQ ICD-10 CCS was applied; and,
  - Certain "potentially planned procedures" and "acute diagnoses" previously defined using ICD-9 codes were re-defined using ICD-10 codes.
- We re-specified the risk models, updating the CC-based risk variables to the ICD-10-compatible HCC system version 22, maintained by RTI International.

Rationale for Measure Re-specification

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

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

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

The ICD-10 Transition Process

In developing the ICD-10-based CCS categories that define the specialty cohorts for the measure and in adopting the AHRQ ICD-10 CCS maps for the planned readmission algorithm, we examined the condition and procedure code maps and created crosswalks. To validate the cohort crosswalks, we compared specialty cohort sizes using ICD-10 codes in a set of claims submitted between October 2015 and March 2016 with cohort sizes using previously-defined ICD-9 codes in a set of claims submitted between October 2014 and March 2015. We then conducted clinical review to identify those AHRQ CCS categories appropriate for the specialty cohorts and planned readmission definitions. Additionally, we examined frequencies of the planned readmission algorithm's "potentially planned procedures" and "acute diagnoses" re-defined using ICD-10 codes.

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

- Experts examined the ICD-9 code-based HCC version 12 and version 22 maps and reviewed shifts that occurred (where an ICD-9 code had moved from one CC to another). Based on these examinations, they recommended new risk variables using version 22 CCs.
- Following re-specification of the risk variables using the HCC version 22 map, we ran risk-adjustment models on several outcome measures, including the HWR measure, to ensure testing of all variables where shifts in the ICD-9 codes included in the CCs had occurred.
- For each tested measure, we used the same claims dataset to calculate and compare two separate sets of measure results using two separate risk-adjustment models: One set using the previously-specified version 12 risk variables, and the

other using the newly-specified version 22 risk variables. For this analysis we used the ICD-9-coded data from the 2016 measurement period.

- We compared the frequencies and model coefficients of the two sets of risk-adjustment variables, to ensure that they were similar.
- We compared the performance of each risk-adjustment model by calculating each model's c-statistic and predictive ability.
- We examined the correlation in the risk-standardized outcome rates produced by the two risk-adjustment models, to ensure that they produced similar measure results.
- We examined the degree to which the models produced similar risk-standardized outcome rates at the hospital level by assessing whether individual hospitals' risk-standardized rates fell into the same quintile in the distribution of risk-standardized rates calculated by each of the two models.
- Based on the results of these analyses, we made minor modifications to the re-specified risk-adjustment variables to ensure that the performance of the risk-adjustment model was as similar as possible to the performance of the previously-specified model, and that the hospital-level results were as similar as possible.

The updated measure specifications can be found in Appendix D.

3.3 Changes to SAS Pack

We revised the measure calculation SAS pack to reflect the re-specification done to accommodate the implementation of ICD-10 coding. The new SAS pack and documentation are available upon request by emailing 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 2017 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.[1-5]

We evaluated the performance of the models, using the July 1, 2015-June 30, 2016 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, 2015-June 30, 2016 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 2017 Model Results

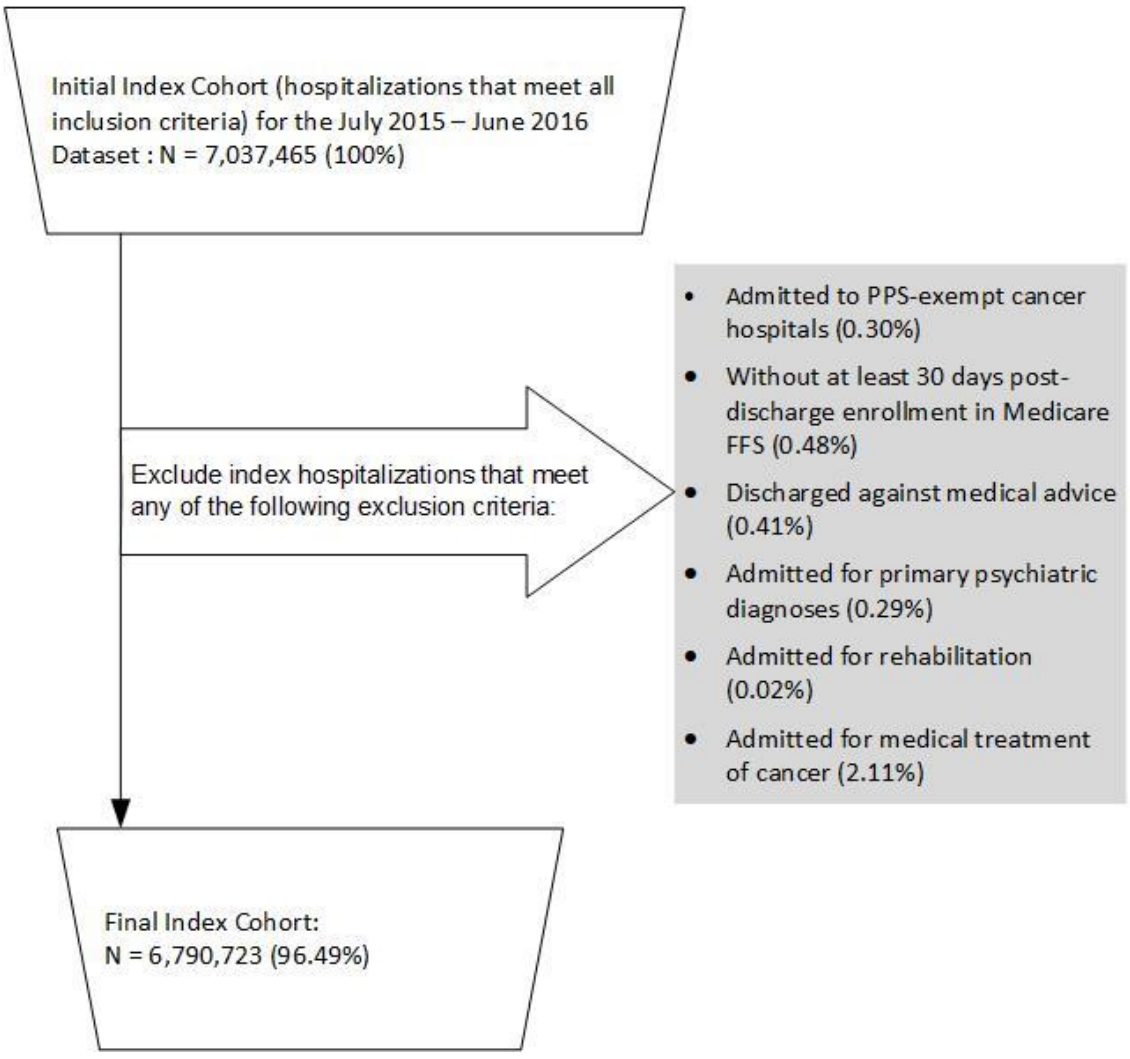
4.2.1 Index Cohort Exclusions

The exclusion criteria for this measure are presented in Section 2.2.1. The percentage of admissions that met each exclusion criterion in the July 2015-June 2016 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 Medicare 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 2015-June 2016 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, 2015-June 30, 2016 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 4,711 hospitals in the study cohort, 197 performed "Better than the National Rate," 4,052 performed "No Different than the National Rate," and 287 performed "Worse than the National Rate." 175 were classified as "Number of Cases Too Small" (fewer than 25) to reliably tell how well the hospital is performing.

Table 4.2.1 – Medicine Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2015-June 2016)

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)	1.75	1.14 (1.12-1.16)	0.131 (0.011)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	11.98	1.02 (1.01-1.03)	0.021 (0.005)
Other infectious diseases and pneumonias (CC 7, 114-116)	29.99	1.10 (1.09-1.11)	0.099 (0.004)
Metastatic cancer or acute leukemia (CC 8)	4.29	1.28 (1.26-1.30)	0.248 (0.008)
Severe cancer (CC 9-10)	6.61	1.27 (1.25-1.28)	0.235 (0.006)
Other cancers (CC 11-14)	9.68	1.08 (1.07-1.09)	0.074 (0.005)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	39.20	1.10 (1.09-1.11)	0.095 (0.004)
Protein-calorie malnutrition (CC 21)	14.09	1.15 (1.14-1.16)	0.137 (0.005)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	34.29	1.16 (1.15-1.17)	0.150 (0.004)
End-stage liver disease; cirrhosis of liver (CC 27-28)	3.64	1.31 (1.29-1.33)	0.269 (0.008)

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)	11.84	1.14 (1.13-1.15)	0.131 (0.005)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	6.19	1.11 (1.09-1.12)	0.103 (0.006)
Severe hematological disorders (CC 46)	1.38	1.34 (1.31-1.38)	0.296 (0.012)
Coagulation defects and other specified hematological disorders (CC 48)	7.36	1.07 (1.06-1.08)	0.067 (0.006)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	50.59	1.21 (1.20-1.21)	0.187 (0.004)
Drug/alcohol psychosis or dependence (CC 54-55)	4.30	1.09 (1.07-1.10)	0.082 (0.008)
Psychiatric comorbidity (CC 57-59, 61, 63)	31.51	1.07 (1.06-1.07)	0.065 (0.004)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	6.32	1.09 (1.08-1.10)	0.085 (0.006)
Seizure disorders and convulsions (CC 79)	5.22	1.10 (1.08-1.11)	0.092 (0.007)
Respirator dependence/tracheostomy status (CC 82)	0.56	1.15 (1.11-1.19)	0.142 (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)	14.16	1.08 (1.07-1.09)	0.081 (0.005)
Congestive heart failure (CC 85)	22.23	1.16 (1.15-1.17)	0.152 (0.005)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	50.30	1.11 (1.10-1.12)	0.106 (0.004)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	24.70	1.09 (1.08-1.10)	0.083 (0.004)
Chronic obstructive pulmonary disease (COPD) (CC 111)	26.74	1.18 (1.17-1.18)	0.162 (0.004)
Fibrosis of lung or other chronic lung disorders (CC 112)	3.33	1.10 (1.08-1.12)	0.096 (0.008)
Transplants (CC 132, 186)	1.13	1.19 (1.16-1.22)	0.176 (0.013)
Dialysis status (CC 134)	3.09	1.28 (1.26-1.30)	0.248 (0.008)
Renal failure (CC 135-140)	40.93	1.22 (1.21-1.22)	0.195 (0.004)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	7.72	1.12 (1.11-1.13)	0.112 (0.006)
Hip fracture/dislocation (CC 170)	2.80	0.93 (0.91-0.94)	-0.077 (0.009)
Condition Specific Indicator (AHRQ CCS)			
Septicemia (except in labor) (CCS 2)	16.59	0.88 (0.86-0.89)	-0.131 (0.010)
Urinary tract infections (CCS 159)	7.18	0.90 (0.88-0.92)	-0.110 (0.011)
Acute and unspecified renal failure (CCS 157)	6.62	0.99 (0.97-1.01)	-0.009 (0.011)
Gastrointestinal hemorrhage (CCS 153)	4.29	0.82 (0.80-0.84)	-0.195 (0.012)
Fluid and electrolyte disorders (CCS 55)	3.79	0.95 (0.93-0.98)	-0.046 (0.012)
Skin and subcutaneous tissue infections (CCS 197)	3.77	0.81 (0.79-0.83)	-0.215 (0.013)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Complication of device; implant or graft (CCS 237)	3.25	0.99 (0.97-1.02)	-0.006 (0.012)
Intestinal obstruction without hernia (CCS 145)	2.79	0.90 (0.88-0.93)	-0.102 (0.014)
Hypertension with complications and secondary hypertension (CCS 99)	2.64	Reference	Reference
Diverticulosis and diverticulitis (CCS 146)	2.60	0.84 (0.82-0.87)	-0.171 (0.014)
Other fractures (CCS 231)	2.58	0.74 (0.72-0.76)	-0.303 (0.015)
Complications of surgical procedures or medical care (CCS 238)	2.50	0.89 (0.87-0.92)	-0.115 (0.014)
Aspiration pneumonitis; food/vomitus (CCS 129)	2.26	0.92 (0.90-0.95)	-0.082 (0.014)
Intestinal infection (CCS 135)	2.03	1.03 (1.01-1.06)	0.034 (0.014)
Diabetes mellitus with complications (CCS 50)	1.95	0.92 (0.89-0.95)	-0.08 (0.014)
Deficiency and other anemia (CCS 59)	1.74	1.02 (0.99-1.05)	0.020 (0.015)
Syncope (CCS 245)	1.53	0.63 (0.60-0.65)	-0.468 (0.018)
Other gastrointestinal disorders (CCS 155)	1.32	1.02 (0.98-1.05)	0.016 (0.016)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	1.25	0.80 (0.77-0.82)	-0.229 (0.019)
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	1.22	0.85 (0.82-0.88)	-0.163 (0.018)
Pancreatic disorders (not diabetes) (CCS 152)	1.12	0.89 (0.86-0.93)	-0.113 (0.019)
Delirium, dementia, and amnestic and other cognitive disorders (CCS 653)	1.09	0.81 (0.78-0.84)	-0.208 (0.019)
Noninfectious gastroenteritis (CCS 154)	0.96	0.84 (0.81-0.87)	-0.177 (0.020)
Biliary tract disease (CCS 149)	0.91	0.98 (0.94-1.02)	-0.021 (0.020)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.88	1.20 (1.16-1.25)	0.184 (0.018)
Other connective tissue disease (CCS 211)	0.85	0.77 (0.74-0.80)	-0.263 (0.022)
Other lower respiratory disease (CCS 133)	0.83	0.91 (0.87-0.95)	-0.095 (0.020)
Other liver diseases (CCS 151)	0.82	1.28 (1.23-1.33)	0.246 (0.018)
Esophageal disorders (CCS 138)	0.78	0.85 (0.82-0.89)	-0.162 (0.021)
Residual codes; unclassified (CCS 259)	0.73	0.86 (0.83-0.90)	-0.148 (0.021)
Other endocrine disorders (CCS 51)	0.62	1.03 (0.99-1.07)	0.028 (0.022)
Gastritis and duodenitis (CCS 140)	0.61	0.90 (0.86-0.94)	-0.102 (0.023)
Acute posthemorrhagic anemia (CCS 60)	0.60	0.94 (0.90-0.98)	-0.066 (0.022)
Essential hypertension (CCS 98)	0.60	0.62 (0.59-0.66)	-0.471 (0.028)
Alcohol-related disorders (CCS 660)	0.57	1.04 (0.99-1.08)	0.036 (0.023)
Conditions associated with dizziness or vertigo (CCS 93)	0.57	0.40 (0.38-0.43)	-0.909 (0.034)
Abdominal hernia (CCS 143)	0.57	0.72 (0.69-0.76)	-0.324 (0.026)
Other injuries and conditions due to external causes (CCS 244)	0.55	0.79 (0.75-0.83)	-0.241 (0.026)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.49	0.93 (0.89-0.98)	-0.068 (0.024)
Low Frequency Conditions	0.49	0.82 (0.78-0.86)	-0.202 (0.026)
Fracture of upper limb (CCS 229)	0.48	0.86 (0.82-0.91)	-0.150 (0.027)
Abdominal pain (CCS 251)	0.47	0.93 (0.89-0.98)	-0.072 (0.025)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Poisoning by other medications and drugs (CCS 242)	0.47	0.84 (0.80-0.88)	-0.175 (0.026)
Influenza (CCS 123)	0.46	0.67 (0.63-0.71)	-0.405 (0.029)
Malaise and fatigue (CCS 252)	0.44	0.85 (0.81-0.90)	-0.162 (0.027)
Other disorders of stomach and duodenum (CCS 141)	0.44	1.07 (1.02-1.12)	0.069 (0.024)
Superficial injury; contusion (CCS 239)	0.43	0.82 (0.77-0.86)	-0.203 (0.028)
Fracture of lower limb (CCS 230)	0.42	0.81 (0.77-0.86)	-0.211 (0.029)
Pathological fracture (CCS 207)	0.38	0.86 (0.82-0.91)	-0.146 (0.029)
Diseases of white blood cells (CCS 63)	0.36	1.06 (1.01-1.12)	0.061 (0.026)
Other diseases of kidney and ureters (CCS 161)	0.35	0.81 (0.77-0.87)	-0.205 (0.031)
Fracture of neck of femur (hip) (CCS 226)	0.33	0.67 (0.62-0.71)	-0.404 (0.034)
Viral infection (CCS 7)	0.32	0.85 (0.80-0.90)	-0.163 (0.031)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.32	0.95 (0.89-1.00)	-0.054 (0.030)
Crushing injury or internal injury (CCS 234)	0.30	0.89 (0.83-0.95)	-0.121 (0.033)
Hemorrhoids (CCS 120)	0.28	0.82 (0.77-0.88)	-0.194 (0.032)
Fever of unknown origin (CCS 246)	0.28	0.93 (0.88-0.99)	-0.071 (0.032)
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted di (CCS 201)	0.27	0.83 (0.77-0.88)	-0.192 (0.032)
Regional enteritis and ulcerative colitis (CCS 144)	0.27	1.15 (1.08-1.22)	0.139 (0.031)
Chronic ulcer of skin (CCS 199)	0.27	0.83 (0.78-0.88)	-0.190 (0.032)
Other non-traumatic joint disorders (CCS 204)	0.26	0.78 (0.72-0.83)	-0.252 (0.036)
Nausea and vomiting (CCS 250)	0.25	1.05 (0.99-1.12)	0.050 (0.032)
Gout and other crystal arthropathies (CCS 54)	0.21	0.69 (0.64-0.75)	-0.364 (0.039)
Calculus of urinary tract (CCS 160)	0.20	0.72 (0.66-0.78)	-0.329 (0.044)
Coagulation and hemorrhagic disorders (CCS 62)	0.20	1.25 (1.17-1.34)	0.225 (0.033)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.19	0.80 (0.74-0.86)	-0.225 (0.041)
Osteoarthritis (CCS 203)	0.19	0.67 (0.61-0.73)	-0.406 (0.045)
Other upper respiratory disease (CCS 134)	0.19	0.86 (0.80-0.93)	-0.146 (0.038)
Other upper respiratory infections (CCS 126)	0.19	0.72 (0.66-0.78)	-0.327 (0.043)
Other and unspecified benign neoplasm (CCS 47)	0.18	0.82 (0.75-0.89)	-0.200 (0.042)
Headache; including migraine (CCS 84)	0.18	0.66 (0.60-0.73)	-0.411 (0.047)
Substance-related disorders (CCS 661)	0.18	0.87 (0.80-0.94)	-0.141 (0.040)
Mycoses (CCS 4)	0.17	1.25 (1.17-1.34)	0.222 (0.034)
Skull and face fractures (CCS 228)	0.16	0.72 (0.65-0.79)	-0.330 (0.048)
Anal and rectal conditions (CCS 147)	0.16	0.96 (0.88-1.04)	-0.045 (0.041)
Bacterial infection; unspecified site (CCS 3)	0.15	0.88 (0.82-0.96)	-0.122 (0.041)
Other diseases of veins and lymphatics (CCS 121)	0.15	0.85 (0.79-0.93)	-0.158 (0.043)
Inflammatory conditions of male genital organs (CCS 165)	0.14	0.68 (0.61-0.75)	-0.385 (0.052)
Peritonitis and intestinal abscess (CCS 148)	0.13	1.08 (0.99-1.17)	0.073 (0.042)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Adverse effects of medical drugs (CCS 2617)	0.12	0.84 (0.77-0.93)	-0.170 (0.047)
Open wounds of head; neck; and trunk (CCS 235)	0.12	0.71 (0.63-0.78)	-0.349 (0.054)
Other screening for suspected conditions (not mental disorders or infectious disease) (CCS 258)	0.12	0.91 (0.83-1.00)	-0.092 (0.047)
Sprains and strains (CCS 232)	0.12	0.77 (0.69-0.85)	-0.266 (0.054)
Hyperplasia of prostate (CCS 164)	0.11	1.01 (0.91-1.11)	0.009 (0.050)
Diseases of mouth; excluding dental (CCS 137)	0.10	0.71 (0.64-0.80)	-0.338 (0.055)
Allergic reactions (CCS 253)	0.10	0.82 (0.74-0.91)	-0.200 (0.054)
Hepatitis (CCS 6)	0.10	1.22 (1.12-1.33)	0.198 (0.045)
Poisoning by psychotropic agents (CCS 241)	0.10	0.79 (0.71-0.88)	-0.232 (0.056)
Thyroid disorders (CCS 48)	0.10	0.99 (0.90-1.10)	-0.007 (0.052)
Gangrene (CCS 248)	0.10	1.33 (1.22-1.46)	0.288 (0.045)
Nutritional deficiencies (CCS 52)	0.09	1.01 (0.92-1.12)	0.014 (0.050)
Chronic kidney disease (CCS 158)	0.09	0.97 (0.88-1.06)	-0.033 (0.048)
Other bone disease and musculoskeletal deformities (CCS 212)	0.09	0.73 (0.65-0.82)	-0.311 (0.060)
Shock (CCS 249)	0.08	0.91 (0.82-1.00)	-0.099 (0.053)
Open wounds of extremities (CCS 236)	0.08	0.81 (0.71-0.91)	-0.215 (0.063)
Other diseases of bladder and urethra (CCS 162)	0.08	1.00 (0.89-1.12)	-0.002 (0.057)
Systemic lupus erythematosus and connective tissue disorders (CCS 210)	0.08	1.02 (0.92-1.15)	0.025 (0.057)
Other infections; including parasitic (CCS 8)	0.07	0.62 (0.53-0.72)	-0.479 (0.078)
Other inflammatory condition of skin (CCS 198)	0.07	1.19 (1.06-1.34)	0.176 (0.060)
Lung disease due to external agents (CCS 132)	0.06	1.02 (0.91-1.15)	0.020 (0.060)
Other aftercare (CCS 257)	0.06	0.58 (0.50-0.68)	-0.538 (0.079)

Table 4.2.2 – Surgery/Gynecology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2015-June 2016)

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)	1.0	1.12 (1.07-1.16)	0.110 (0.020)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	5.1	0.96 (0.94-0.97)	-0.045 (0.010)
Other infectious diseases and pneumonias (CC 7, 114-116)	12.8	1.12 (1.11-1.14)	0.117 (0.007)
Metastatic cancer or acute leukemia (CC 8)	3.4	1.32 (1.28-1.35)	0.274 (0.013)
Severe cancer (CC 9-10)	3.9	1.21 (1.19-1.24)	0.193 (0.011)
Other cancers (CC 11-14)	6.3	1.06 (1.04-1.07)	0.054 (0.009)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	30.2	1.16 (1.15-1.18)	0.152 (0.005)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Protein-calorie malnutrition (CC 21)	7.6	1.21 (1.19-1.23)	0.192 (0.008)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	17.1	1.08 (1.06-1.09)	0.076 (0.007)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.3	1.34 (1.29-1.38)	0.289 (0.017)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	5.7	1.04 (1.03-1.06)	0.043 (0.009)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.3	1.14 (1.11-1.16)	0.127 (0.010)
Severe hematological disorders (CC 46)	0.6	1.32 (1.26-1.38)	0.277 (0.025)
Coagulation defects and other specified hematological disorders (CC 48)	3.4	1.03 (1.01-1.05)	0.030 (0.011)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	44.3	1.27 (1.26-1.28)	0.239 (0.006)
Drug/alcohol psychosis or dependence (CC 54-55)	2.6	1.13 (1.10-1.16)	0.119 (0.013)
Psychiatric comorbidity (CC 57-59, 61, 63)	23.4	1.11 (1.10-1.13)	0.108 (0.006)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	3.9	1.08 (1.06-1.11)	0.080 (0.011)
Seizure disorders and convulsions (CC 79)	2.6	1.13 (1.10-1.16)	0.121 (0.013)
Respirator dependence/tracheostomy status (CC 82)	0.2	1.02 (0.95-1.10)	0.023 (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)	6.5	1.02 (1.01-1.04)	0.024 (0.009)
Congestive heart failure (CC 85)	10.5	1.12 (1.11-1.14)	0.117 (0.008)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	37.5	1.18 (1.17-1.20)	0.168 (0.006)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	13.5	1.09 (1.07-1.10)	0.082 (0.007)
Chronic obstructive pulmonary disease (COPD) (CC 111)	17.9	1.26 (1.25-1.28)	0.232 (0.006)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.8	1.14 (1.10-1.17)	0.129 (0.015)
Transplants (CC 132, 186)	0.6	1.38 (1.31-1.44)	0.320 (0.024)
Dialysis status (CC 134)	1.4	1.35 (1.31-1.39)	0.303 (0.015)
Renal failure (CC 135-140)	22.6	1.27 (1.25-1.28)	0.239 (0.006)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	4.9	1.05 (1.03-1.07)	0.047 (0.011)
Hip fracture/dislocation (CC 170)	2.1	0.96 (0.93-0.99)	-0.042 (0.015)
Condition Specific Indicator (AHRQ CCS)			
Osteoarthritis (CCS 203)	22.74	0.28 (0.26-0.30)	-1.260 (0.035)
Fracture of neck of femur (hip) (CCS 226)	8.93	0.61 (0.57-0.65)	-0.496 (0.035)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	5.55	0.50 (0.47-0.54)	-0.690 (0.037)
Complication of device; implant or graft (CCS 237)	4.89	0.72 (0.67-0.77)	-0.330 (0.036)
Septicemia (except in labor) (CCS 2)	3.02	0.93 (0.87-1.00)	-0.071 (0.036)
Heart valve disorders (CCS 96)	2.92	0.72 (0.67-0.77)	-0.333 (0.036)
Biliary tract disease (CCS 149)	2.76	0.65 (0.61-0.70)	-0.429 (0.037)
Coronary atherosclerosis and other heart disease (CCS 101)	2.28	0.71 (0.66-0.76)	-0.342 (0.037)
Occlusion or stenosis of precerebral arteries (CCS 110)	2.20	0.39 (0.36-0.42)	-0.935 (0.040)
Fracture of lower limb (CCS 230)	2.02	0.65 (0.60-0.70)	-0.434 (0.038)
Complications of surgical procedures or medical care (CCS 238)	1.97	0.83 (0.77-0.89)	-0.192 (0.037)
Low Frequency Conditions	1.92	0.82 (0.76-0.88)	-0.203 (0.037)
Abdominal hernia (CCS 143)	1.76	0.69 (0.64-0.75)	-0.367 (0.039)
Cancer of colon (CCS 14)	1.45	0.67 (0.62-0.72)	-0.404 (0.039)
Acute myocardial infarction (CCS 100)	1.39	0.86 (0.80-0.93)	-0.146 (0.038)
Intestinal obstruction without hernia (CCS 145)	1.32	0.84 (0.78-0.91)	-0.169 (0.039)
Fracture of upper limb (CCS 229)	1.25	0.51 (0.47-0.55)	-0.682 (0.042)
Peripheral and visceral atherosclerosis (CCS 114)	1.23	0.96 (0.89-1.03)	-0.046 (0.039)
Other acquired deformities (CCS 209)	1.19	0.47 (0.43-0.51)	-0.762 (0.044)
Diabetes mellitus with complications (CCS 50)	1.12	0.84 (0.78-0.90)	-0.178 (0.039)
Other and unspecified benign neoplasm (CCS 47)	1.05	0.64 (0.59-0.70)	-0.440 (0.042)
Cancer of bronchus; lung (CCS 19)	1.04	0.65 (0.60-0.71)	-0.427 (0.041)
Cardiac dysrhythmias (CCS 106)	1.03	0.79 (0.73-0.86)	-0.232 (0.040)
Acute cerebrovascular disease (CCS 109)	0.99	0.91 (0.84-0.99)	-0.093 (0.040)
Pathological fracture (CCS 207)	0.93	0.69 (0.64-0.75)	-0.366 (0.041)
Other fractures (CCS 231)	0.90	0.74 (0.68-0.80)	-0.303 (0.041)
Diverticulosis and diverticulitis (CCS 146)	0.88	0.82 (0.75-0.89)	-0.201 (0.042)
Cancer of prostate (CCS 29)	0.85	0.40 (0.37-0.45)	-0.907 (0.050)
Secondary malignancies (CCS 42)	0.84	0.86 (0.79-0.93)	-0.150 (0.041)
Other gastrointestinal disorders (CCS 155)	0.83	0.80 (0.74-0.87)	-0.225 (0.041)
Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted di (CCS 201)	0.64	0.66 (0.61-0.72)	-0.412 (0.044)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	0.63	0.79 (0.73-0.87)	-0.230 (0.044)
Cancer of kidney and renal pelvis (CCS 33)	0.60	0.58 (0.53-0.63)	-0.550 (0.048)
Appendicitis and other appendiceal conditions (CCS 142)	0.58	0.55 (0.50-0.61)	-0.600 (0.050)
Intracranial injury (CCS 233)	0.53	1.01 (0.93-1.10)	0.011 (0.044)
Other connective tissue disease (CCS 211)	0.53	0.43 (0.39-0.48)	-0.837 (0.053)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Cancer of bladder (CCS 32)	0.51	1.19 (1.09-1.30)	0.175 (0.043)
Hyperplasia of prostate (CCS 164)	0.51	0.55 (0.50-0.60)	-0.603 (0.050)
Gastrointestinal hemorrhage (CCS 153)	0.51	0.86 (0.79-0.94)	-0.150 (0.043)
Gangrene (CCS 248)	0.50	1.12 (1.03-1.22)	0.117 (0.042)
Other diseases of kidney and ureters (CCS 161)	0.44	0.66(0.60-0.72)	-0.422 (0.049)
Acute and unspecified renal failure (CCS 157)	0.42	1.02 (0.93-1.11)	0.016 (0.044)
Skin and subcutaneous tissue infections (CCS 197)	0.41	0.65 (0.59-0.71)	-0.436 (0.049)
Other nervous system disorders (CCS 95)	0.40	0.75 (0.68-0.82)	-0.290 (0.049)
Congestive heart failure; nonhypertensive (CCS 108)	0.40	1.02 (0.93-1.11)	0.018 (0.044)
Pancreatic disorders (not diabetes) (CCS 152)	0.39	0.76 (0.69-0.84)	-0.275 (0.050)
Cancer of rectum and anus (CCS 15)	0.38	1.07 (0.98-1.18)	0.071 (0.047)
Urinary tract infections (CCS 159)	0.38	0.96 (0.87-1.05)	-0.044 (0.046)
Calculus of urinary tract (CCS 160)	0.36	0.65 (0.58-0.72)	-0.433 (0.053)
Cancer of breast (CCS 24)	0.35	0.43 (0.38-0.49)	-0.841 (0.061)
Other bone disease and musculoskeletal deformities (CCS 212)	0.34	0.50 (0.45-0.56)	-0.696 (0.058)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.34	0.49 (0.44-0.56)	-0.705 (0.061)
Prolapse of female genital organs (CCS 170)	0.33	0.33 (0.29-0.39)	-1.094 (0.072)
Chronic ulcer of skin (CCS 199)	0.31	0.71 (0.65-0.79)	-0.336 (0.050)
Other non-traumatic joint disorders (CCS 204)	0.31	0.31 (0.27-0.36)	-1.178 (0.073)
Cancer of uterus (CCS 25)	0.30	0.67 (0.60-0.75)	-0.398 (0.057)
Anal and rectal conditions (CCS 147)	0.28	0.66 (0.59-0.74)	-0.410 (0.056)
Hypertension with complications and secondary hypertension (CCS 99)	0.27	Reference	Reference
Cancer of head and neck (CCS 11)	0.27	0.64 (0.58-0.72)	-0.439 (0.057)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.25	1.08 (0.98-1.20)	0.080 (0.051)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	0.24	0.92 (0.83-1.01)	-0.088 (0.051)
Cancer of pancreas (CCS 17)	0.23	1.17 (1.06-1.29)	0.156 (0.052)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.23	0.76 (0.68-0.84)	-0.275 (0.054)
Esophageal disorders (CCS 138)	0.22	0.68 (0.60-0.76)	-0.389 (0.060)
Other disorders of stomach and duodenum (CCS 141)	0.21	0.94 (0.85-1.04)	-0.062 (0.053)
Neoplasms of unspecified nature or uncertain behavior (CCS 44)	0.21	0.68 (0.60-0.77)	-0.387 (0.063)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	0.20	0.94 (0.85-1.04)	-0.061 (0.052)
Other diseases of bladder and urethra (CCS 162)	0.20	0.76 (0.68-0.86)	-0.271 (0.059)
Cancer of ovary (CCS 27)	0.19	0.75 (0.66-0.85)	-0.289 (0.062)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Cancer of other GI organs; peritoneum (CCS 18)	0.18	0.95 (0.85-1.06)	-0.055 (0.058)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transm (CCS 97)	0.18	0.96 (0.86-1.07)	-0.042 (0.057)
Non-Hodgkin`s lymphoma (CCS 38)	0.17	1.53 (1.38-1.70)	0.427 (0.054)
Joint disorders and dislocations; trauma-related (CCS 225)	0.17	0.61 (0.54-0.70)	-0.488 (0.069)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.17	0.81 (0.72-0.91)	-0.216 (0.061)
Other lower respiratory disease (CCS 133)	0.16	0.70 (0.62-0.80)	-0.350 (0.067)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.16	0.94 (0.84-1.06)	-0.058 (0.061)
Cancer of brain and nervous system (CCS 35)	0.16	1.21 (1.08-1.37)	0.194 (0.060)
Cancer of stomach (CCS 13)	0.15	0.93 (0.83-1.05)	-0.072 (0.061)
Other and ill-defined cerebrovascular disease (CCS 111)	0.15	0.57 (0.49-0.66)	-0.559 (0.076)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	0.13	1.12 (1.00-1.26)	0.115 (0.060)
Other aftercare (CCS 257)	0.13	0.48 (0.41-0.56)	-0.731 (0.078)
Sprains and strains (CCS 232)	0.12	0.47 (0.40-0.56)	-0.746 (0.088)
Other female genital disorders (CCS 175)	0.12	0.70 (0.60-0.81)	-0.356 (0.075)
Open wounds of extremities (CCS 236)	0.12	0.58 (0.50-0.68)	-0.545 (0.079)
Other upper respiratory disease (CCS 134)	0.11	0.68 (0.59-0.78)	-0.387 (0.072)
Other hereditary and degenerative nervous system conditions (CCS 81)	0.11	0.70 (0.60-0.82)	-0.357 (0.080)
Aspiration pneumonitis; food/vomitus (CCS 129)	0.11	0.94 (0.83-1.07)	-0.060 (0.064)
Crushing injury or internal injury (CCS 234)	0.10	0.76 (0.65-0.88)	-0.275 (0.076)
Cancer of bone and connective tissue (CCS 21)	0.10	0.79 (0.68-0.92)	-0.234 (0.077)
Other circulatory disease (CCS 117)	0.10	0.90 (0.78-1.03)	-0.108 (0.070)
Fluid and electrolyte disorders (CCS 55)	0.10	1.00 (0.88-1.14)	-0.001 (0.067)
Cardiac and circulatory congenital anomalies (CCS 213)	0.10	0.70 (0.59-0.81)	-0.364 (0.081)
Cancer of liver and intrahepatic bile duct (CCS 16)	0.09	0.99 (0.86-1.14)	-0.013 (0.073)
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	0.09	0.89 (0.77-1.03)	-0.119 (0.074)
Other non-epithelial cancer of skin (CCS 23)	0.09	0.49 (0.41-0.59)	-0.714 (0.093)
Cancer of other urinary organs (CCS 34)	0.08	0.71 (0.60-0.84)	-0.345 (0.085)
Other liver diseases (CCS 151)	0.08	1.12 (0.97-1.28)	0.110 (0.071)
Skull and face fractures (CCS 228)	0.08	0.55 (0.46-0.67)	-0.594 (0.096)
Parkinson`s disease (CCS 79)	0.08	0.46 (0.37-0.58)	-0.777 (0.115)
Cancer of other female genital organs (CCS 28)	0.08	0.66 (0.55-0.79)	-0.420 (0.092)
Thyroid disorders (CCS 48)	0.08	0.37 (0.29-0.47)	-0.990 (0.121)
Regional enteritis and ulcerative colitis (CCS 144)	0.07	1.30 (1.12-1.51)	0.261 (0.077)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Cancer of esophagus (CCS 12)	0.07	1.17 (1.00-1.36)	0.157 (0.078)
Rheumatoid arthritis and related disease (CCS 202)	0.07	0.35 (0.27-0.45)	-1.047 (0.131)
Other congenital anomalies (CCS 217)	0.07	0.49 (0.39-0.62)	-0.713 (0.119)
Other injuries and conditions due to external causes (CCS 244)	0.07	0.73 (0.61-0.88)	-0.310 (0.092)
Cancer of thyroid (CCS 36)	0.06	0.51 (0.41-0.63)	-0.678 (0.113)
Other endocrine disorders (CCS 51)	0.06	0.82 (0.68-0.99)	-0.198 (0.094)
Burns (CCS 240)	0.06	0.84 (0.70-1.01)	-0.172 (0.093)

Table 4.2.3 – Cardiorespiratory Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2015-June 2016)

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)	-0.003 (0.000)
Severe infection (CC 1, 3-6)	1.54	1.15 (1.11-1.19)	0.138 (0.018)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	9.84	1.02 (1.01-1.04)	0.022 (0.008)
Other infectious diseases and pneumonias (CC 7, 114-116)	37.80	1.09 (1.07-1.10)	0.083 (0.006)
Metastatic cancer or acute leukemia (CC 8)	2.79	1.23 (1.19-1.27)	0.206 (0.015)
Severe cancer (CC 9-10)	6.26	1.22 (1.20-1.25)	0.203 (0.010)
Other cancers (CC 11-14)	6.05	1.07 (1.05-1.09)	0.067 (0.010)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	40.62	1.09 (1.08-1.11)	0.090 (0.005)
Protein-calorie malnutrition (CC 21)	11.00	1.09 (1.07-1.11)	0.086 (0.008)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	34.75	1.14 (1.12-1.15)	0.128 (0.006)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.89	1.15 (1.12-1.19)	0.144 (0.016)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	8.61	1.06 (1.05-1.08)	0.061 (0.008)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	5.80	1.08 (1.06-1.10)	0.074 (0.010)
Severe hematological disorders (CC 46)	1.13	1.28 (1.23-1.33)	0.245 (0.021)
Coagulation defects and other specified hematological disorders (CC 48)	6.93	1.04 (1.02-1.05)	0.035 (0.009)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	47.00	1.20 (1.18-1.21)	0.181 (0.006)
Drug/alcohol psychosis or dependence (CC 54-55)	3.52	1.17 (1.15-1.20)	0.160 (0.012)
Psychiatric comorbidity (CC 57-59, 61, 63)	33.67	1.09 (1.08-1.10)	0.088 (0.005)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	4.32	1.08 (1.05-1.10)	0.074 (0.011)
Seizure disorders and convulsions (CC 79)	3.78	1.07 (1.05-1.10)	0.070 (0.012)
Respirator dependence/tracheostomy status (CC 82)	0.60	1.18 (1.12-1.24)	0.165 (0.027)
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)	28.25	1.18 (1.16-1.19)	0.164 (0.006)
Congestive heart failure (CC 85)	37.48	1.19 (1.18-1.21)	0.176 (0.007)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	58.73	1.13 (1.12-1.14)	0.122 (0.006)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	33.11	1.10 (1.09-1.11)	0.095 (0.006)
Chronic obstructive pulmonary disease (COPD) (CC 111)	51.36	1.21 (1.20-1.22)	0.189 (0.006)
Fibrosis of lung or other chronic lung disorders (CC 112)	7.61	1.10 (1.08-1.12)	0.093 (0.009)
Transplants (CC 132, 186)	0.67	1.08 (1.02-1.13)	0.073 (0.027)
Dialysis status (CC 134)	2.36	1.23 (1.20-1.26)	0.206 (0.014)
Renal failure (CC 135-140)	43.05	1.21 (1.19-1.22)	0.189 (0.006)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	5.43	1.12 (1.10-1.14)	0.115 (0.010)
Hip fracture/dislocation (CC 170)	2.26	0.90 (0.87-0.93)	-0.106 (0.016)
Condition Specific Indicator (AHRQ CCS)			
Congestive heart failure; nonhypertensive (CCS 108)	34.81	1.04 (1.02-1.06)	0.038 (0.009)
Pneumonia (except that caused by tuberculosis or sexually transmitted disease) (CCS 122)	26.25	0.87 (0.86-0.89)	-0.136 (0.009)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	19.74	1.02 (1.01-1.04)	0.023 (0.009)
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	10.94	Reference	Reference
Pulmonary heart disease (CCS 103)	4.88	0.82 (0.80-0.85)	-0.196 (0.015)
Asthma (CCS 128)	1.73	0.85 (0.81-0.88)	-0.168 (0.022)
Acute bronchitis (CCS 125)	1.65	0.71 (0.68-0.75)	-0.340 (0.025)
Low Frequency Conditions	0.01	0.88 (0.45-1.71)	-0.129 (0.338)

Table 4.2.4 – Cardiovascular Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2015-June 2016)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Age minus 65 (years above 65, continuous)	0.79	1.01 (1.01-1.02)	0.014 (0.000)
Severe infection (CC 1, 3-6)	4.89	1.17 (1.09-1.25)	0.156 (0.034)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	16.90	0.99 (0.96-1.02)	-0.009 (0.015)
Other infectious diseases and pneumonias (CC 7, 114-116)	1.65	1.16 (1.13-1.18)	0.146 (0.010)
Metastatic cancer or acute leukemia (CC 8)	3.55	1.46 (1.39-1.53)	0.375 (0.025)
Severe cancer (CC 9-10)	5.03	1.24 (1.20-1.28)	0.216 (0.017)
Other cancers (CC 11-14)	36.97	1.05 (1.02-1.08)	0.048 (0.015)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	5.60	1.16 (1.14-1.18)	0.150 (0.008)
Protein-calorie malnutrition (CC 21)	21.74	1.17 (1.14-1.20)	0.155 (0.014)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	1.29	1.13 (1.11-1.15)	0.121 (0.010)
End-stage liver disease; cirrhosis of liver (CC 27-28)	6.06	1.34 (1.27-1.41)	0.290 (0.026)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	4.99	1.06 (1.04-1.09)	0.063 (0.013)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	0.74	1.14 (1.11-1.18)	0.134 (0.015)
Severe hematological disorders (CC 46)	4.46	1.33 (1.25-1.43)	0.288 (0.034)
Coagulation defects and other specified hematological disorders (CC 48)	33.85	1.02 (0.99-1.05)	0.020 (0.015)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	2.51	1.29 (1.27-1.31)	0.254 (0.008)
Drug/alcohol psychosis or dependence (CC 54-55)	24.47	1.23 (1.18-1.27)	0.203 (0.020)
Psychiatric comorbidity (CC 57-59, 61, 63)	3.19	1.15 (1.13-1.17)	0.138 (0.008)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	2.98	1.09 (1.05-1.13)	0.084 (0.018)
Seizure disorders and convulsions (CC 79)	0.17	1.13 (1.09-1.17)	0.120 (0.019)
Respirator dependence/tracheostomy status (CC 82)	10.12	1.08 (0.94-1.23)	0.074 (0.067)
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)	21.62	1.08 (1.05-1.10)	0.075 (0.012)
Congestive heart failure (CC 85)	63.26	1.26 (1.23-1.28)	0.229 (0.010)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	27.05	1.11 (1.09-1.13)	0.102 (0.009)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	24.98	1.08 (1.06-1.10)	0.079 (0.009)
Chronic obstructive pulmonary disease (COPD) (CC 111)	2.78	1.31 (1.29-1.33)	0.273 (0.008)
Fibrosis of lung or other chronic lung disorders (CC 112)	0.56	1.10 (1.06-1.14)	0.097 (0.019)
Transplants (CC 132, 186)	2.32	1.19 (1.10-1.29)	0.173 (0.040)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Dialysis status (CC 134)	33.68	1.37 (1.32-1.42)	0.313 (0.019)
Renal failure (CC 135-140)	3.41	1.29 (1.27-1.32)	0.258 (0.008)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	1.42	1.22 (1.18-1.26)	0.198 (0.017)
Hip fracture/dislocation (CC 170)	0.79	0.92 (0.87-0.97)	-0.084 (0.026)
Condition Specific Indicator (AHRQ CCS)			
Cardiac dysrhythmias (CCS 106)	37.32	0.84 (0.80-0.89)	-0.170 (0.027)
Acute myocardial infarction (CCS 100)	23.29	0.86 (0.82-0.91)	-0.150 (0.027)
Coronary atherosclerosis and other heart disease (CCS 101)	11.19	0.68 (0.64-0.72)	-0.389 (0.029)
Nonspecific chest pain (CCS 102)	7.87	0.58 (0.55-0.62)	-0.538 (0.030)
Other circulatory disease (CCS 117)	5.24	0.72 (0.68-0.77)	-0.323 (0.030)
Conduction disorders (CCS 105)	3.85	0.58 (0.55-0.62)	-0.541 (0.034)
Peripheral and visceral atherosclerosis (CCS 114)	3.75	0.75 (0.71-0.80)	-0.284 (0.032)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	2.89	0.74 (0.69-0.79)	-0.304 (0.035)
Heart valve disorders (CCS 96)	1.50	0.71 (0.66-0.77)	-0.341 (0.038)
Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transm (CCS 97)	1.46	Reference	Reference
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.52	0.89 (0.80-0.99)	-0.114 (0.053)
Other and ill-defined heart disease (CCS 104)	0.47	0.72 (0.64-0.82)	-0.324 (0.062)
Cardiac arrest and ventricular fibrillation (CCS 107) quit	0.39	0.78 (0.69-0.88)	-0.247 (0.060)
Cardiac and circulatory congenital anomalies (CCS 213)	0.27	0.82 (0.72-0.93)	-0.204 (0.066)

Table 4.2.5 – Neurology Specialty Cohort Hierarchical Logistic Regression Model Risk Factor Frequencies, ORs, and Model Coefficients (July 2015-June 2016)

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 (0.001)
Severe infection (CC 1, 3-6)	1.18	1.22 (1.13-1.31)	0.196 (0.036)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	5.68	0.98 (0.94-1.02)	-0.021 (0.019)
Other infectious diseases and pneumonias (CC 7, 114-116)	16.64	1.12 (1.09-1.15)	0.112 (0.013)
Metastatic cancer or acute leukemia (CC 8)	3.12	1.26 (1.19-1.32)	0.228 (0.026)
Severe cancer (CC 9-10)	4.30	1.32 (1.26-1.37)	0.276 (0.021)
Other cancers (CC 11-14)	6.33	1.10 (1.06-1.14)	0.095 (0.018)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	36.30	1.15 (1.13-1.18)	0.143 (0.010)
Protein-calorie malnutrition (CC 21)	8.10	1.13 (1.09-1.16)	0.120 (0.016)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	23.78	1.12 (1.09-1.15)	0.114 (0.013)
End-stage liver disease; cirrhosis of liver (CC 27-28)	1.34	1.23 (1.15-1.32)	0.208 (0.034)
Pancreatic disease; peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34, 36)	5.80	1.06 (1.02-1.09)	0.054 (0.018)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	4.62	1.08 (1.04-1.13)	0.079 (0.021)
Severe hematological disorders (CC 46)	0.67	1.27 (1.15-1.39)	0.236 (0.047)
Coagulation defects and other specified hematological disorders (CC 48)	4.45	1.01 (0.97-1.05)	0.009 (0.020)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	31.29	1.24 (1.21-1.27)	0.215 (0.011)
Drug/alcohol psychosis or dependence (CC 54-55)	3.91	1.09 (1.04-1.13)	0.082 (0.022)
Psychiatric comorbidity (CC 57-59, 61, 63)	29.13	1.05 (1.03-1.07)	0.051 (0.010)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	7.67	1.07 (1.04-1.11)	0.069 (0.016)
Seizure disorders and convulsions (CC 79)	10.45	1.15 (1.12-1.19)	0.143 (0.015)
Respirator dependence/tracheostomy status (CC 82)	0.22	1.06 (0.91-1.23)	0.055 (0.079)
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)	8.31	1.05 (1.01-1.08)	0.046 (0.017)
Congestive heart failure (CC 85)	14.47	1.15 (1.12-1.18)	0.137 (0.014)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	56.04	1.13 (1.11-1.16)	0.125 (0.010)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	19.45	1.11 (1.08-1.13)	0.101 (0.013)
Chronic obstructive pulmonary disease (COPD) (CC 111)	18.09	1.18 (1.15-1.21)	0.166 (0.012)
Fibrosis of lung or other chronic lung disorders (CC 112)	1.81	1.09 (1.02-1.16)	0.084 (0.031)
Transplants (CC 132, 186)	0.51	1.26 (1.14-1.40)	0.234 (0.052)
Dialysis status (CC 134)	1.86	1.39 (1.32-1.46)	0.327 (0.027)
Renal failure (CC 135-140)	27.84	1.21 (1.19-1.24)	0.194 (0.011)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	3.21	1.14 (1.09-1.19)	0.132 (0.023)
Hip fracture/dislocation (CC 170)	2.18	0.87 (0.82-0.92)	-0.138 (0.030)
Condition Specific Indicator (AHRQ CCS)			
Acute cerebrovascular disease (CCS 109)	46.35	0.87 (0.85-0.89)	-0.140 (0.013)
Other nervous system disorders (CCS 95)	16.35	Reference	Reference
Transient cerebral ischemia (CCS 112)	11.65	0.68 (0.65-0.70)	-0.389 (0.019)
Intracranial injury (CCS 233)	10.58	1.13 (1.09-1.17)	0.123 (0.017)
Epilepsy; convulsions (CCS 83)	8.18	0.86 (0.83-0.89)	-0.153 (0.019)

Variable	% of Hospitalizations with This Risk Variable	OR (95% CI)	Model Coefficients (SE)
Late effects of cerebrovascular disease (CCS 113)	1.45	0.81 (0.75-0.87)	-0.214 (0.040)
Parkinson`s disease (CCS 79)	1.36	0.92 (0.85-1.00)	-0.082 (0.042)
Other hereditary and degenerative nervous system conditions (CCS 81)	1.35	0.97 (0.90-1.05)	-0.030 (0.040)
Occlusion or stenosis of precerebral arteries (CCS 110)	0.92	0.72 (0.65-0.80)	-0.328 (0.053)
Other and ill-defined cerebrovascular disease (CCS 111)	0.59	0.75 (0.66-0.85)	-0.287 (0.065)
Low Frequency Conditions	0.36	1.01 (0.87-1.16)	0.005 (0.073)
Multiple sclerosis (CCS 80)	0.30	1.07 (0.90-1.25)	0.063 (0.083)
Coma; stupor; and brain damage (CCS 85)	0.29	1.12 (0.97-1.31)	0.117 (0.076)
Paralysis (CCS 82)	0.28	0.81 (0.68-0.97)	-0.210 (0.089)

Table 4.2.6 – Model Performance by Specialty Cohort (July 2015-June 2016)

Specialty Cohort	Predictive Ability, % (lowest decile-highest decile)	c-statistic
Medicine	8.1-32.1	0.65
Surgery/Gynecology	3.7-25.7	0.68
Cardiorespiratory	9.6-35.3	0.64
Cardiovascular	5.1-29.2	0.66
Neurology	7.2-25.1	0.63

Table 4.2.7 – Index Hospitalizations and Observed Readmission Rates by Specialty Cohort (July 2015-June 2016)

Specialty Cohort	Index Hospitalizations	Observed Readmission Rate
Medicine	2,848,725	16.8%
Surgery/Gynecology	1,758,448	11.3%
Cardiorespiratory	1,088,019	19.4%
Cardiovascular	672,927	14.3%
Neurology	422,604	13.0%
HWR	6,790,723	15.3%

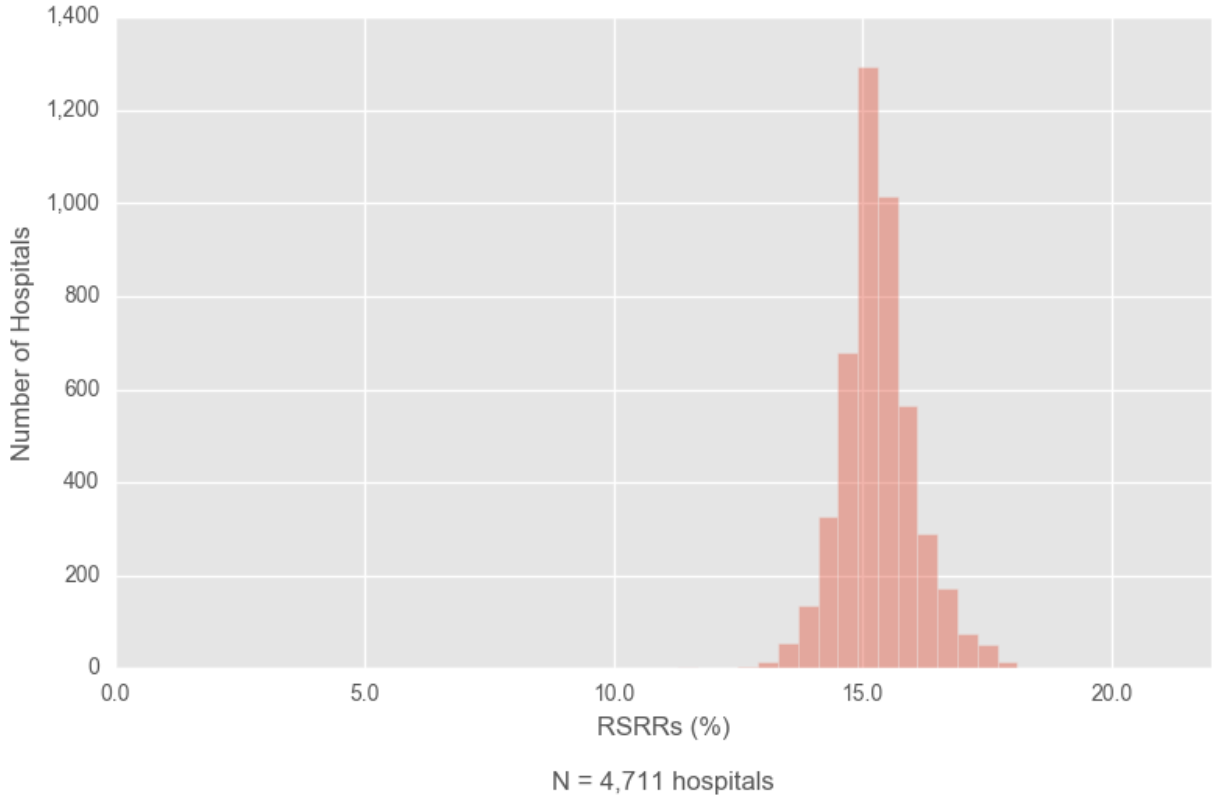
Table 4.2.8 – Hospital-Level Observed Readmission Rates and SRRs (July 2015-June 2016)

Variable	Number of Hospitals	Mean Observed Readmission Rate (standard deviation [SD])	Median Observed Readmission Rate (IQR)	Mean SRR (SD)	Median SRR (IQR)
Medicine	4,669	15.2 (6.5)	15.6 (12.7-18.0)	1.001 (0.064)	0.997 (0.962-1.036)
Surgery/ Gynecology	3,953	10.6 (7.8)	10.4 (7.0-13.3)	1.001 (0.065)	0.997 (0.969-1.030)
Cardiorespiratory	4,535	17.7 (7.4)	18.0 (14.3-21.3)	1.001 (0.069)	0.995 (0.960-1.037)
Cardiovascular	4,347	14.2 (10.9)	13.9 (9.7-17.5)	1.001 (0.041)	0.998 (0.984-1.016)
Neurology	4,311	12.0 (11.3)	11.7 (5.9-15.5)	1.001 (0.041)	0.997 (0.983-1.015)
HWR	4,711	14.3 (4.8)	14.6 (12.2-16.8)	1.000 (0.050)	0.996 (0.972-1.025)

Table 4.2.9 – Distribution of Hospital-Level Observed Readmission Rates and RSRRs (July 2015-June 2016)

Composite Readmission Rate	Mean	SD	Min	10th Percentile	Lower Quartile	Median	Upper Quartile	90th Percentile	Max
Observed	14.3	4.8	0.0	9.0	12.1	14.6	16.8	19.1	100.0
RSRR	15.3	0.8	11.3	14.4	14.9	15.3	15.7	16.3	21.3

Figure 4.2.2 – Distribution of Hospital 30-Day HWR RSRRs between July 2015 and June 2016



5. GLOSSARY

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

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

Clinical Classification Software (CCS): Software maintained by the AHRQ that groups thousands of individual procedure and diagnosis codes into clinically coherent, mutually exclusive procedure and diagnosis categories. AHRQ CCS 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-9 and ICD-10 codes to the AHRQ CCS diagnosis and procedure categories are available on the AHRQ website.

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

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

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

Condition Categories (CCs): Groupings of ICD-9-CM/ICD-10-CM diagnosis codes in clinically relevant categories, from the Hierarchical Condition Categories (HCCs) system.[11,12] 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.

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 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 to RSRRs for HWR

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

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

Specifically, for a given specialty cohort, we use a hierarchical logistic regression model to account for the natural clustering of observations within hospitals. Let Y_{ij} denote the outcome (equal to 1 if patient *i* is readmitted within 30 days, zero otherwise) for a patient in cohort C $\subseteq$ {1.,,,.5 at hospital *j*; $\mathbf{Z_{ij}}$ denotes a set of risk factors. Let *M* denote the total number of hospitals and m_j the number of index patient stays in hospital *j*. We assume the outcome is related linearly to the covariates via a logit function with dispersion:

$$\text{logit}(\text{Prob}(Y_i = 1)) = \alpha_j + \boldsymbol{\beta}^{*}\mathbf{Z_{ij}} + \varepsilon_i \qquad (1)$$

$$\alpha_j = \mu + \omega_j \; ; \; \omega_j \sim N(0,\tau^2)$$

where $\mathbf{Z_{ij}} = (Z_1, Z_2, \ldots Z_k)$ is a set of *k* patient-level covariates. α_j represents the hospital-specific intercept; μ is the adjusted average intercept across all hospitals in the sample; and τ^2 is the between-hospital variance component and $\varepsilon \sim N(0,\sigma^2)$ captures any over- or under-dispersion.[13] The hierarchical logistic regression models are estimated using the SAS software system (SAS 9.3 GLIMMIX).

Hospital Performance Reporting

The previous section describes how the models for each specialty cohort are specified and estimated, using a separate hierarchical logistic regression model for that cohort. Each model is then used to calculate an SRR for each hospital that contributes index admissions to that model. These SRRs, weighted by volume, are pooled for each hospital to create a composite hospital-wide SRR.

SRR for each specialty cohort

We use the results of each hierarchical logistic regression model to calculate the predicted number of readmissions and the expected number of readmissions at each hospital. The predicted number of readmissions in each cohort is calculated, using the corresponding hierarchical logistic regression model, as the sum of the predicted probability of readmission for each patient, including the hospital-specific (random) effect. The expected number of readmissions in each cohort for each hospital is similarly calculated as the sum of the predicted probability of readmission for each patient, ignoring the hospital-specific (random) effect. Using the notation of the previous section, the model-specific risk-standardized readmission ratio is calculated as follows. To calculate the predicted number of admissions $pred_{Cj}$ for index admissions in cohort C=1,...,5 at hospital *j*, we use

$$pred_{Cj} = \sum \text{logit}^{-1}(\alpha_j + \boldsymbol{\beta}^{*}\mathbf{Z}_{ij}) \quad (2)$$

where the sum is over all m_{Cj} index admissions in cohort C with index admissions at hospital *j*. To calculate the expected number exp_{Cj} we use

$$exp_{Cj} = \sum \text{logit}^{-1}(\mu + \boldsymbol{\beta}^{*}\mathbf{Z}_{ij}) \quad (3)$$

Then, as a measure of excess or reduced readmissions among index admissions in cohort C at hospital *j*, we calculate the standardized risk ratio SRR_{Cj} as

$$SRR_{Cj} = pred_{Cj}/exp_{Cj} \quad (4)$$

Risk-standardized hospital-wide 30-day readmission rate

To report a single readmission score, the separate specialty cohort SRRs are combined into a single value. We create a single score as follows.

For a given hospital, j, which has patients in some subset of cohorts $C \subseteq \{1,...,5\}$, the SRR is calculated as described for each specialty cohort for which the hospital discharged patients. If the hospital does not have index admissions in a given cohort c, then $m_{cj} = 0$ and we take $SRR_{cj} = 1$. Then, we calculate the volume-weighted logarithmic mean:

$$SRR_j = \exp\left(\left(\sum m_{cj} \log(R_{cj})\right) / \sum m_{cj} \right) \quad (5)$$

where the sums are over all specialty cohorts; note that if a hospital does not have index admissions in a given cohort ($m_{cj} = 0$) that cohort contributes nothing to the overall score SRR_j. This value, SRR_j , is the hospital-wide SRR for hospital *j*. To aid interpretation, this ratio is then multiplied by the overall national observed readmission rate for all index admissions in all cohorts, $\overline{Y}$, to produce the $RSRR_j$.

$$RSRR_j = SRR_j^* \bar{Y} \quad (6)$$

Creating Interval Estimates

Because the statistic described in Equation 6**,** that is, $RSRR_j$, is a complex function of parameter estimates, we use the re-sampling technique, bootstrapping, to derive an interval estimate. Bootstrapping has the advantage of avoiding unnecessary distributional assumptions.

Algorithm:

Let *M* denote the total number of hospitals in the sample. We repeat steps 1 – 4 below for b times, where b is the number of bootstrap samples desired:

1. Sample *M* hospitals with replacement.

2. Fit the five cohort hierarchical logistic regression models using all patients within each sampled hospital. As starting values, we use 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 *M* random effects to estimate the variance components. At the conclusion of Step 2, we have

    1. $\boldsymbol{\beta}^{(b)}$, the vector of coefficients, and the corresponding variance covariance matrix **V**.

    2. $\mu^{(b)}$, the average hospital rate; $\tau^{2(b)}$, the between hospital variance, and

    3. the set of hospital-specific intercepts and corresponding variances; $\{\alpha_j^{(b)}$, $var[\alpha_j^{(b)}] : j = 1,2,\ldots,M\}$

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 $\alpha_j^{(b*)} \sim N(\alpha_j^{(b)}$, var $[\alpha_j^{(b)}])$ for the unique set of hospitals sampled in Step 1.

4. Within each unique hospital *j* sampled in Step 1, and using index admissions $i=1,\ldots,m_j$ in that hospital, we calculate SRR^*_j and then $RSRR^*_j$ as in equations (5) and (6).

Ninety-five percent interval estimates (or alternative interval estimates) for the hospital-standardized outcome can be computed by identifying the 2.5^{th} and 97.5^{th} percentiles of the B estimates (or the percentiles corresponding to the alternative desired intervals).[14]

Appendix B. Data QA

This production year required revision of all SAS packs to account for the ICD-10 code transition. In order to assure the quality of measure output, we utilized a multi-phase approach to QA of the 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 started prior to the SAS pack revisions. We tested the conversion of the HCC map from version 12 to version 22 to ensure that the risk variables were well-aligned in both coding schemes. Following risk variable testing, we tested the impact of ICD-10 coding on the cohort inclusion and exclusion criteria, outcomes, and risk factors. We drew comparisons between the first six months of data from the start of the ICD-10 transition and the same six months in the prior year for ICD-9.

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

Phase II

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

Phase III

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

Appendix C. Annual Updates

Prior annual updates for the 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.

2017

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 AHRQ ICD-10 CCS and ICD-10 codes for certain "potentially planned procedures" and "acute diagnoses" to the algorithm specifications, for discharges on or after October 1, 2015.
   - Re-specified the risk 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. HHS mandated that ICD-10 codes be used for medical coding, effective October 1, 2015 discharges. The measurement period for 2017 public reporting required data from claims that include ICD-10 codes in addition to data from claims that include ICD-9 codes. Thus, re-specification was warranted to accommodate ICD-10 coding.
2. Updated the methodologies used to identify transfers to psychiatric and rehabilitation units, to ensure these transfers are not counted as readmissions for any hospital (as described in the 2013 update below and the 2010 AMI, HF, and pneumonia readmission measures maintenance report):
   - Psychiatric admissions – Previous criterion (2) and (3) apply. However, criterion (1) was modified slightly to:
     (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with '29', '30' or '31', for discharges prior to October 1, 2015, or ICD-10-CM codes beginning with 'F', for discharges on or after October 1, 2015);
   - Rehabilitation admissions – For discharges on or after October 1, 2015, the previous approach is replaced with:
     (1) the index admission has a discharge disposition code to a rehabilitation hospital or rehabilitation unit from the index admission; and,
     (2) the admission being evaluated as a potential readmission occurred on the same day as or the day following the index discharge.
     - Rationale: With the implementation of ICD-10 coding effective with October 1, 2015+ discharges, the ICD-9-code-based criterion developed in 2010 needed to be re-specified. For psychiatric admissions, defining "psychiatric diagnosis" with ICD-10-CM codes for October 1, 2015+ discharges was a simple solution, as mental health diagnosis codes all reside under the Category 'F' (Mental, Behavioral and Neurodevelopmental disorders). However, for rehabilitation admissions, rehabilitation diagnosis codes are not coded consistently. Thus, re-defining the

V57.0 ICD-9-CM code criterion with ICD-10-CM codes was not a viable option, and a different strategy was warranted.

2016

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.

2015

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.

2014

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.

2013

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 CMS certification number [CCN]) as the acute care hospital in which they are housed. Transfers to these units can therefore look like readmissions. In order to accurately assess readmissions in Maryland and allow for public reporting of Maryland readmission rates, methodologies to identify these cases were needed, to ensure these transfers are not counted as readmissions for any hospital. Rehabilitation admissions are identified by ICD-9-CM principal discharge diagnosis code (codes beginning with 'V57' indicate admission to a rehabilitation unit). A psychiatric admission is identified if all three of the following criteria are met:
     (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with '29', '30', or '31');
     (2) the index admission has a discharge disposition code to a psychiatric hospital or psychiatric unit from the index admission; and,
     (3) the admission being evaluated as a potential readmission occurred during the same day as or the day following the index discharge.
     Psychiatric/rehabilitation admissions identified as described above are not counted as readmissions. Note that we do not expect to see rehabilitation claims in hospital data from states other than Maryland.
   - The criteria for identifying such admissions are available in the 2010 AMI, HF, and pneumonia readmission measures maintenance report.

Appendix D. Measure Specifications

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

Cohort

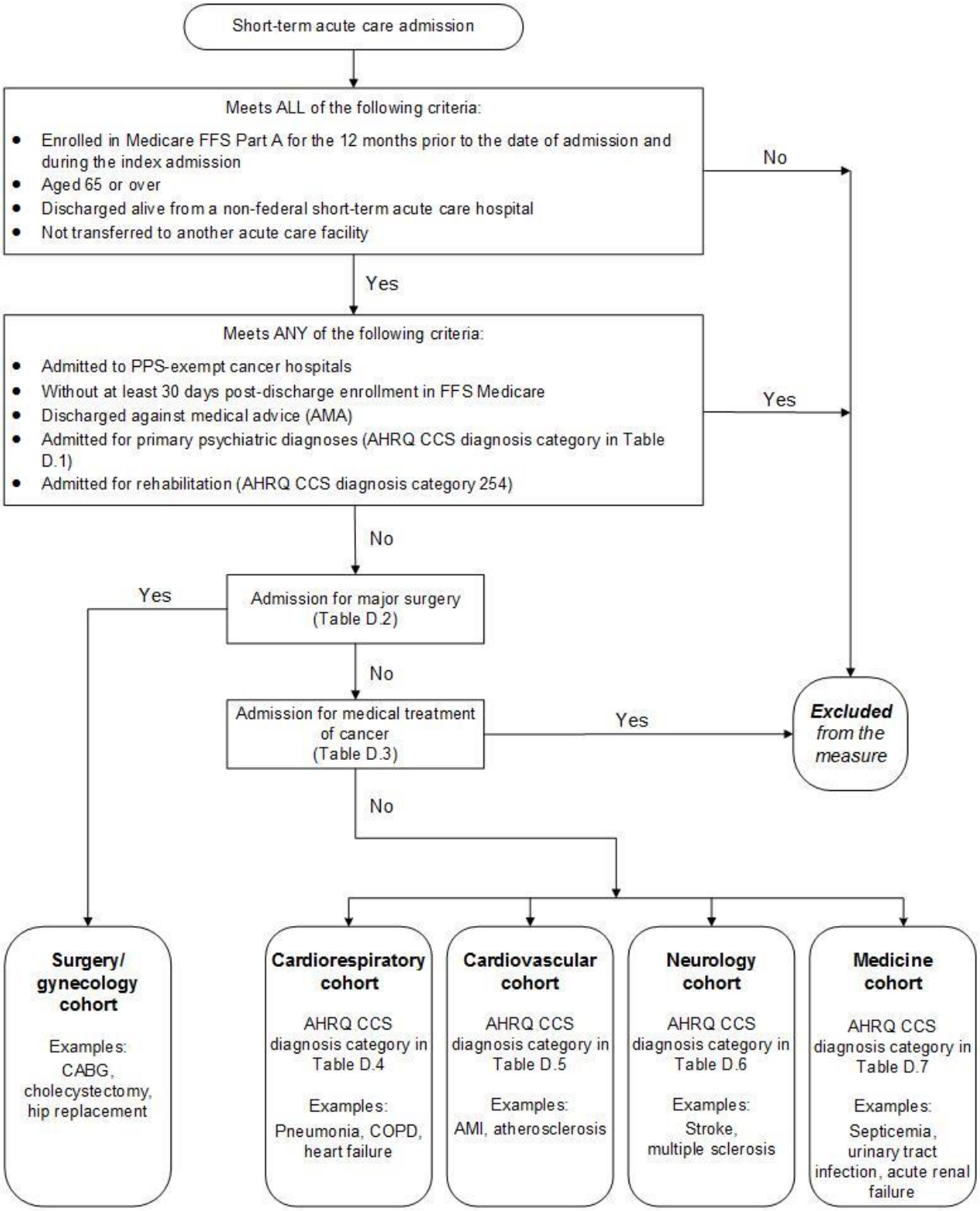
Inclusion Criteria for HWR Measure

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



Note that the ICD-10-based AHRQ CCS categories listed in Tables D.1 through D.7 below are used to define the specialty cohorts and cohort exclusions for discharges on or after October 1, 2015. The ICD-9-based AHRQ CCS categories for discharges prior to October 1, 2015 can be found in the 2016 hospital-wide readmission measure updates and specifications report posted on *QualityNet.*

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 – Procedure Categories Defining the Surgery/Gynecology Cohort

Note: These categories are not mutually exclusive. Multiple procedures may be performed during a single admission**.**

AHRQ CCS Procedure	Description
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

AHRQ CCS Procedure	Description
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
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
134	Cesarean section

AHRQ CCS Procedure	Description
135	Forceps; vacuum; and breech delivery
139	Fetal measurement and monitoring
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)
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)

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

AHRQ CCS Diagnosis	Description
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
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

AHRQ CCS Diagnosis	Description
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

AHRQ CCS Diagnosis	Description
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
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

AHRQ CCS Diagnosis	Description
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
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

AHRQ CCS Diagnosis	Description
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
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

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

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.

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 or acute leukemia (CC 8)	Metastatic cancer or 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

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")
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 gastrointestinal disorders (CC 34, 36)	Chronic pancreatitis (CC 34)	
	Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 36)	X
Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	Rheumatoid arthritis and inflammatory connective tissue disease (CC 40)	
Severe hematological disorders (CC 46)	Severe hematological disorders (CC 46)	
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
	Acute myocardial infarction (CC 86)	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")
Coronary atherosclerosis or angina, cerebrovascular disease (CC 86-89, 102, 105-109)	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)	
	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

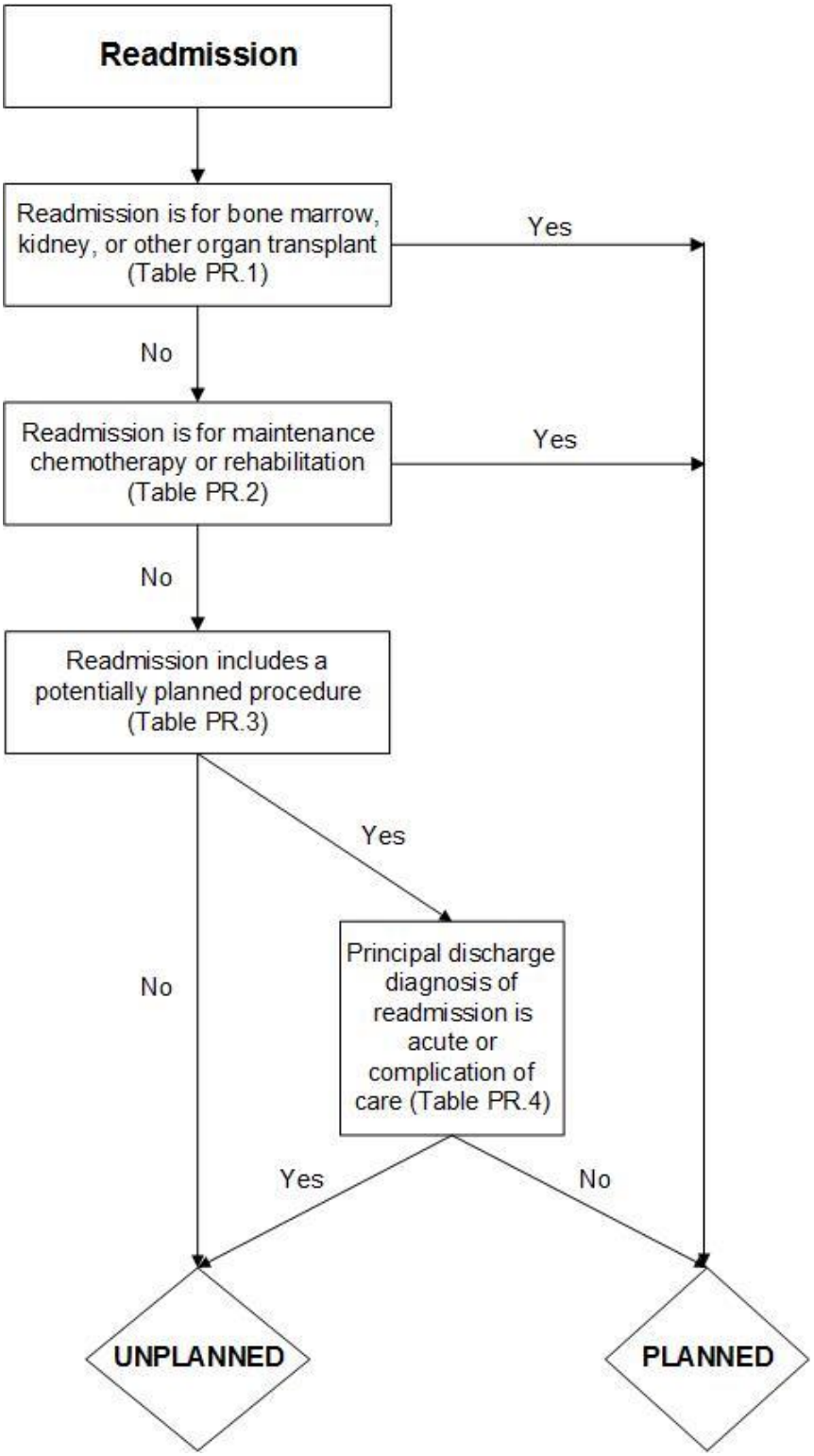
Outcome Criteria for HWR Measure

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 (ICD-10) Flowchart



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

Note that the ICD-10-based AHRQ CCS categories listed in Tables PR.1 through PR.4 below and the singular ICD-10 codes listed in Tables PR.3 and PR.4 are used to identify planned readmissions in claims for discharges on or after October 1, 2015. The ICD-9-based AHRQ CCS categories and singular ICD-9 code lists for discharges prior to October 1, 2015 can be found in the 2016 hospital-wide readmission measure updates and specifications report posted on *QualityNet.*

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

AHRQ CCS Procedure	Description
64	Bone marrow transplant
105	Kidney transplant
134	Cesarean section [Included only in all-payer population, not Medicare]
135	Forceps; vacuum; and breech delivery [Included only in all-payer population, not Medicare]
176	Other organ transplantation (other than bone marrow corneal or kidney)

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

AHRQ CCS Diagnosis	Description
45	Maintenance chemotherapy; radiotherapy
194	Forceps delivery [Included only in all-payer population, not Medicare]
196	Other pregnancy and delivery including normal [Included only in all-payer population, not Medicare]
254	Rehabilitation care; fitting of prostheses; and adjustment of devices

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

Procedure Category/ICD-10-PCS Codes	Description
AHRQ CCS Procedure Categories	
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
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

Procedure Category/ICD-10-PCS Codes	Description
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	
0CBS4ZZ, 0CBS7ZZ, 0CBS8ZZ	Laryngectomy
0B5N0ZZ, 0B5N3ZZ, 0B5N4ZZ, 0B5P0ZZ, 0B5P3ZZ, 0B5P4ZZ, 0BW10FZ, 0BW13FZ, 0BW14FZ	Revision of tracheostomy, scarification of pleura
0TC03ZZ, 0TC04ZZ, 0TC13ZZ, 0TC14ZZ, 0TC33ZZ, 0TC34ZZ, 0TC43ZZ, 0TC44ZZ	Nephrostomy
0T9030Z, 0T9130Z	Kidney procedures
GZB0ZZZ, GZB1ZZZ, GZB2ZZZ, GZB3ZZZ, GZB4ZZZ	Electroshock therapy

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

Diagnosis Category/ICD-10-CM Codes	Description
AHRQ CCS Diagnosis Categories	
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
99	Hypertension with complications and secondary hypertension
102	Nonspecific chest pain
104	Other and ill-defined heart disease
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis

Diagnosis Category/ICD-10-CM Codes	Description
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
232	Sprains and strains
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin

Diagnosis Category/ICD-10-CM Codes	Description
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	
A36.81, A39.50, A39.51, A39.52, A39.53, B33.20, B33.21, B33.22, B33.23, B37.6, B58.81, I01.0, I01.1, I01.2, I01.8, I01.9, I02.0, I09.0, I09.89, I09.9, I30.0, I30.1, I30.8, I30.9, I31.0, I31.1, I31.2, I31.4, I32, I33.0, I33.9, I39, I40.0, I40.1, I40.8, I40.9, I41, I51.4	Peri-; endo-; and myocarditis; cardiomyopathy
I21.01, I21.02, I21.09, I21.11, I21.19, I21.21, I21.29, I21.3, I21.4	Acute myocardial infarction (without subsequent MI)
I44.0, I44.1, I44.2, I44.30, I44.39, I44.4, I44.5, I44.60, I44.69, I44.7, I45.0, I45.10, I45.19, I45.2, I45.3, I45.4, I45.5, I45.6, I45.81, I45.9	Conduction disorders
I47.9, I49.3, I49.49, I49.8, I49.9, R00.0, R00.1	Dysrhythmia
I09.81, I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.9	Congestive heart failure; nonhypertensive
K80.00, K80.01, K80.12, K80.13, K80.30, K80.31, K80.32, K80.33, K80.36, K80.37, K80.42, K80.43, K80.46, K80.47, K80.62,	Biliary tract disease

Diagnosis Category/ICD-10-CM Codes	Description
K80.63, K80.66, K80.67, K81.0, K81.2, K83.0	
K85.0, K85.1, K85.2, K85.3, K85.8, K85.9	Pancreatic disorders