2013 Measure Updates and Specifications Report: Hospital-Wide All-Cause Unplanned Readmission Measure (Version 2.0)

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March 2013

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Acknowledgements

This work is a collaborative effort, and the authors gratefully acknowledge and thank Mai Hubbard, Angela Merrill, Candace Natoli, Sandra Nelson, Bailey Orshan, Eric Schone, and Matthew Sweeney from Mathematica Policy Research, Inc.; Sharon-Lise Normand from Harvard Medical School, Department of Health Care Policy and Harvard School of Public Health, Department of Biostatistics; Jennifer Mattera, Jinghong Gao, Lori Geary, Elizabeth Eddy, Julia Montague and Mark Volpe from Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation; Dima Turkmani from Taybah for Healthcare Consulting, Inc.; and Lein Han and Kate Goodrich at the Centers for Medicare & Medicaid Services for their contributions to this work.

We would also like to acknowledge the very thoughtful and instructive comments on the CMS Planned Readmission Algorithm from stakeholders during the public comment periods and from surgeons nominated by their specialty societies to participate in brief reviews of the procedures considered planned and unplanned in their specialty area.

1. HOW TO USE THIS REPORT

This report describes the Centers for Medicare & Medicaid Services (CMS) Hospital-Wide All-Cause Unplanned Readmission (HWR) measure used in the Hospital Inpatient Quality Reporting (IQR) program and publicly reported on *Hospital Compare*.

This report is intended to provide a single source of information about the current measure for a wide range of readers. Within this report we provide an overview of the measure methodology, describe methodology updates to the measure and the national results for 2013 public reporting, as well as a description of our quality assurance processes. The appendices provide further details, including concise tables of measure specifications and a list of the annual updates. Specifically the reader can find:

- **An overview of the HWR measure (Section 2):**
  - History of the measure
  - Measure cohort
    - included and excluded hospitalizations
    - how transfers are handled
    - specialty cohort assignment
  - Outcome (what readmissions are counted)
    - What is considered a planned readmission
  - Risk-adjustment variables
  - Data sources
  - How the RSRR is calculated
  - How hospitals are characterized

- **2013 Measure Updates (Section 3):**
  - The most significant update for 2013 reporting is the modification of the planned readmission algorithm used to identify planned readmissions for procedures and treatments and not count them in the outcome.

- **2013 results (Section 4):**
  - Results from the models that are used for the Hospital Inpatient Quality Reporting (IQR) program in 2013.

- **Quality assurance process (Section 5)**

The Appendices contain detailed measure information, including:

- Appendix A: Measure specifications;
- Appendix B: Annual updates to the measure since measure development;
- Appendix C: Detailed overview of the Planned Readmission Algorithm;
- Appendix D: Definitions for common terms; and
- Appendix E: RTI International's memorandum on updates to the Condition Category (CC) map.

For additional references, the original measure methodology and development technical report is also available on the claims based readmission measure page of *QualityNet*:

- Hospital-Wide All-Cause Unplanned Readmission Measure: Final Technical Report (2011).[1]

2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

2.1 Background on Measure

In July 2009, CMS began publicly reporting hospital 30-day risk-standardized readmission rates (RSRRs) for acute myocardial infarction (AMI), heart failure (HF), and pneumonia for the nation's non-federal* acute care hospitals, including critical access hospitals.[2-4] In 2011, CMS and the Veterans Health Administration (VA) collaborated to update the readmission measures to include hospitalizations for patients admitted for AMI, HF, or pneumonia in VA hospitals. The readmission measures are posted on *Hospital Compare*, and CMS updates them annually.

In order to provide a broader assessment of the quality of care at hospitals, CMS developed the Hospital-Wide All-Cause Unplanned Readmission Measure (HWR measure), a claims-based, risk-adjusted hospital-wide readmission measure for public reporting that reflects the quality of care for hospitalized patients in the United States. The National Quality Forum (NQF) has endorsed the measure (NQF #1789). CMS added the HWR measure to the Inpatient Quality Reporting (IQR) program (see Fiscal Year 2013 Hospital Inpatient Prospective Payment System (PPS) Final Rule) and will begin publicly reporting the measure on *Hospital Compare* in 2013.

CMS contracted with YNHHSC/CORE to update the HWR measure for 2013 public reporting through a process of measure maintenance. Measure maintenance is an annual process to improve the measures by responding to stakeholder input on the measure and incorporating advances in the science or changes in coding.

2.2 Overview of Measure Methodology

For 2013 public reporting CMS has made several refinements to the HWR measure. The updated measure uses the NQF-endorsed methodology set forth in the initial measure methodology report[1] with the refinements to the measure listed in Appendix B. Below, we provide an overview of the methodology.

2.2.1 Cohort

Index Admissions Included in the Measure

An *index admission* is the hospitalization considered for the readmission outcome.

The HWR measure includes index admissions for patients:

- Who are enrolled in Medicare fee-for-service (FFS);
- Aged 65 years or over;
- Discharged from non-federal acute care hospitals;
- Without an in-hospital death; and
- Who were not transferred to another acute care facility, as described further below, because the measure evaluates hospitalizations for patients discharged to non-acute care settings.

* Note: Includes Indian Health Services hospitals

Index Admissions Excluded from the Measure[†]

The HWR measure excludes admissions for patients:

- Who were admitted to Prospective Payment System (PPS)-exempt cancer hospitals, because these hospitals care for a unique population of patients that cannot reasonably be compared to the patients admitted to other hospitals;
- Without at least 30 days post-discharge enrollment in FFS Medicare, because the 30-day readmission outcome cannot be assessed in this group;
- Who were not enrolled in Part A Medicare for the 12 months prior to and including the date of the index admission, which ensures a full year of administrative data for risk adjustment;
- Who were discharged against medical advice (AMA), because providers did not have the opportunity to deliver full care and prepare the patient for discharge;
- Who were admitted for primary psychiatric diagnoses, because these patients are typically cared for in separate psychiatric or rehabilitation centers that are not comparable to acute care hospitals;
- Who were admitted for rehabilitation, because these patients are not typically admitted to an acute care hospital and are not for acute care; and
- Who were admitted for medical treatment of cancer, because these admissions have a very different readmission profile than the rest of the Medicare population, and outcomes for these admissions do not correlate well with outcomes for other admissions.

The number of admissions excluded based on each criterion is show in Section 4 in Figure 1. See Appendix A for specific CCS categories excluded from the measure.

Transferred Patients

The measure considers multiple contiguous hospitalizations as a single acute episode of care. Admissions to another hospital within one day of discharge are considered transfers, regardless of the disposition of the previous admission.

Readmissions for transferred patients are attributed to the hospital that ultimately discharges the patient to a non-acute care setting (for example, to home or a skilled nursing facility). Thus, if a patient is admitted to Hospital A, transferred to Hospital B, and ultimately discharged from Hospital B to a non-acute care setting, a readmission within 30 days of discharge to any acute-care hospital is attributed to Hospital B.

Please note that if a patient is readmitted to the same hospital on the same day of discharge for the same diagnosis as the index admission, the measure combines both

[†] Note: 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, and stays for patients not listed in the Medicare enrollment file as well as records for providers with invalid provider IDs

stays. However, if the diagnosis of the readmission is different from the index admission, this is considered a readmission.

Specialty Cohort Assignment

Each 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 surgical procedure category. Admissions with an eligible surgical procedure category are assigned to the surgical cohort, regardless of the diagnosis code of the admission. All remaining admissions are assigned to cohorts on the basis of the discharge condition category. See Appendix A for more information on the assignment of patients to specialty cohort groups.

2.2.2 Outcome

All-Cause Unplanned Readmissions

The measure counts all unplanned readmissions. It is designed to capture readmissions that arise from acute clinical events requiring urgent rehospitalization within 30 days of discharge. Planned readmissions, which are generally not a signal of quality of care, are not counted in the measure. For more details about how the planned readmissions are defined see Section 3 and Appendix C.

There are a number of reasons for counting 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, it is difficult to make inferences about quality issues and accountability based solely on the documented cause of readmission. For example, a patient with HF who develops a hospital-acquired infection may ultimately be readmitted for sepsis. In this context it would be inappropriate to consider the readmission to be unrelated to the care the patient received for HF during the index admission.

30-Day Time Frame

The measure assesses unplanned readmissions within a 30-day period from the date of discharge from an index admission. This standard time period is necessary so that the outcome for each patient is measured uniformly. The measures use a 30 day time frame because outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the outpatient setting.[5] The use of the 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce readmissions.

Multiple Readmissions

Note that a readmission is also eligible as an index admission if it meets all other eligibility criteria. This differs from the publicly reported AMI, heart failure, pneumonia and hip/knee readmission measures, which do not count readmissions as a new index

admission within the same measure. However, if the first readmission after discharge is planned, then no readmission is considered in the outcome, regardless of whether a subsequent unplanned readmission takes place because it would be unfair to attribute the unplanned readmission back to the care received during the index admission.

2.2.3 Risk-adjustment Variables

The measure adjusts for variables (that is, age, comorbid diseases, and condition categories) that are clinically relevant and have strong relationships with the outcome. For each patient, risk-adjustment variables are obtained from inpatient Medicare administrative claims extending 12 months prior to, and including, the index admission.

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

The measure does not adjust for the patients' admission source or their discharge disposition (for example, skilled nursing facility) because these factors are associated with the structure of the health care system, not solely patients' clinical comorbidities. Regional differences in the availability of post-acute care providers and practice patterns might exert an undue influence on model results.

The measure also 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 received by groups of patients with varying SES. Risk adjusting for patient SES would suggest that hospitals with low SES patients should be held to different standards for patient outcomes than hospitals treating higher SES patient populations. It could also mask important disparities and minimize incentives to improve outcomes for vulnerable populations. The intention is for the measure to adjust for patient demographic and clinical characteristics while illuminating important quality differences. This methodology is consistent with guidance from the National Quality Forum (NQF). Additionally, recent analyses have shown that hospitals caring for high proportions of low SES patients perform similarly on the measure to hospitals caring for low proportions of low SES patients.[6]

Please refer to Table 2, Table 3, Table 4, Table 5, and Table 6 in Section 4 of this report for the list of risk-adjustment variables.

2.2.4 Data Source

The data sources for these analyses are Medicare administrative claims and enrollment information for patients with hospitalizations that occurred between July 1, 2011 and June 30, 2012.

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. This makes it feasible to implement with Medicare data. The impact of not including outpatient data (Part B) on model performance has been studied for six publicly reported outcome measures (AMI, HF, and pneumonia 30-day risk-standardized mortality and readmission rates) and the results reported in a separate memo to CMS.[7]

Please see the methodology report[1] for further description of these data sources.

2.2.5 Measure Calculation

The measure estimates a hospital-level 30-day all-cause RSRR using hierarchical logistic regression models (Appendix A). In brief, the approach simultaneously models two levels of data (patient and hospital) to account for the variance in patient outcomes within and between hospitals.[8] At the patient level, it models the log-odds of readmission within 30 days of admission using age, selected clinical covariates, and a hospital-specific intercept. At the hospital level, it models the hospital-specific intercepts as arising from a normal distribution. The hospital intercept represents the underlying risk of readmission at the hospital, after accounting for patient risk. The hospital-specific intercepts are given a distribution in order to account for the clustering (non-independence) of patients within the same hospital.[8] If there were no differences among hospitals, then after adjusting for patient risk, the hospital intercepts 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, CMS calculates a standardized readmission ratio (SRR), the ratio of the number of "predicted" readmissions to the number of "expected" readmissions. For each hospital, the "numerator" of the SRR is the number of readmissions within 30 days predicted based on the hospital's performance with its observed case mix and service mix. The "denominator" is the number of readmissions expected on the basis of 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. Thus an SRR of less than one indicates a lower-than-expected readmission rate (or better quality), and a ratio of greater than one indicates a higher-than-expected readmission rate (or worse quality).

For each specialty cohort, the number of "predicted" readmissions (the numerator) is calculated by regressing the risk factors (found in Table 2 for the medicine cohort, Table 3 for the surgery/gynecology cohort, Table 4 for the cardiovascular cohort, Table 5, for the cardiorespiratory cohort, and Table 6 for the neurology cohort) and the hospital-specific intercept on the risk of readmission. The results are then transformed and summed over all patients attributed to the hospital to get a value. The "expected" number of readmissions (the denominator) is obtained by regressing the risk factors and a common intercept on the readmission outcome using all hospitals in our sample. The estimated regression coefficients are then multiplied by the patient characteristics in the hospital. The results are then transformed and summed over all patients in the

hospital to get a 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 hospital's risk-standardized readmission rate (RSRR).

The statistical modeling approach is described fully in the original methodology report.[1]

2.2.6 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 U.S. national rate" if the 95% interval estimate surrounding the hospital's rate includes the national observed readmission rate.
- "Worse than U.S. national rate" if the entire 95% interval estimate surrounding the hospital's rate is higher than the national observed readmission rate.
- "Better than U.S. 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: "The number of cases is too small (fewer than 25) to reliably tell how well the hospital is performing." If a hospital has fewer than 25 eligible cases, the hospital's readmission rates and interval estimates will not be publicly reported for the measure.

Section 4 describes the distribution of hospitals by performance category in the U.S. for this 2011-2012 reporting period.

3. UPDATES TO METHODS FOR 2013 PUBLIC REPORTING

3.1 Rationale for Measure Updates

Measure maintenance ensures that the risk-standardized readmission models are continually assessed and remain valid given possible changes in the data over time, and allows for model refinements. As described in this report, for 2013 public reporting, we undertook the following measure maintenance activities:

- Updated the measure with *Planned Readmission Algorithm Version 2.1: General Population* to remove additional planned readmissions from the outcome;
- Removed procedure CCS 61 from the list of procedures qualifying an admission for the surgery cohort;
- Incorporated ICD-9-CM coding updates for the Condition Categories;
- Updated the AHRQ CCS software used to the 2012 version[9];
- Evaluated and validated model performance in the July 2011-June 2012 dataset; and
- Updated the measure SAS pack and documentation

3.2 Detailed Discussion of Measure Updates

3.2.1 Update measure with *Planned Readmission Algorithm Version 2.1: General Population*

Modification: We developed the algorithm based on a hospital-wide (not condition-specific) cohort of patients. We began the development by using the Agency for Healthcare Research and Quality's (AHRQ's) Clinical Classification Software (CCS) codes to group thousands of individual procedure and diagnosis International Statistical Classification of Disease, ninth revision (ICD-9-CM) codes into clinically coherent, mutually exclusive procedure and diagnosis categories (PROC-CCS categories and Diagnosis-CCS categories, respectively). Clinicians then reviewed the procedure categories and identified those that are commonly planned and require admission. Clinicians also reviewed the diagnosis categories and identified those that were acute diagnoses unlikely to accompany elective procedures.

The algorithm underwent several reviews by stakeholders. We initially posted the detailed algorithm for public comment during development of the HWR measure. NQF reviewed and made the algorithm available for public comment during its endorsement review of the measure. We also recruited 27 surgical subspecialists nominated by their specialty societies to review the algorithm and suggest refinements. In addition, hospitals participating in CMS's September 2012 dry run (confidential reporting) of the hospital-wide measure commented on the initial algorithm. This work resulted in Version 2.1 of the Planned Readmission Algorithm.

Please see Appendix C for the flowchart and tables the algorithm uses to identify planned readmissions. For a more detailed discussion of the algorithm, see the *Centers for Medicare & Medicaid Services Planned Readmission Algorithm Version 2.1: General Population* report.

Change in Treatment of Unplanned Readmissions after a Planned Readmission

Under the new Planned Readmission Algorithm, unplanned readmissions within 30 days of discharge from an index admission that occur *after a planned readmission* will not be counted in the outcome. It would be unfair to attribute the unplanned readmission back to the care received during the index admission when there is an intervening planned readmission.

Rationale: The algorithm was updated after stakeholder review, additional consultation with specialists and recommendations received during CMS's September 2012 dry run (confidential reporting).

Effect on Patient Cohort: Applying the original hospital wide readmission measure to the 2013 public reporting dataset (July 1, 2011-June 30, 2012), the observed 30-day unplanned readmission rate would be 16.5% and the planned readmission rate would be 0.8 % for this reporting period. The updated measure decreased the number of readmissions counted in the outcome by identifying additional readmissions as planned. For the updated hospital wide readmission measure, the observed 30-day unplanned readmission rate is 16.0%. Thus, the revised measure increases the rate of planned readmissions by approximately 0.5%.

3.2.2 Removed procedure CCS 61 from the list of procedures qualifying an admission for the surgery cohort

Modification: Procedure CCS 61 (Other OR procedures on vessels other than head and neck) was removed from the surgical cohort definition. Discharges assigned to the surgical cohort based on this procedure CCS were reclassified to one of the other four cohorts based on the other procedure and diagnosis CCS codes of each discharge.

Rationale: This procedure CCS was removed from the surgical cohort based on feedback received during the September 2012 dry run that patients undergoing these procedures are typically admitted primarily for cardiac or medical problems rather than surgical care.

Effect on Patient Cohort: Table 1 shows how the specialty cohort sizes changed as a result of this reclassification using the 2013 public reporting dataset (July 1, 2011-June 30, 2012).

Table 1 – Change in Size of Specialty Cohorts after Removal of Procedure CCS 61

Specialty Cohort	Original Measure Frequency	Original Measure Percent	Updated Measure Frequency	Updated Measure Percent
Medicine	2,829,721	41%	2,885,247	42%
Surgical	1,837,483	27%	1,611,698	23%
Cardiorespiratory	1,165,611	17%	1,179,213	17%
Cardiovascular	660,567	10%	812,287	12%
Neurology	426,800	6%	430,022	6%
Total	6,920,182		6,918,467	

Note that the total number of discharges that are included dropped slightly because there were some cases (1,715) that were classified as Surgical by Procedure CCS 61 in the original, but were excluded because they no longer had a qualifying surgical procedure and were admitted for the medical treatment of cancer.

3.2.3 Updates to the Condition Category (CC) Map

RTI International, contracted by CMS to maintain the CC system, assigns new ICD-9-CM codes to the existing CCs based on their clinical expertise and the historical assignment of related ICD-9-CM codes to the CCs. CCs are clinically relevant diagnostic groups of the more than 14,500 ICD-9 codes. The CCs group the ICD-9-CM codes into larger groups that are used in models to predict medical care utilization, spending, mortality, or other related measures.[16] CMS revises the ICD-9-CM CC map annually to reflect changes in ICD-9-CM codes so that the measures will capture all relevant comorbidities coded in patient claims data.

The assignment of new codes and the removal of retired codes had little impact on the model variables since RTI assigned the majority of new codes, which were more specific versions of retired codes, to the same CCs as retired codes. For more details on the CC changes, see Appendix E for RTI's memo to CMS detailing the map changes.

3.3 Changes to SAS Analytic Package (SAS Pack)

We revised the measure calculation SAS pack to reflect all changes to the index admission cohorts and models as needed, including any ad-hoc patches to address data issues. The primary changes this year were made to update the measure with the *Planned Readmission Algorithm Version 2.1: General Population*. 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.**

4. RESULTS FOR 2013 PUBLIC REPORTING

4.1 Assessment of Updated Models

In this report we evaluate the performance of the models and provide national results using the data for 2013 reporting. We fit the updated models to the July 1, 2011-June 30, 2012 dataset and examined the frequency of patient risk factors, the model variable coefficients, and model performance.

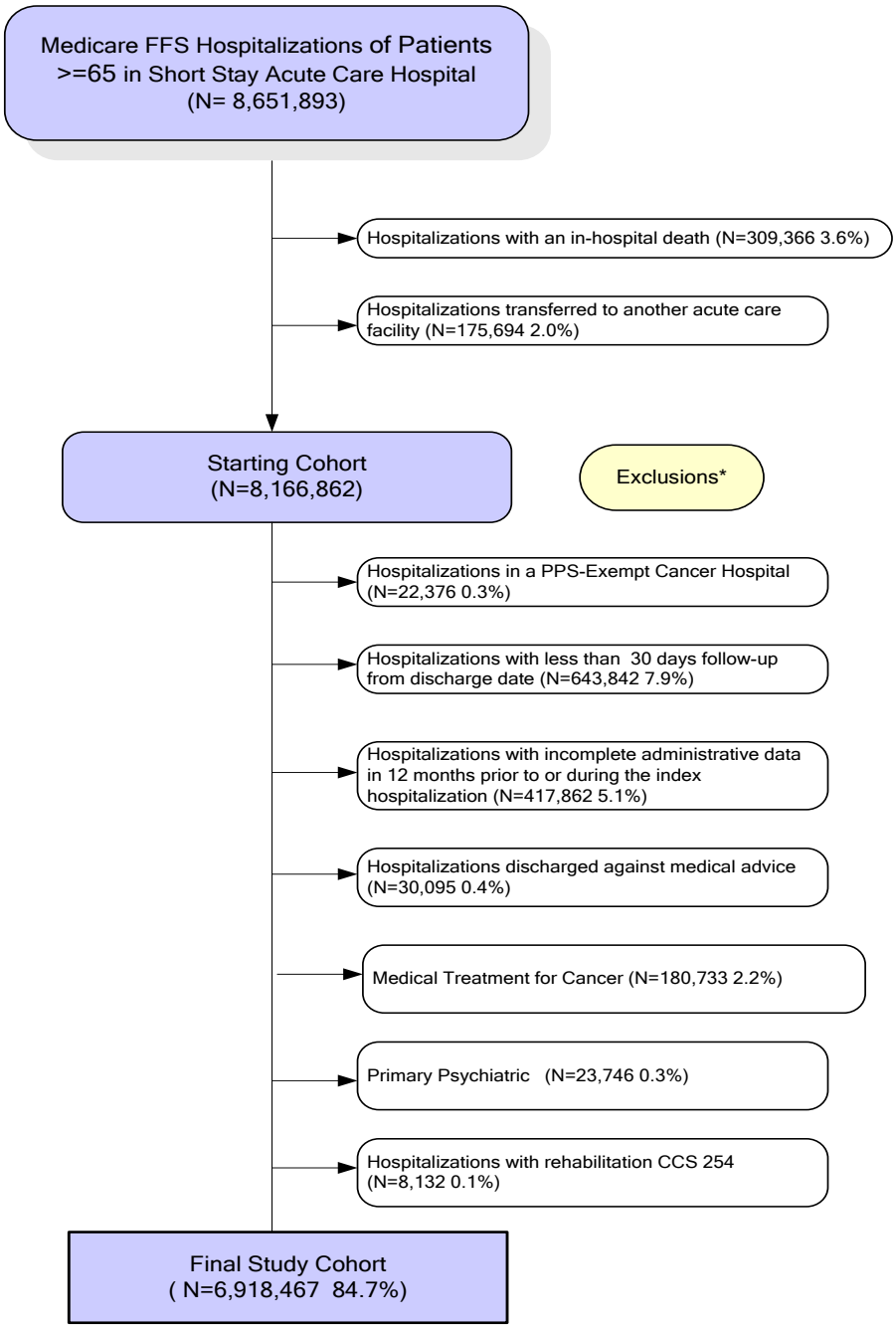
We assessed logistic regression and hierarchical logistic regression model performance in terms of discriminant ability for each specialty cohort. We computed two summary statistics for assessing model performance: the predictive ability and the area under the receiver operating characteristic (ROC) curve (c-statistic). The c-statistic is 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 meaning perfect discrimination).

The results of these analyses are presented in Section 4.3.

4.2 HWR Index Cohort Exclusions

The exclusion criteria for the measure is presented in Section 2 and the percentage of patients meeting each exclusion criterion in the July 1, 2011-June 30, 2012 dataset is presented in Figure 1.

Figure 1 – Index Cohort Sample for the July 1, 2011-June 30, 2012 Dataset[†]



* Not mutually exclusive

[†] This year, there was an increase in the percentage of hospitalizations excluded from the measure for having less than 30 days of follow up from the discharge date (7.9%). This is in part due to incomplete enrollment data for discharges in June 2012.

4.3 HWR 2013 Specialty Cohort Model Risk Factors, Parameters and Performance

Table 2, Table 3, Table 4, Table 5, and Table 6 show the specialty cohort level frequency of risk factors, the risk-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the medicine, surgery/gynecology, cardiovascular, cardiorespiratory and neurology cohorts, respectively. Table 7 presents the cohort-level model performance, and Table 8 presents the number of index hospitalizations and observed readmission rates for each specialty cohort.

4.3.1 Medicine Cohort Model Results

Table 2 – Medicine Specialty Cohort Model Risk Factor Frequencies and Odds Ratios

Risk Variable (CCs)	% of hospitalizations with this risk variable	OR (95% CI)
Mean age, years (SD)	79.5 (8.3)	1.00 (1.00-1.00)
Metastatic cancer/acute leukemia (CC 7)	4.18	1.28 (1.26-1.30)
Severe Cancer (CC 8, 9)	6.32	1.27 (1.26-1.29)
Other major cancers (CC 10-12)	9.76	1.07 (1.06-1.08)
Other hematological disorders (CC 44)	3.02	1.25 (1.23-1.27)
Coagulation defects and other specified hematological disorders (CC 46)	7.33	1.08 (1.07-1.09)
Iron deficiency (CC 47)	51.20	1.22 (1.21-1.23)
End-stage liver disease (CC 25, 26)	2.81	1.28 (1.26-1.31)
Pancreatic disease (CC 32)	3.05	1.14 (1.12-1.16)
Dialysis status (CC 130)	2.74	1.32 (1.30-1.35)
Acute renal failure (CC 131)	26.02	1.15 (1.14-1.16)
Transplants (CC 128, 174)	0.79	1.23 (1.20-1.27)
Severe Infection (CC 1, 3-5)	1.75	1.13 (1.10-1.15)
Other infectious disease & pneumonias (CC 6, 111-	28.47	1.12 (1.11-1.13)
Septicemia/shock (CC 2)	8.27	1.05 (1.03-1.06)
CHF (CC 80)	22.36	1.19 (1.18-1.20)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 81-84, 89, 98, 99, 103-106)	59.37	1.14 (1.13-1.15)
Specified arrhythmias (CC 92, 93)	24.35	1.10 (1.09-1.11)
Cardiorespiratory failure or cardiorespiratory shock (CC 79)	10.73	1.08 (1.07-1.10)
Coronary obstructive pulmonary disease (COPD) (CC 108)	26.42	1.18 (1.17-1.19)
Fibrosis of lung or other chronic lung disorders (CC 109)	3.54	1.10 (1.09-1.12)
Protein-calorie malnutrition (CC 21)	13.02	1.15 (1.14-1.16)
Disorders of fluid, electrolyte, acid-base (CC 22, 23)	34.71	1.18 (1.17-1.19)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	5.66	1.12 (1.11-1.14)
Diabetes mellitus (CC 15-20, 119, 120)	37.79	1.11 (1.10-1.11)
Ulcers (CC 148, 149)	8.18	1.11 (1.10-1.12)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177, 178)	6.60	1.08 (1.07-1.09)

Risk Variable (CCs)	% of hospitalizations with this risk variable	OR (95% CI)
Seizure disorders and convulsions (CC 74)	5.06	1.10 (1.09-1.12)
Respirator dependence/tracheostomy status (CC 77)	0.55	1.11 (1.07-1.15)
Drug and alcohol disorders (CC 51, 52)	3.59	1.09 (1.07-1.11)
Psychiatric comorbidity (CC 54-56, 58, 60)	29.45	1.08 (1.08-1.09)
Hip fracture/dislocation (CC 158)	2.92	0.92 (0.90-0.93)
Condition Specific Indicator (AHRQ CCS)		
Septicemia (except in labor) (CCS 2)	10.30	0.93 (0.91-0.95)
Urinary tract infections (CCS 159)	7.89	0.93 (0.91-0.95)
Acute and unspecified renal failure (CCS 157)	6.27	1.04 (1.02-1.07)
Fluid and electrolyte disorders (CCS 55)	4.60	0.98 (0.95-1.00)
Gastrointestinal hemorrhage (CCS 153)	4.34	0.85 (0.83-0.87)
Skin and subcutaneous tissue infections (CCS 197)	3.90	0.83 (0.80-0.85)
Complication of device; implant or graft (CCS 237)	3.33	0.99 (0.96-1.01)
Intestinal obstruction without hernia (CCS 145)	2.80	0.93 (0.90-0.95)
Syncope (CCS 245)	2.80	0.61 (0.59-0.63)
Diverticulosis and diverticulitis (CCS 146)	2.70	0.83 (0.81-0.86)
Complications of surgical procedures or medical care	2.62	0.91 (0.88-0.93)
Deficiency and other anemia (CCS 59)	2.59	1.07 (1.05-1.10)
Aspiration pneumonitis; food/vomitus (CCS 129)	2.59	0.96 (0.93-0.98)
Intestinal infection (CCS 135)	2.35	1.11 (1.08-1.14)
Hypertension with complications and secondary	2.28	Reference Group
Other fractures (CCS 231)	2.25	0.80 (0.78-0.83)
Diabetes mellitus with complications (CCS 50)	2.18	0.88 (0.86-0.91)
Phlebitis; thrombophlebitis and thromboembolism (CCS 118)	1.79	0.83 (0.81-0.86)
Other gastrointestinal disorders (CCS 155)	1.49	1.02 (0.99-1.05)
Delirium, dementia, and amnestic and other cognitive	1.19	0.85 (0.82-0.88)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	1.18	0.90 (0.86-0.93)
Residual codes; unclassified (CCS 259)	1.08	0.91 (0.87-0.94)
Pancreatic disorders (not diabetes) (CCS 152)	1.08	0.83 (0.80-0.86)
Noninfectious gastroenteritis (CCS 154)	1.05	0.82 (0.79-0.85)
Biliary tract disease (CCS 149)	1.03	0.87 (0.84-0.91)
Other lower respiratory disease (CCS 133)	1.02	0.94 (0.90-0.97)
Esophageal disorders (CCS 138)	0.95	0.82 (0.78-0.85)
Other connective tissue disease (CCS 211)	0.95	0.82 (0.79-0.86)
Pleurisy; pneumothorax; pulmonary collapse (CCS	0.90	1.26 (1.22-1.31)
Conditions associated with dizziness or vertigo (CCS 93)	0.84	0.43 (0.41-0.45)
Gastritis and duodenitis (CCS 140)	0.82	0.90 (0.86-0.94)
Abdominal pain (CCS 251)	0.74	0.86 (0.83-0.90)
Other liver diseases (CCS 151)	0.73	1.29 (1.24-1.34)
Other injuries and conditions due to external causes	0.62	0.78 (0.74-0.82)

Risk Variable (CCs)	% of hospitalizations with this risk variable	OR (95% CI)
Other disorders of stomach and duodenum (CCS 141)	0.59	1.05 (1.01-1.10)
Essential hypertension (CCS 98)	0.58	0.70 (0.67-0.74)
Low Frequency Conditions	0.55	0.89 (0.84-0.93)
Other endocrine disorders (CCS 51)	0.55	1.03 (0.99-1.08)
Other nutritional; endocrine; and metabolic disorders	0.52	0.98 (0.93-1.02)
Acute posthemorrhagic anemia (CCS 60)	0.48	1.01 (0.97-1.06)
Superficial injury; contusion (CCS 239)	0.47	0.80 (0.76-0.85)
Fracture of upper limb (CCS 229)	0.46	0.97 (0.92-1.02)
Diseases of white blood cells (CCS 63)	0.44	1.11 (1.06-1.16)
Pathological fracture (CCS 207)	0.44	1.01 (0.96-1.07)
Calculus of urinary tract (CCS 160)	0.42	0.73 (0.69-0.78)
Poisoning by other medications and drugs (CCS 242)	0.42	0.77 (0.73-0.81)
Malaise and fatigue (CCS 252)	0.42	0.89 (0.84-0.93)
Fever of unknown origin (CCS 246)	0.41	0.89 (0.85-0.94)
Fracture of lower limb (CCS 230)	0.39	0.95 (0.90-1.00)
Chronic ulcer of skin (CCS 199)	0.38	0.82 (0.77-0.86)
Genitourinary symptoms and ill-defined conditions	0.36	0.92 (0.87-0.97)
Hemorrhoids (CCS 120)	0.36	0.82 (0.77-0.87)
Nausea and vomiting (CCS 250)	0.35	1.06 (1.00-1.11)
Substance-related disorders (CCS 661)	0.34	0.93 (0.88-0.99)
Viral infection (CCS 7)	0.34	0.89 (0.84-0.94)
Alcohol-related disorders (CCS 660)	0.31	0.85 (0.79-0.90)
Fracture of neck or femur (hip) (CCS 226)	0.29	0.74 (0.69-0.79)
Other non-traumatic joint disorders (CCS 204)	0.28	0.76 (0.71-0.82)
Other upper respiratory disease (CCS 134)	0.27	0.87 (0.81-0.92)
Crushing injury or internal injury (CCS 234)	0.26	0.91 (0.85-0.97)
Mycoses (CCS 4)	0.25	1.29 (1.22-1.37)
Abdominal hernia (CCS 143)	0.25	0.83 (0.77-0.89)
Regional enteritis and ulcerative colitis (CCS 144)	0.25	1.17 (1.10-1.25)
Coagulation and hemorrhagic disorders (CCS 62)	0.23	1.38 (1.30-1.46)
Infective arthritis and osteomyelitis (except that	0.22	0.85 (0.80-0.91)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.22	0.85 (0.79-0.92)
Gout and other crystal arthropathies (CCS 54)	0.21	0.84 (0.78-0.90)
Other upper respiratory infections (CCS 126)	0.20	0.66 (0.60-0.72)
Osteoarthritis (CCS 203)	0.19	0.74 (0.68-0.81)
Other diseases of veins and lymphatics (CCS 121)	0.19	0.86 (0.79-0.92)
Headache; including migraine (CCS 84)	0.19	0.63 (0.57-0.68)
Other diseases of kidney and ureters (CCS 161)	0.19	1.02 (0.95-1.09)
Other and unspecified benign neoplasm (CCS 47)	0.18	0.95 (0.87-1.02)
Anal and rectal conditions (CCS 147)	0.16	0.98 (0.91-1.06)
Influenza (CCS 123)	0.15	0.63 (0.57-0.70)
Sprains and strains (CCS 232)	0.15	0.75 (0.68-0.82)

Risk Variable (CCs)	% of hospitalizations with this risk variable	OR (95% CI)
Skull and face fractures (CCS 228)	0.14	0.75 (0.68-0.83)
Inflammatory conditions of male genital organs (CCS 165)	0.14	0.67 (0.60-0.74)
Chronic renal failure (CCS 158)	0.13	0.95 (0.88-1.03)
Allergic reactions (CCS 253)	0.13	0.73 (0.66-0.80)
Hyperplasia of prostate (CCS 164)	0.13	0.93 (0.85-1.02)
Peritonitis and intestinal abscess (CCS 148)	0.13	1.17 (1.07-1.26)
Screening and history of mental health and substance	0.13	1.26 (1.16-1.37)
Other bone disease and musculoskeletal deformities	0.12	0.80 (0.72-0.88)
Open wounds of head; neck; and trunk (CCS 235)	0.12	0.68 (0.62-0.76)
Poisoning by psychotropic agents (CCS 241)	0.12	0.72 (0.65-0.80)
Diseases of mouth; excluding dental (CCS 137)	0.12	0.79 (0.72-0.87)
Gangrene (CCS 248)	0.11	0.81 (0.74-0.89)
Hepatitis (CCS 6)	0.11	1.43 (1.32-1.55)
Nutritional deficiencies (CCS 52)	0.10	1.13 (1.03-1.23)
Thyroid disorders (CCS 48)	0.10	1.03 (0.93-1.13)
Other diseases or bladder and urethra (CCS 162)	0.10	0.95 (0.86-1.05)
Rheumatoid arthritis and related disease (CCS 202)	0.08	0.77 (0.68-0.87)
Open wounds of extremities (CCS 236)	0.08	0.87 (0.77-0.98)
Other infections' including parasitic (CCS 8)	0.07	0.61 (0.53-0.70)
Inflammation' infection of eye (except that caused by TB/STD) (CCS 90)	0.07	0.84 (0.73-0.96)
Other inflammatory condition of skin (CCS 198)	0.06	1.08 (0.96-1.21)
Lung disease due to external agents (CCS 132)	0.06	1.11 (0.99-1.25)
Meningitis (except that caused by TB/STD) (CCS 76)	0.06	0.96 (0.84-1.09)
Diabetes mellitus without complication (CCS 49)	0.06	0.76 (0.66-0.87)
Blindness and vision defects (CCS 89)	0.05	0.58 (0.48-0.69)
Disorders of teeth and jaw (CCS 136)	0.05	0.79 (0.68-0.92)
Encephalitis (except that caused by TB/STD) (CCS 77)	0.05	1.08 (0.94-1.25)
Burns (CCS 240)	0.04	0.96 (0.82-1.12)
Other eye disorders (CCS 91)	0.04	0.67 (0.56-0.81)
Bacterial infection; unspecified site (CCS 3)	0.04	0.82 (0.70-0.96)
Poisoning by nonmedicinal substances (CCS 243)	0.04	0.59 (0.49-0.73)
Systemic lupus erythematosus and connective tissue	0.04	1.28 (1.11-1.47)
Other female genital disorders (CCS 175)	0.04	0.76 (0.64-0.90)

4.3.2 Surgery/Gynecology Cohort Model Results

Table 3 – Surgery/Gynecology Specialty Cohort Model Risk Factor Frequencies and Odds Ratios

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Mean age, years (SD)	76.2 (7.4)	1.02 (1.02-1.02)
Metastatic cancer/acute leukemia (CC 7)	3.93	1.28 (1.24-1.31)
Severe Cancer (CC 8, 9)	3.53	1.17 (1.14-1.19)
Other major cancers (CC 10-12)	6.35	1.07 (1.05-1.09)
Other hematological disorders (CC 44)	1.01	1.23 (1.19-1.28)
Coagulation defects and other specified hematological disorders (CC 46)	3.19	1.02 (0.99-1.04)
Iron deficiency (CC 47)	45.24	1.29 (1.27-1.30)
End-stage liver disease (CC 25, 26)	0.98	1.42 (1.36-1.47)
Pancreatic disease (CC 32)	1.81	1.11 (1.07-1.14)
Dialysis status (CC 130)	1.02	1.42 (1.37-1.48)
Acute renal failure (CC 131)	11.27	1.11 (1.09-1.13)
Transplants (CC 128, 174)	0.39	1.33 (1.25-1.41)
Severe Infection (CC 1, 3-5)	0.98	1.13 (1.09-1.18)
Other infectious disease & pneumonias (CC 6, 111-113)	12.68	1.13 (1.11-1.14)
Septicemia/shock (CC 2)	3.09	0.97 (0.95-1.00)
CHF (CC 80)	9.82	1.15 (1.13-1.17)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 81-84, 89, 98, 99, 103-106)	42.74	1.25 (1.23-1.26)
Specified arrhythmias (CC 92, 93)	13.13	1.08 (1.07-1.10)
Cardiorespiratory failure or cardiorespiratory shock (CC 79)	4.78	1.03 (1.01-1.05)
Coronary obstructive pulmonary disease (COPD) (CC 108)	18.58	1.27 (1.26-1.29)
Fibrosis of lung or other chronic lung disorders (CC 109)	2.00	1.13 (1.09-1.16)
Protein-calorie malnutrition (CC 21)	7.11	1.20 (1.18-1.22)
Disorders of fluid, electrolyte, acid-base (CC 22, 23)	17.13	1.10 (1.08-1.12)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	4.67	1.15 (1.13-1.18)
Diabetes mellitus (CC 15-20, 119, 120)	28.97	1.17 (1.16-1.18)
Ulcers (CC 148, 149)	4.46	1.02 (0.99-1.04)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177, 178)	3.39	1.07 (1.04-1.09)
Seizure disorders and convulsions (CC 74)	2.42	1.15 (1.12-1.19)
Respirator dependence/tracheostomy status (CC 77)	0.19	1.06 (0.98-1.15)
Drug and alcohol disorders (CC 51, 52)	2.40	1.11 (1.08-1.15)
Psychiatric comorbidity (CC 54-56, 58, 60)	20.64	1.13 (1.11-1.14)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Hip fracture/dislocation (CC 158)	2.13	0.94 (0.92-0.97)
Condition Specific Indicator (AHRQ CCS)		
Osteoarthritis (CCS 203)	19.04	0.26 (0.24-0.29)
Joint disorders and dislocations; trauma-related (CCS 225)	9.33	0.51 (0.46-0.56)
Spondylosis; intervertebral disc disorders; other back problems (CCS 205)	6.00	0.39 (0.35-0.43)
Open wounds of extremities (CCS 236)	4.65	0.60 (0.55-0.66)
Biliary tract disease (CCS 149)	3.24	0.48 (0.44-0.53)
Occlusion or stenosis of precerebral arteries (CCS 110)	2.77	0.32 (0.29-0.36)
Abdominal hernia (CCS 143)	2.52	0.51 (0.46-0.56)
Coronary atherosclerosis and other heart disease (CCS 101)	2.42	0.66 (0.60-0.73)
Fracture of upper limb (CCS 229)	2.14	0.53 (0.48-0.58)
Low Frequency Conditions	2.13	0.64 (0.58-0.71)
Heart valve disorders (CCS 96)	2.13	0.76 (0.69-0.84)
Complication of device; implant or graft (CCS 237)	1.81	0.65 (0.59-0.72)
Cancer of colon (CCS 14)	1.73	0.54 (0.48-0.59)
Septicemia (except in labor) (CCS 2)	1.50	0.75 (0.68-0.83)
Aortic; peripheral; and visceral artery aneurysms (CCS 115)	1.46	0.56 (0.50-0.62)
Skull and face fractures (CCS 228)	1.46	0.42 (0.38-0.47)
Intestinal obstruction without hernia (CCS 145)	1.39	0.66 (0.59-0.73)
Peripheral and visceral atherosclerosis (CCS 114)	1.33	0.71 (0.64-0.78)
Cardiac dysrhythmias (CCS 106)	1.31	0.56 (0.50-0.62)
Other and unspecified benign neoplasm (CCS 47)	1.30	0.53 (0.47-0.59)
Prolapse of female genital organs (CCS 170)	1.14	0.21 (0.19-0.24)
Acute myocardial infarction (CCS 100)	1.13	0.78 (0.71-0.87)
Cancer of bronchus; lung (CCS 19)	1.13	0.55 (0.50-0.61)
Nutritional deficiencies (CCS 52)	1.07	0.61 (0.55-0.68)
Hyperplasia of prostate (CCS 164)	1.02	0.38 (0.34-0.43)
Cancer of prostate (CCS 29)	0.97	0.34 (0.30-0.38)
Secondary malignancies (CCS 42)	0.96	0.66 (0.60-0.74)
Pathological fracture (CCS 207)	0.93	0.59 (0.53-0.66)
Diverticulosis and diverticulitis (CCS 146)	0.89	0.67 (0.61-0.75)
Cancer of breast (CCS 24)	0.83	0.29 (0.26-0.33)
Fracture of lower limb (CCS 230)	0.82	0.59 (0.53-0.66)
Acute cerebrovascular disease (CCS 109)	0.79	0.77 (0.69-0.86)
Other gastrointestinal disorders (CCS 155)	0.79	0.59 (0.53-0.66)
Other acquired deformities (CCS 209)	0.79	0.42 (0.37-0.47)
Cancer of bladder (CCS 32)	0.73	0.77 (0.69-0.86)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Appendicitis and other appendiceal conditions (CCS 142)	0.73	0.46 (0.41-0.52)
Calculus of urinary tract (CCS 160)	0.66	0.50 (0.45-0.56)
Other bone disease and musculoskeletal deformities (CCS 212)	0.62	0.43 (0.39-0.49)
Cancer of kidney and renal pelvis (CCS 33)	0.61	0.44 (0.39-0.49)
Lymphadenitis (CCS 247)	0.59	0.78 (0.70-0.87)
Infective arthritis and osteomyelitis (except that caused by TB/STD) (CCS 201)	0.54	0.56 (0.50-0.62)
Other connective tissue disease (CCS 211)	0.51	0.35 (0.31-0.39)
Sprains and strains (CCS 232)	0.50	0.82 (0.73-0.91)
Cancer of rectum and anus (CCS 15)	0.48	0.85 (0.76-0.95)
Cancer of uterus (CCS 25)	0.44	0.47 (0.41-0.53)
Pancreatic disorders (not diabetes) (CCS 152)	0.40	0.53 (0.47-0.60)
Anal and rectal conditions (CCS 147)	0.34	0.50 (0.44-0.57)
Urinary tract infections (CCS 159)	0.33	0.78 (0.70-0.88)
Congestive heart failure; non-hypertensive (CCS 108)	0.32	0.92 (0.82-1.03)
Other non-traumatic joint disorders (CCS 204)	0.32	0.28 (0.24-0.33)
Other hereditary and degenerative nervous system conditions (CCS 81)	0.31	0.70 (0.62-0.79)
Skin and subcutaneous tissue infections (CCS 197)	0.30	0.56 (0.50-0.64)
Chronic ulcer of skin (CCS 199)	0.30	0.54 (0.47-0.61)
Cancer of head and neck (CCS 11)	0.29	0.54 (0.47-0.61)
Acute and unspecified renal failure (CCS 157)	0.28	0.88 (0.78-0.99)
Aortic and peripheral arterial embolism or thrombosis (CCS 116)	0.27	0.84 (0.74-0.95)
Neoplasms of unspecified nature or uncertain behavior (CCS 44)	0.26	0.57 (0.50-0.65)
Other diseases or bladder and urethra (CCS 162)	0.25	0.63 (0.55-0.72)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.23	0.63 (0.56-0.72)
Other congenital anomalies (CCS 217)	0.23	0.47 (0.40-0.54)
Other nutritional; endocrine; and metabolic disorders (CCS 58)	0.22	0.47 (0.40-0.55)
Thyroid disorders (CCS 48)	0.21	0.20 (0.17-0.25)
Cancer of other GI organs; peritoneum (CCS 18)	0.21	0.76 (0.66-0.86)
Other nervous system disorders (CCS 95)	0.21	0.54 (0.47-0.62)
Non-Hodgkin's lymphoma (CCS 38)	0.21	1.04 (0.92-1.18)
Cancer of pancreas (CCS 17)	0.21	0.93 (0.82-1.05)
Other female genital disorders (CCS 175)	0.20	0.45 (0.39-0.52)
Other lower respiratory disease (CCS 133)	0.20	0.53 (0.46-0.61)
Cancer of ovary (CCS 27)	0.20	0.63 (0.55-0.72)
Peri-; endo-; and myocarditis; cardiomyopathy (except caused by TB/STD) (CCS 97)	0.20	0.74 (0.65-0.84)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Pleurisy; pneumothorax; pulmonary collapse (CCS 130)	0.20	0.69 (0.61-0.79)
Other diseases of kidney and ureters (CCS 161)	0.19	0.66 (0.57-0.75)
Esophageal disorders (CCS 138)	0.19	0.50 (0.43-0.59)
Nervous system congenital anomalies (CCS 216)	0.19	0.35 (0.29-0.41)
Cancer of stomach (CCS 13)	0.19	0.73 (0.64-0.84)
Genitourinary symptoms and ill-defined conditions (CCS 163)	0.18	0.63 (0.55-0.73)
Gastroduodenal ulcer (except hemorrhage) (CCS 139)	0.17	0.75 (0.65-0.86)
Other fractures (CCS 231)	0.16	0.32 (0.27-0.39)
Cancer of brain and nervous system (CCS 35)	0.16	0.83 (0.72-0.96)
Gastrointestinal hemorrhage (CCS 153)	0.16	0.72 (0.63-0.82)
Hypertension with complications and secondary hypertension (CCS 99)	0.14	Reference Group
Respiratory failure; insufficiency; arrest (adult) (CCS 131)	0.13	0.64 (0.55-0.74)
Cancer of thyroid (CCS 36)	0.13	0.27 (0.22-0.33)
Intestinal infection (CCS 135)	0.12	1.03 (0.89-1.18)
Other non-epithelial cancer of skin (CCS 23)	0.11	0.41 (0.34-0.48)
Other and ill-defined cerebrovascular disease (CCS 111)	0.11	0.37 (0.30-0.45)
Cancer of bone and connective tissue (CCS 21)	0.11	0.73 (0.63-0.86)
Open wounds of head; neck; and trunk (CCS 235)	0.10	0.45 (0.38-0.54)
Intracranial injury (CCS 233)	0.10	0.66 (0.56-0.77)
Disorders of lipid metabolism (CCS 53)	0.10	0.42 (0.34-0.51)
Cancer of other female genital organs (CCS 28)	0.09	0.61 (0.51-0.73)
Other circulatory disease (CCS 117)	0.09	0.66 (0.56-0.78)
Other disorders of stomach and duodenum (CCS 141)	0.09	0.82 (0.70-0.97)
Fluid and electrolyte disorders (CCS 55)	0.08	0.65 (0.55-0.77)
Rheumatoid arthritis and related disease (CCS 202)	0.08	0.31 (0.25-0.40)
Cancer of other urinary organs (CCS 34)	0.08	0.60 (0.50-0.72)
Spinal cord injury (CCS 227)	0.08	0.35 (0.28-0.44)
Other upper respiratory disease (CCS 134)	0.08	0.58 (0.48-0.69)
Other male genital disorders (CCS 166)	0.08	0.48 (0.39-0.59)
Aspiration pneumonitis; food/vomitus (CCS 129)	0.07	0.91 (0.77-1.07)
Cancer of liver and intrahepatic bile duct (CCS 16)	0.07	0.71 (0.60-0.86)
Regional enteritis and ulcerative colitis (CCS 144)	0.07	1.11 (0.94-1.32)
Cardiac and circulatory congenital anomalies (CCS 213)	0.07	0.46 (0.37-0.58)
Benign neoplasm of uterus (CCS 46)	0.06	0.30 (0.22-0.40)
Parkinson's disease (CCS 79)	0.06	0.37 (0.28-0.48)
Cancer of esophagus (CCS 12)	0.06	1.12 (0.94-1.34)

4.3.3 Cardiovascular Cohort Model Results

Table 4 – Cardiovascular Specialty Cohort Model Risk Factor Frequencies and Odds Ratios

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Mean age, years (SD)	78.4 (7.9)	1.02 (1.02-1.02)
Metastatic cancer/acute leukemia (CC 7)	1.53	1.44 (1.37-1.50)
Severe Cancer (CC 8, 9)	3.31	1.28 (1.24-1.32)
Other major cancers (CC 10-12)	4.95	1.05 (1.02-1.08)
Other hematological disorders (CC 44)	1.35	1.24 (1.19-1.30)
Coagulation defects and other specified hematological disorders (CC 46)	4.29	1.03 (1.01-1.06)
Iron deficiency (CC 47)	32.95	1.31 (1.29-1.33)
End-stage liver disease (CC 25, 26)	0.91	1.34 (1.26-1.41)
Pancreatic disease (CC 32)	1.32	1.13 (1.08-1.19)
Dialysis status (CC 130)	1.95	1.51 (1.45-1.56)
Acute renal failure (CC 131)	18.09	1.16 (1.14-1.18)
Transplants (CC 128, 174)	0.37	1.36 (1.24-1.48)
Severe Infection (CC 1, 3-5)	0.79	1.17 (1.10-1.24)
Other infectious disease & pneumonias (CC 6, 111-	16.60	1.17 (1.15-1.19)
Septicemia/shock (CC 2)	3.03	0.99 (0.96-1.02)
CHF (CC 80)	21.13	1.27 (1.25-1.30)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 81-84, 89, 98, 99, 103-106)	69.07	1.14 (1.12-1.16)
Specified arrhythmias (CC 92, 93)	26.78	1.11 (1.09-1.12)
Cardiorespiratory failure or cardiorespiratory shock (CC 79)	7.32	1.07 (1.05-1.10)
Coronary obstructive pulmonary disease (COPD) (CC	24.57	1.33 (1.31-1.35)
Fibrosis of lung or other chronic lung disorders (CC 109)	2.97	1.16 (1.12-1.20)
Protein-calorie malnutrition (CC 21)	4.82	1.13 (1.10-1.16)
Disorders of fluid, electrolyte, acid-base (CC 22, 23)	21.56	1.17 (1.15-1.19)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	4.50	1.14 (1.11-1.17)
Diabetes mellitus (CC 15-20, 119, 120)	36.17	1.19 (1.17-1.20)
Ulcers (CC 148, 149)	3.74	1.16 (1.12-1.19)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177, 178)	3.59	1.13 (1.10-1.17)
Seizure disorders and convulsions (CC 74)	2.82	1.15 (1.11-1.19)
Respirator dependence/tracheostomy status (CC 77)	0.15	1.06 (0.93-1.20)
Drug and alcohol disorders (CC 51, 52)	1.92	1.17 (1.12-1.22)
Psychiatric comorbidity (CC 54-56, 58, 60)	22.48	1.16 (1.14-1.18)
Hip fracture/dislocation (CC 158)	1.45	0.87 (0.83-0.91)
Condition Specific Indicator (AHRQ CCS)		
Cardiac dysrhythmias (CCS 106)	34.52	0.83 (0.78-0.87)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Acute myocardial infarction (CCS 100)	18.41	0.95 (0.90-1.00)
Coronary atherosclerosis and other heart disease	16.25	0.63 (0.60-0.67)
Nonspecific chest pain (CCS 102)	12.20	0.55 (0.52-0.58)
Other circulatory disease (CCS 117)	5.97	0.73 (0.69-0.77)
Peripheral and visceral atherosclerosis (CCS 114)	4.95	0.73 (0.68-0.77)
Conduction disorders (CCS 105)	3.16	0.60 (0.56-0.64)
Peri-; endo-; and myocarditis; cardiomyopathy (except caused by TB/STD) (CCS 97)	1.23	Reference Group
Heart valve disorders (CCS 96)	1.19	0.76 (0.70-0.82)
Aortic; peripheral; and visceral artery aneurysms (CCS	0.88	0.82 (0.76-0.89)
Aortic and peripheral arterial embolism or thrombosis	0.58	0.81 (0.73-0.89)
Other and ill-defined heart disease (CCS 104)	0.30	0.75 (0.66-0.86)
Cardiac arrest and ventricular fibrillation (CCS 107)	0.27	0.85 (0.75-0.96)
Low Frequency Conditions	0.08	0.64 (0.51-0.82)

4.3.4 Cardiorespiratory Cohort Model Results

Table 5 – Cardiorespiratory Specialty Cohort Model Risk Factor Frequencies and Odds Ratios

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Mean age, years (SD)	79.2 (8.4)	1.00 (1.00-1.00)
Metastatic cancer/acute leukemia (CC 7)	2.69	1.22 (1.18-1.25)
Severe Cancer (CC 8, 9)	6.16	1.22 (1.20-1.25)
Other major cancers (CC 10-12)	6.11	1.07 (1.05-1.09)
Other hematological disorders (CC 44)	2.19	1.15 (1.12-1.18)
Coagulation defects and other specified hematological disorders (CC 46)	6.91	1.05 (1.03-1.07)
Iron deficiency (CC 47)	48.34	1.19 (1.18-1.21)
End-stage liver disease (CC 25, 26)	1.45	1.18 (1.14-1.22)
Pancreatic disease (CC 32)	1.54	1.07 (1.03-1.11)
Dialysis status (CC 130)	2.09	1.29 (1.26-1.33)
Acute renal failure (CC 131)	27.99	1.11 (1.10-1.13)
Transplants (CC 128, 174)	0.45	1.13 (1.06-1.20)
Severe Infection (CC 1, 3-5)	1.72	1.15 (1.11-1.19)
Other infectious disease & pneumonias (CC 6, 111-	38.81	1.09 (1.08-1.10)
Septicemia/shock (CC 2)	6.19	1.02 (1.01-1.04)
CHF (CC 80)	37.54	1.21 (1.20-1.23)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 81-84, 89, 98, 99, 103-106)	66.37	1.17 (1.15-1.18)
Specified arrhythmias (CC 92, 93)	32.51	1.10 (1.08-1.11)
Cardiorespiratory failure or cardiorespiratory shock (CC 79)	21.73	1.15 (1.14-1.16)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Coronary obstructive pulmonary disease (COPD) (CC	50.18	1.24 (1.23-1.26)
Fibrosis of lung or other chronic lung disorders (CC 109)	8.39	1.10 (1.08-1.12)
Protein-calorie malnutrition (CC 21)	10.56	1.10 (1.09-1.12)
Disorders of fluid, electrolyte, acid-base (CC 22, 23)	34.96	1.17 (1.15-1.18)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	5.31	1.07 (1.05-1.09)
Diabetes mellitus (CC 15-20, 119, 120)	40.31	1.10 (1.09-1.11)
Ulcers (CC 148, 149)	5.95	1.14 (1.12-1.16)
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177, 178)	4.81	1.06 (1.04-1.08)
Seizure disorders and convulsions (CC 74)	3.79	1.10 (1.08-1.13)
Respirator dependence/tracheostomy status (CC 77)	0.64	1.12 (1.07-1.18)
Drug and alcohol disorders (CC 51, 52)	2.94	1.13 (1.10-1.16)
Psychiatric comorbidity (CC 54-56, 58, 60)	31.91	1.12 (1.11-1.13)
Hip fracture/dislocation (CC 158)	2.38	0.92 (0.89-0.95)
Condition Specific Indicator (AHRQ CCS)		
Congestive heart failure; non-hypertensive (CCS 108)	31.90	1.04 (1.02-1.05)
Pneumonia (CCS 122)	28.93	0.85 (0.84-0.87)
Chronic obstructive pulmonary disease and bronchiectasis (CCS 127)	21.44	1.04 (1.02-1.06)
Respiratory failure; insufficiency; arrest (adult) (CCS	7.61	Reference Group
Pulmonary heart disease (CCS 103)	4.42	0.84 (0.81-0.86)
Asthma (CCS 128)	4.05	0.88 (0.86-0.91)
Acute bronchitis (CCS 125)	1.65	0.68 (0.65-0.71)
Low Frequency Conditions	0.00	2.62 (1.11-6.18)

4.3.5 Neurology Cohort Model Results

Table 6 – Neurology Specialty Cohort Model Risk Factor Frequencies and Odds Ratios

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Mean age, years (SD)	79.6 (8.1)	1.00 (1.00-1.01)
Metastatic cancer/acute leukemia (CC 7)	2.79	1.19 (1.13-1.26)
Severe Cancer (CC 8, 9)	3.83	1.30 (1.25-1.36)
Other major cancers (CC 10-12)	6.10	1.09 (1.05-1.13)
Other hematological disorders (CC 44)	1.30	1.20 (1.12-1.28)
Coagulation defects and other specified hematological disorders (CC 46)	4.28	1.08 (1.03-1.12)
Iron deficiency (CC 47)	31.37	1.21 (1.18-1.23)
End-stage liver disease (CC 25, 26)	0.99	1.34 (1.24-1.44)
Pancreatic disease (CC 32)	1.24	1.08 (1.01-1.16)
Dialysis status (CC 130)	1.49	1.55 (1.46-1.64)

Risk variable	% of hospitalizations with this risk variable	OR (95% CI)
Acute renal failure (CC 131)	15.53	1.12 (1.09-1.15)
Transplants (CC 128, 174)	0.34	1.30 (1.15-1.47)
Severe Infection (CC 1, 3-5)	1.14	1.20 (1.12-1.29)
Other infectious disease & pneumonias (CC 6, 111-	16.85	1.13 (1.10-1.16)
Septicemia/shock (CC 2)	3.56	1.01 (0.97-1.05)
CHF (CC 80)	14.52	1.18 (1.14-1.21)
Coronary atherosclerosis or angina, cerebrovascular disease (CC 81-84, 89, 98, 99, 103-106)	53.90	1.17 (1.15-1.19)
Specified arrhythmias (CC 92, 93)	19.63	1.06 (1.04-1.09)
Cardiorespiratory failure or cardiorespiratory shock	6.20	1.03 (0.99-1.06)
Coronary obstructive pulmonary disease (COPD) (CC	18.54	1.19 (1.16-1.21)
Fibrosis of lung or other chronic lung disorders (CC	2.08	1.12 (1.06-1.18)
Protein-calorie malnutrition (CC 21)	7.26	1.20 (1.16-1.24)
Disorders of fluid, electrolyte, acid-base (CC 22, 23)	23.77	1.13 (1.10-1.16)
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	4.14	1.12 (1.07-1.16)
Diabetes mellitus (CC 15-20, 119, 120)	34.16	1.14 (1.12-1.17)
Ulcers (CC 148, 149)	3.38	1.05 (1.00-1.09)
Hemiplegia, paraplegia, paralysis, functional disability	8.70	1.08 (1.05-1.12)
Seizure disorders and convulsions (CC 74)	10.05	1.14 (1.11-1.17)
Respirator dependence/tracheostomy status (CC 77)	0.20	1.22 (1.04-1.42)
Drug and alcohol disorders (CC 51, 52)	3.12	1.05 (1.00-1.10)
Psychiatric comorbidity (CC 54-56, 58, 60)	27.44	1.04 (1.02-1.06)
Hip fracture/dislocation (CC 158)	2.20	0.85 (0.81-0.90)
Condition Specific Indicator (AHRQ CCS)		
Acute cerebrovascular disease (CCS 109)	43.00	0.92 (0.90-0.95)
Transient cerebral ischemia (CCS 112)	16.91	0.68 (0.66-0.70)
Other nervous system disorders (CCS 95)	13.87	Reference Group
Intracranial injury (CCS 233)	9.04	1.09 (1.05-1.13)
Epilepsy; convulsions (CCS 83)	8.25	0.87 (0.83-0.90)
Other hereditary and degenerative nervous system	2.00	1.02 (0.95-1.08)
Occlusion or stenosis of precerebral arteries (CCS 110)	1.48	0.78 (0.72-0.85)
Late effects of cerebrovascular disease (CCS 113)	1.35	0.80 (0.74-0.87)
Coma; stupor; and brain damage (CCS 85)	1.28	0.92 (0.86-1.00)
Parkinson's disease (CCS 79)	1.05	0.84 (0.77-0.92)
Other and ill-defined cerebrovascular disease (CCS	1.00	0.66 (0.59-0.73)
Low Frequency Conditions	0.53	1.01 (0.90-1.13)
Multiple sclerosis (CCS 80)	0.23	1.11 (0.93-1.32)

Table 7 – Model Performance by Specialty Cohort

Characteristic	Medicine	Surgical	Cardiovascular	Cardio-Respiratory	Neurology
Predictive ability, % (lowest decile – highest decile)	8.2-32.8	4.3-25.1	5.0-29.1	10.1-36.3	7.2-25.3
c-statistic	0.65	0.67	0.67	0.64	0.62

Table 8 – Index Hospitalizations and Observed Readmission Rates by Specialty Cohort

Specialty Cohort	Index Hospitalizations	Observed Readmission Rate
Medicine	2,885,247	17.4%
Surgical	1,611,698	11.7%
Cardiorespiratory	1,179,213	20.4%
Cardiovascular	812,287	14.0%
Neurology	430,022	13.7%
Total	6,918,467	16.0%

4.4 Distribution of Hospital SRRs and RSRRs

Table 9 shows the number of hospitals with at least one admission and the mean and median national observed readmission rates by specialty cohort as well as the risk-adjusted SRRs. Table 10 presents the distribution of the hospital-level observed rates and RSRRs. Figure 2 presents the distribution of the hospital-level RSRRs.

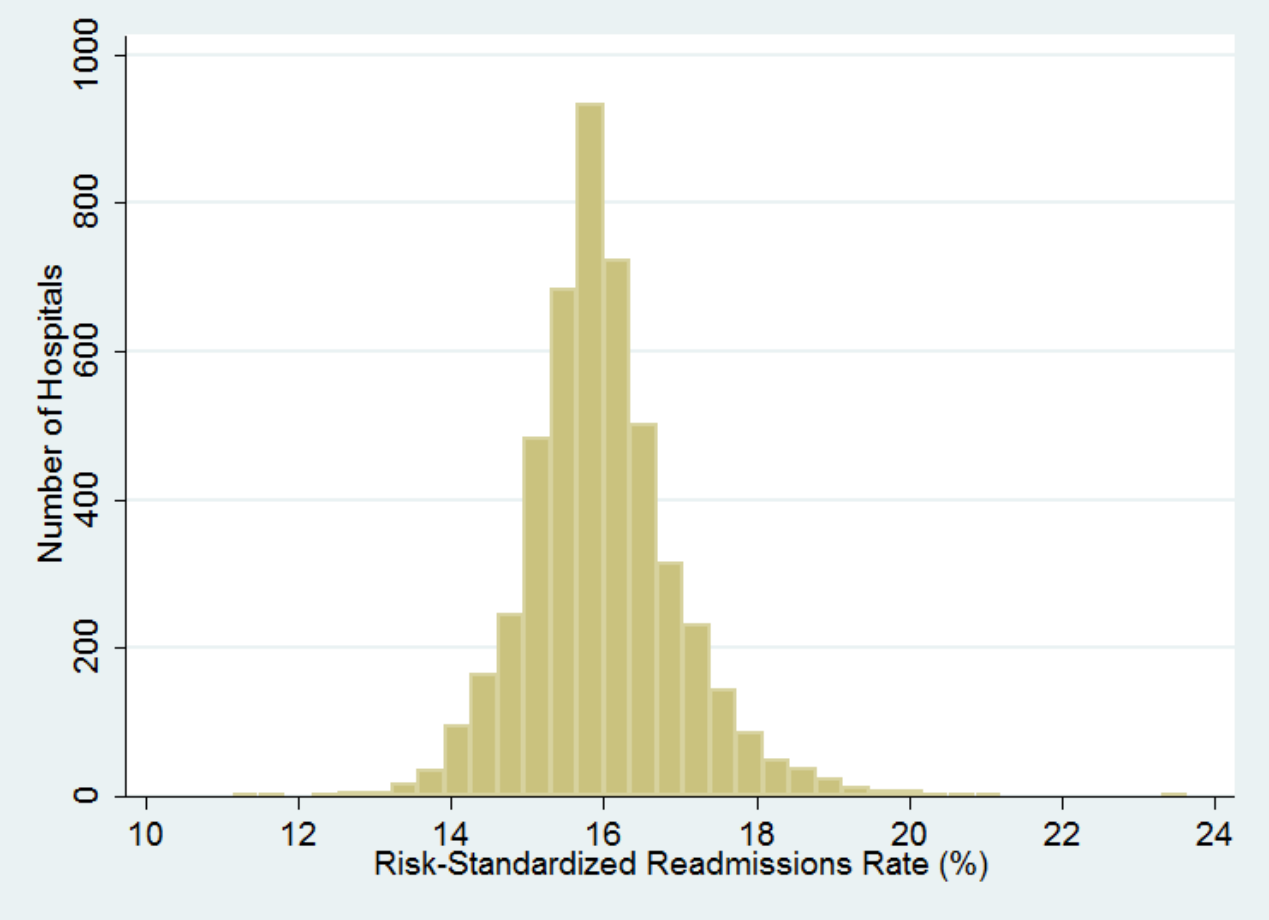
Table 9 – Hospital-level observed readmission rates and standardized readmission ratios (SRRs)

Variable	N	Mean observed readmission rate (SD)	Median observed readmission rate (IQR)	Mean SRR (SD)	Median SRR (IQR)
Medicine	4,754	15.9 (5.6)	16.2 (13.6-18.7)	1.002 (0.08)	0.996 (0.953 – 1.044)
Surgery/ gynecology	4,123	11.3 (9.3)	10.9 (7.6 – 13.9)	1.002 (0.08)	0.997 (0.961 - 1.039)
Cardiovascular	4,524	14.2 (9.8)	13.8 (10.2 -17.4)	1.001 (0.05)	0.998 (0.979 - 1.022)
Cardiorespiratory	4,636	18.5 (6.9)	19.0 (15.1 – 22.3)	1.002 (0.08)	0.995 (0.956 - 1.041)
Neurology	4,511	12.5 (10.0)	12.5 (7.3 – 16.7)	1.001 (0.05)	0.997 (0.979 - 1.032)
HWR	4,809	15.1 (4.8)	15.4 (12.9 – 17.6)	1.001 (0.06)	0.996 (0.964 – 1.032)

Table 10 – Distribution of hospital-level observed and risk-standardized readmission rates (RSRRs)

Composite readmission rate	Mean	SD	Min	10th Percentile	Lower Quartile	Median	Upper Quartile	90th Percentile	Max
Observed	15.1	4.8	0.00	9.7	12.9	15.4	17.6	20.0	100.0
RSRR	16.0	1.0	11.1	14.9	15.4	15.9	16.5	17.2	23.7

Figure 2 – Distribution of Hospital HWR RSRRs between July 2011 and June 2012



N = 4,809 Hospitals

4.5 Distribution of Hospitals by performance category

Out of 4,809 hospitals in the U.S., 304 performed "better than the U.S. national rate," 3,983 performed "no different from the U.S. national rate," and 364 performed "worse than the U.S. national rate." 158 were classified as "number of cases too small" (fewer than 25) to reliably tell how well the hospital is performing.

5. QUALITY ASSURANCE (QA)

We have a two-phase approach to internal QA for the readmission measure maintenance process. These phases are described below. Please refer to Figure 3 for a detailed outline of phase I, and Figure 4 for a detailed outline of phase II.

Note that this section represents QA for the subset of the work conducted by YNHHSC/CORE to maintain and report these readmission measures. It does not describe the QA to process data and create the input files, nor does it include the QA for the final processing of production data for public reporting because that work is conducted by another contractor (Mathematica Policy Research Inc.).

5.1 Phase I

The first step in the QA process is to ensure the validity of the input data files. There were no substantial changes to the data input processing, and only one additional year of data was added to our existing data sets. Only one new field was added to support the production of another measure. There was minimal need for targeted quality checks this year, so the automated process we developed previously allowed for a thorough review of the new data sets.

In general, all condition-specific files for each reporting year are evaluated by comparing them to the prior year's QA results. We conduct data validity checks, including crosschecking of readmission information, distributions of ICD-9-CM codes, and frequencies of key variables. We employ both manual scan and descriptive analyses to carry out these tasks. The results are reviewed for accuracy and changes over time compared to prior datasets. Any new variable constructs and other changes in formatting to the input files are also verified as part of this process. We share our QA findings with our data extraction contractor as needed.

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

5.2 Phase II

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

This phase also includes a comparison of prior years' risk-adjustment coefficients and variable frequencies. This enables us to check for potential inconsistencies in the data as well as the impact of any changes to the SAS pack.

Figure 3 – YNHHSC/CORE QA Phase I

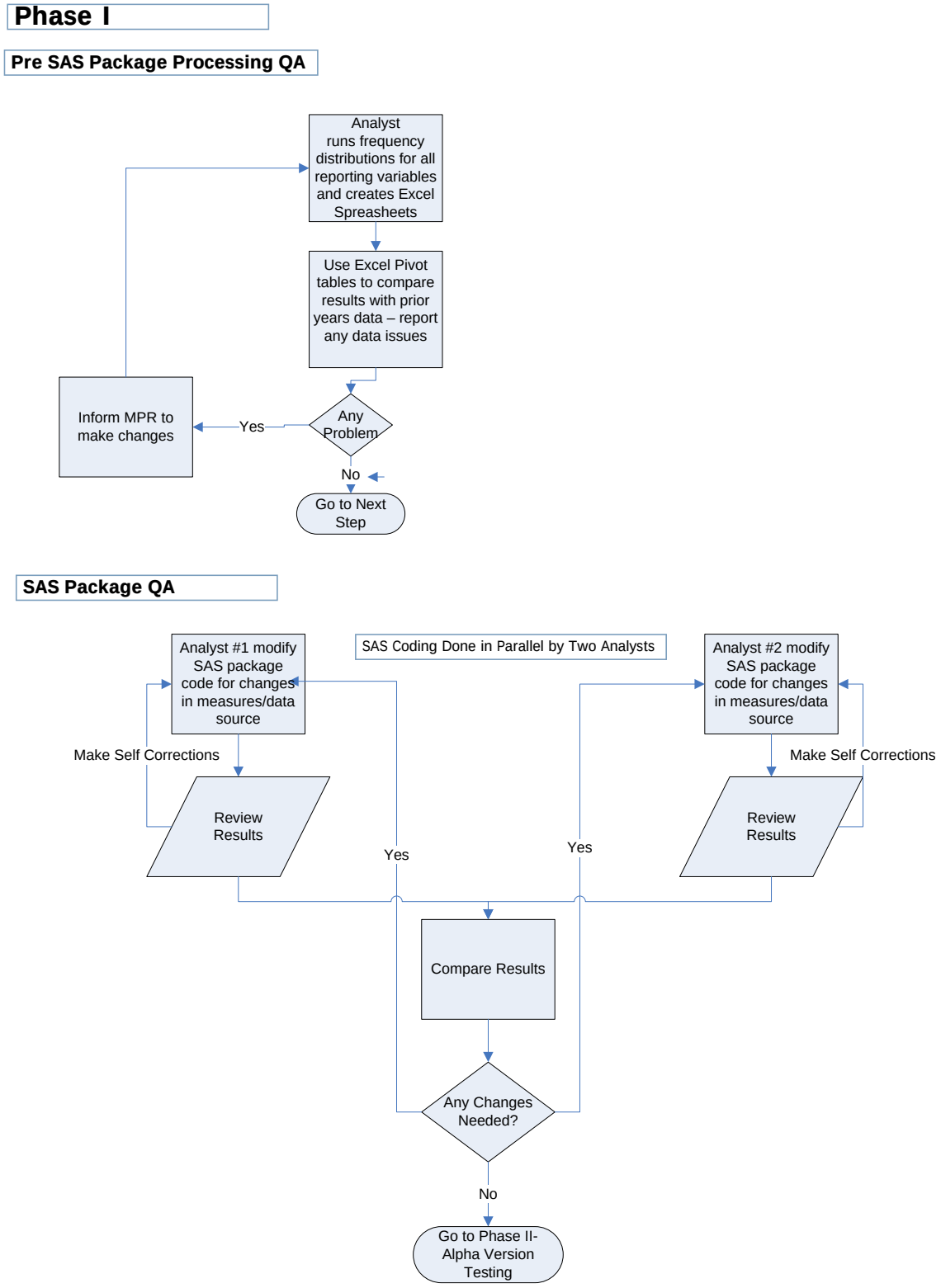
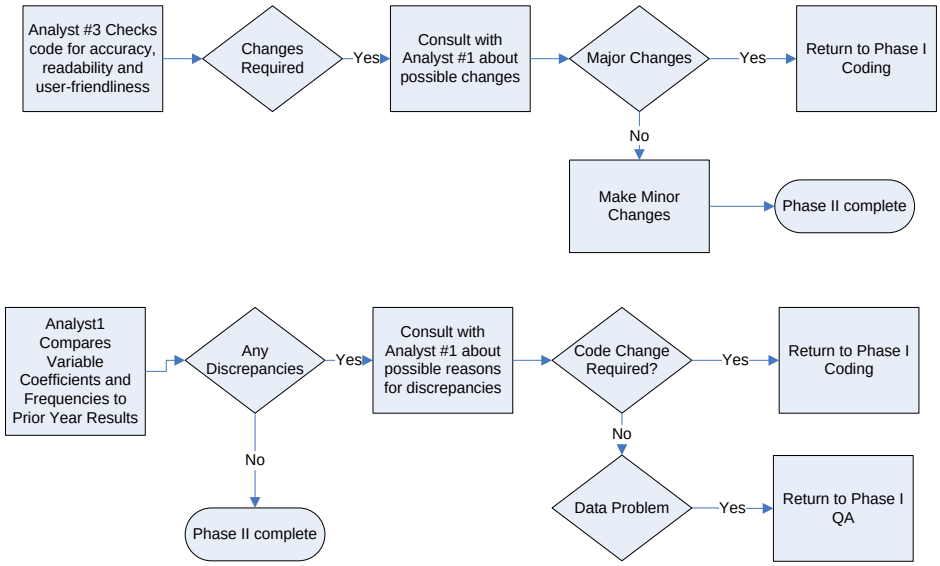


Figure 4 – YNHHSC/CORE QA Phase 2

Phase II

Results Testing – Alpha Version



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7. APPENDICES

Appendix A. Measure Specifications

1. Measure Inclusion/Exclusion Criteria, Specialty Cohort Assignment and associated Discharge Condition and Procedure Categories

Figure A1 – HWR Flow Diagram of Inclusion and Exclusion Criteria and Specialty Cohort Assignment for the Index Admission

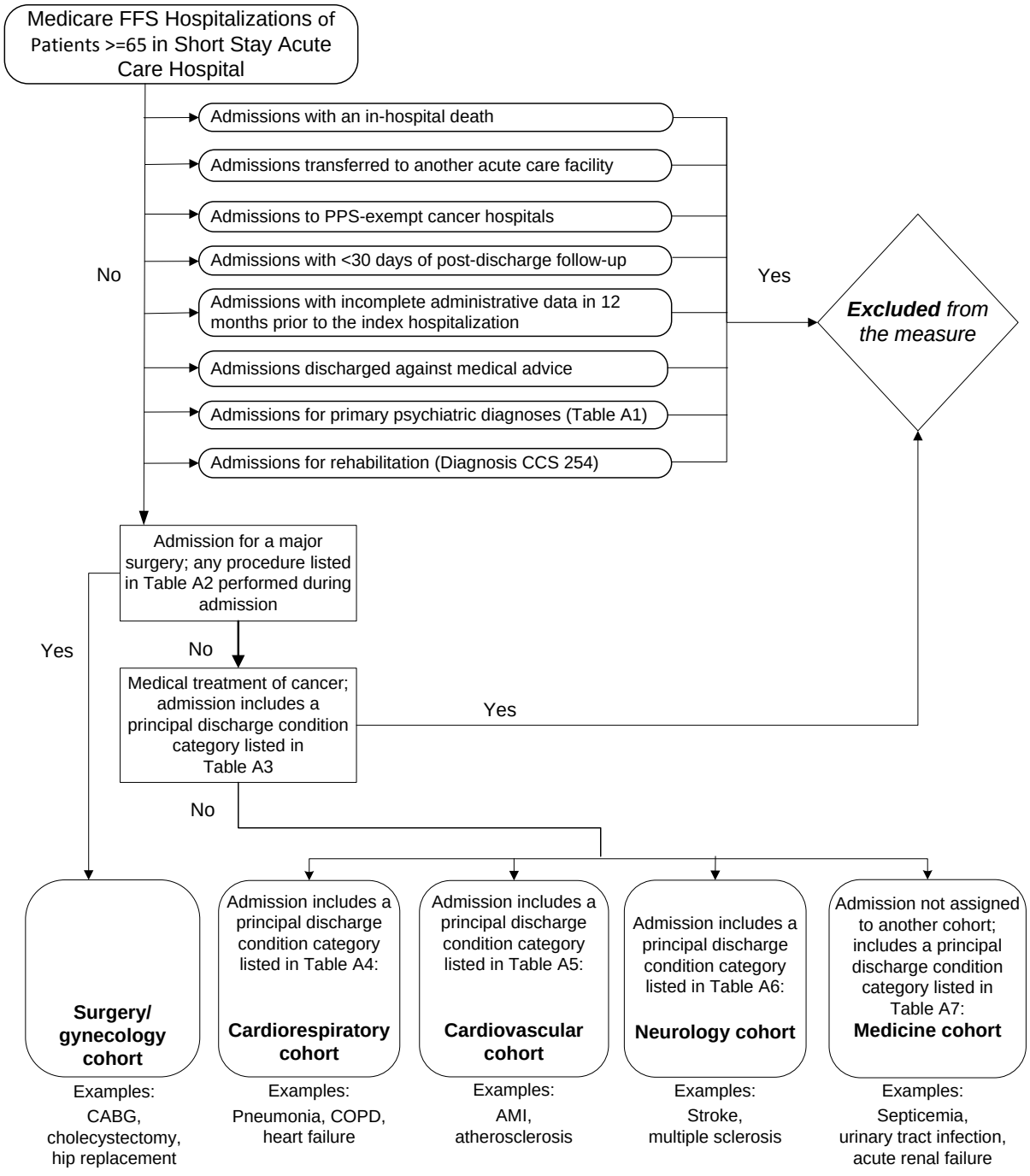


Table A1 – Psychiatric discharge condition categories excluded from the measure

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

Table A2 – Procedure categories defining the surgery/gynecology cohort*

AHRQ Procedure CCS	Description
1	Incision and excision of CNS
2	Insertion; replacement; or removal of extracranial ventricular shunt
3	Laminectomy; excision intervertebral disc
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
13	Corneal transplant
14	Glaucoma procedures
15	Lens and cataract procedures
16	Repair of retinal tear; detachment
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 ear procedures
28	Plastic procedures on nose
30	Tonsillectomy and/or adenoidectomy
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
42	Other OR Rx procedures on respiratory system and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis

* Not mutually exclusive; multiple procedures may be performed during a single admission

AHRQ Procedure CCS	Description
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 therapeutic procedures; hemic and lymphatic system
72	Colostomy; temporary and permanent
73	Ileostomy and other enterostomy
74	Gastrectomy; partial and total
75	Small bowel resection
78	Colorectal resection
79	Local excision of large intestine lesion (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
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
122	Removal of ectopic pregnancy
123	Other operations on fallopian tubes
124	Hysterectomy; abdominal and vaginal
125	Other excision of cervix and uterus
126	Abortion (termination of pregnancy)
127	Dilatation and curettage (D&C); aspiration after delivery or abortion
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
135	Forceps; vacuum; and breech delivery
136	Artificial rupture of membranes to assist delivery
137	Other procedures to assist delivery

AHRQ Procedure CCS	Description
139	Fetal monitoring
140	Repair of current obstetric laceration
141	Other therapeutic obstetrical procedures
142	Partial excision bone
143	Bunionectomy or repair of toe deformities
144	Treatment; facial fracture or dislocation
145	Treatment; fracture or dislocation of radius and ulna
146	Treatment; fracture or dislocation of hip and femur
147	Treatment; fracture or dislocation of lower extremity (other than hip or femur)
148	Other fracture and dislocation procedure
150	Division of joint capsule; ligament or cartilage
151	Excision of semilunar cartilage of knee
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 and breast
176	Other organ transplantation

Table A3 – Cancer discharge condition categories excluded from the measure

AHRQ Diagnosis CCS	Description
11	Cancer of head and neck
12	Cancer of esophagus
13	Cancer of stomach
14	Cancer of colon
15	Cancer of rectum and anus
16	Cancer of liver and intrahepatic bile duct
17	Cancer of pancreas
18	Cancer of other GI organs; peritoneum
19	Cancer of bronchus; lung
20	Cancer; other respiratory and intrathoracic
21	Cancer of bone and connective tissue
22	Melanomas of skin
23	Other non-epithelial cancer of skin
24	Cancer of breast
25	Cancer of uterus
26	Cancer of cervix
27	Cancer of ovary
28	Cancer of other female genital organs
29	Cancer of prostate
30	Cancer of testis
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 A4 – Condition categories defining the cardiorespiratory cohort

AHRQ Diagnosis CCS	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 A5 – Condition categories defining the cardiovascular cohort

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

Table A6 – Condition categories defining the neurology cohort

AHRQ Diagnosis CCS	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 A7 – Condition categories defining the medicine cohort

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

AHRQ Diagnosis CCS	Description
120	Hemorrhoids
121	Other diseases of veins and lymphatics
123	Influenza
124	Acute and chronic tonsillitis
126	Other upper respiratory infections
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
132	Lung disease due to external agents
133	Other lower respiratory disease
134	Other upper respiratory disease
135	Intestinal infection
136	Disorders of teeth and jaw
137	Diseases of mouth; excluding dental
138	Esophageal disorders
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
141	Other disorders of stomach and duodenum
142	Appendicitis and other appendiceal conditions
143	Abdominal hernia
144	Regional enteritis and ulcerative colitis
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
147	Anal and rectal conditions
148	Peritonitis and intestinal abscess
149	Biliary tract disease
151	Other liver diseases
152	Pancreatic disorders (not diabetes)
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
155	Other gastrointestinal disorders
156	Nephritis; nephrosis; renal sclerosis
157	Acute and unspecified renal failure
158	Chronic renal failure
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

AHRQ Diagnosis CCS	Description
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 di
202	Rheumatoid arthritis and related disease
203	Osteoarthritis
204	Other non-traumatic joint disorders
205	Spondylosis; intervertebral disc disorders; other back problems
206	Osteoporosis
207	Pathological fracture
208	Acquired foot deformities
209	Other acquired deformities
210	Systemic lupus erythematosus and connective tissue disorders
211	Other connective tissue disease
212	Other bone disease and musculoskeletal deformities
214	Digestive congenital anomalies
215	Genitourinary congenital anomalies
217	Other congenital anomalies
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
231	Other fractures
232	Sprains and strains
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
236	Open wounds of extremities
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

AHRQ Diagnosis CCS	Description
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

2. **Outcome Definition Criteria**

- **30-day time frame**
    - Rationale: Outcomes occurring within 30 days of discharge can be influenced by hospital care and the early transition to the outpatient setting. The use of the 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce readmissions.
- **All-cause readmission**
    - Rationale: From a patient perspective, an unplanned readmission from any cause is an adverse event.
- **Unplanned readmission**
    - 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.

3. **Cohort Inclusion Criteria**

- **Patient is aged 65 or older**
    - Rationale: Medicare patients younger than 65 are not included in the measure because they are considered to be too clinically different from patients 65 and over as they often qualify for Medicare at a younger age because of disabilities.
- **Patient survives hospitalization**
    - Rationale: Patients who die during the initial hospitalization cannot be readmitted.
- **Patient is discharged home or to a non-acute setting**
    - Rationale: Readmission is attributed to the hospital that discharged the patient to the non-acute care setting. Transferred patients are still included in the measure cohort, but the initial admitting hospital is not accountable for the outcome (thus the "transfer-out" hospitalization is excluded as an index admission).

4. **Cohort Exclusion Criteria**

- **Admissions to Prospective Payment System (PPS)-exempt cancer hospitals**
    - Rationale: These hospitals care for a unique population of patients that cannot reasonably be compared to the patients admitted to other hospitals.
- **Admissions for patients without at least 30 days of post-discharge enrollment in FFS Medicare**
    - Rationale: The 30-day readmission outcome cannot be assessed in this group since claims data are used to determine whether or not a patient was readmitted.
- **Admissions for patients not enrolled in Part A Medicare for the 12 months prior to and including the date of the index admission**
    - Rationale: The 12 month prior enrollment ensures a full year of administrative data for risk adjustment. Part A is required during the index admission to ensure no Medicare Advantage patients are included in the measures.
- **Admissions for patients discharged against medical advice (AMA)**
    - Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- **Admissions for primary psychiatric diagnoses**

    - Rationale: Patients admitted for psychiatric treatment are typically cared for in separate psychiatric or rehabilitation centers which are not comparable to acute care hospitals.
- **Admissions for rehabilitation**
    - Rationale: These admissions are not typically admitted to an acute care hospital and are not for acute care.
- **Admissions for medical treatment of cancer**
    - Rationale: These admissions have a very 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 who are admitted for other diagnoses or for surgical treatment of their cancer remain in the measure.

Table A8 – Risk Variables

Description	CMS-CCs[1010]
Severe Infection	1, 3-5
Other infectious diseases and pneumonias	6, 111-113
Metastatic cancer/acute leukemia	7
Severe Cancer	8, 9
Other major cancers	10, 11, 12
Diabetes mellitus	15-20, 119, 120
Protein-calorie malnutrition	21
End-stage liver disease	25, 26
Other hematologoical disorders	44
Drug and Alcohol disorders	51, 52
Psychiatric comorbidity	54-56, 58, 60
Hemiplegia, paraplegia, paralysis, functional disability	67-69, 100-102, 177, 178
Seizure disorders and convulsions	74
CHF	80
Coronary atherosclerosis or angina, cerebrovascular disease	81-84, 89, 98, 99, 103-106
Specified arrhythmias	92, 93
COPD	108
Fibrosis of lung or other chronic lung disorders	109
Dialysis status	130
Ulcers	148, 149
Septicemia/Shock	2
Disorders of fluid, electrolyte, acid-base	22, 23
Iron deficiency	47
Cardio-respiratory failure or cardio-respiratory shock	79
Acute renal failure	131
Pancreatic disease	32
Rheumatoid arthritis and inflammatory connective tissue disease	38
Respirator dependence/tracheostomy status	77
Transplants	128, 174
Coagulation defects and other specified hematological disorders	46
Hip fracture/dislocation	158

Table A9 – Risk Variables Considered Complications of Care During the Index Admission*

CMS-CC	Label	Potential Complications
2	Septicemia/Shock	x
6	Other Infectious Diseases	x
17	Diabetes with Acute Complications	x
23	Disorders of Fluid/Electrolyte/Acid-Base	x
24	Other Endocrine/Metabolic/ Nutritional Disorders	
28	Acute Liver Failure/Disease	x
31	Intestinal Obstruction/Perforation	x
34	Peptic Ulcer, Hemorrhage, Other Specified Gastrointestinal Disorders	x
36	Other Gastrointestinal Disorders	
37	Bone/Joint/Muscle Infections/Necrosis	
43	Other Musculoskeletal and Connective Tissue Disorders	
46	Coagulation Defects and Other Specified Hematological Disorders	x
47	Iron Deficiency and Other/ Unspecified Anemias and Blood Disease	
48	Delirium and Encephalopathy	x
51	Drug/Alcohol Psychosis	
75	Coma, Brain Compression/Anoxic Damage	x
76	Mononeuropathy, Other Neurological Conditions/Injuries	
77	Respirator Dependence/Tracheostomy Status	x
78	Respiratory Arrest	x
79	Cardio-Respiratory Failure and Shock	x
80	Congestive Heart Failure	x
81	Acute Myocardial Infarction	x
82	Unstable Angina and Other Acute Ischemic Heart Disease	x
85	Heart Infection/Inflammation, Except Rheumatic	
92	Specified Heart Arrhythmias	x
93	Other Heart Rhythm and Conduction Disorders	x
95	Cerebral Hemorrhage	x
96	Ischemic or Unspecified Stroke	x
97	Precerebral Arterial Occlusion and Transient Cerebral Ischemia	x
100	Hemiplegia/Hemiparesis	x
101	Diplegia (Upper), Monoplegia, and Other Paralytic Syndromes	x
102	Speech, Language, Cognitive, Perceptual	x
104	Vascular Disease with Complications	x
105	Vascular Disease	x
106	Other Circulatory Disease	x
111	Aspiration and Specified Bacterial Pneumonias	x
112	Pneumococcal Pneumonia, Emphysema, Lung Abscess	x
114	Pleural Effusion/Pneumothorax	x

* The selected CC's are considered complications of care and are not risk-adjusted for if they only occur during the index admission.

CMS-CC	Label	Potential Complications
124	Other Eye Disorders	
129	End Stage Renal Disease	x
130	Dialysis Status	x
131	Renal Failure	x
132	Nephritis	x
133	Urinary Obstruction and Retention	x
135	Urinary Tract Infection	x
148	Decubitus Ulcer of Skin	x
152	Cellulitis, Local Skin Infection	x
154	Severe Head Injury	x
155	Major Head Injury	x
156	Concussion or Unspecified Head Injury	x
157	Vertebral Fractures	
158	Hip Fracture/Dislocation	x
159	Major Fracture, Except of Skull, Vertebrae, or Hip	x
160	Internal Injuries	
161	Traumatic Amputation	
162	Other Injuries	
163	Poisonings and Allergic Reactions	x
164	Major Complications of Medical Care and Trauma	x
165	Other Complications of Medical Care	x
166	Major Symptoms, Abnormalities	
174	Major Organ Transplant Status	x
175	Other Organ Transplant/Replacement	x
176	Artificial Openings for Feeding or Elimination	x
177	Amputation Status, Lower Limb/Amputation	x
178	Amputation Status, Upper Limb	x
179	Post-Surgical States/Aftercare/Elective	x

5. Statistical Approach to Risk-Standardized Readmission Rates

We estimate the hospital-specific risk-standardized readmission rates 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, 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 readmission rates. We calculate these rates as the ratio of a hospital's "predicted" readmissions to "expected" readmissions multiplied by the national observed readmission rate. Specifically, for the hospital wide readmission measure, this is done at the specialty cohort level. The expected number of readmissions for each cohort in each hospital is estimated using its patient mix and the average hospital-specific intercept (that is, the average intercept among all hospitals in the sample). The predicted number of readmissions for each cohort in each hospital is estimated given the same patient-mix but an estimated hospital-specific intercept. 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. The predicted number of readmissions for each hospital is calculated by summing the predicted probabilities for all patients in the hospital. The predicted probability for each patient is calculated through the hierarchical model which applies the estimated regression coefficients to the patient characteristics observed and adding the hospital-specific intercept.

Specifically, for a given specialty cohort, we estimated a hierarchical logistic regression model as follows. 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 outcome over all hospitals; and τ^2 is the between hospital variance component[11] and $\varepsilon \sim N(0,\sigma^2)$ captures any over- or under-dispersion. The hierarchical generalized linear models are estimated using the SAS software system (SAS 9.2 GLIMMIX).

a. 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 a standardized risk ratio (SRR) for each hospital which contributes index admissions to that model. These SRRs, weighted by volume, are then pooled for each hospital to create a composite hospital-wide SRR.

Standardized risk ratio for each specialty cohort

We used 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 was 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 was 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 used

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

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 used

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

Then, as a measure of excess or reduced readmissions among index admissions in cohort C at hospital *j*, we calculated 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 were combined into a single value. We created a single score as follows.

For a given hospital, j, which has patients in some subset of cohorts $C \subseteq \{1,...,5\}$, calculate the SRR as described above 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, 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 ($m_{cj} = 0$) then that cohort contributes nothing to the overall score SRR_j. **This value, SRR_j , is the hospital-wide standardized risk ratio** for hospital *j*. To aid interpretation, this ratio is then multiplied by the overall national raw readmission rate for all index admissions in all cohorts, $\overline{Y}$, to produce **the risk-standardized hospital-wide readmission rate ($RSRR_j$)**.

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

b. 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 = 1,2,…B times:

1. Sample *M* hospitals with replacement.

2. Fit the five cohort hierarchical logistic regression models using all patients within each sampled hospital. We use as starting values 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:

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

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

    c. 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 randomly half of the B estimates (or the percentiles corresponding to the alternative desired intervals).[12]

Appendix B. Annual Updates

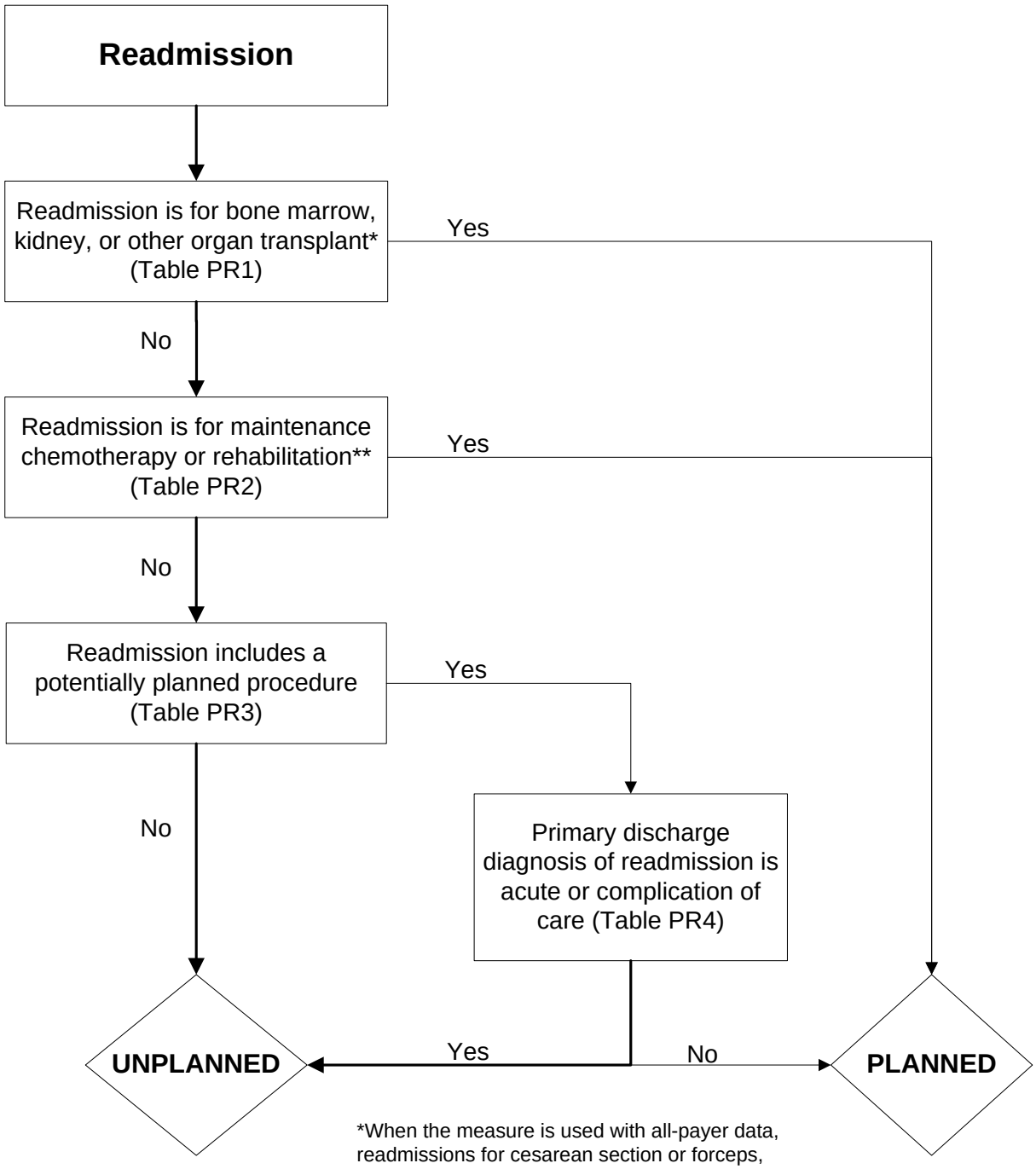
The measure presented in this report, the Hospital-Wide All-Cause Unplanned Readmission Measure (Version 2.0), is the first update to the HWR measure. In 2013, CMS began assigning version numbers to its measures. The measure specified in the original methodology report is Version 1.0 of the measure. The report is posted on *QualityNet*. The measure will receive a new version number for each subsequent year of updates.

2013 Measure Updates and Specifications Report (Version 2.0)

1. Updated the measure with Planned Readmission Algorithm Version 2.1: General Population.
    a. Rationale: The algorithm was updated after stakeholder review, additional consultation with specialists and recommendations received during CMS's September 2012 dry run (confidential reporting).
2. Removed procedure CCS 61 from the list of procedures qualifying an admission for the surgery cohort.
    a. Rationale: This procedure CCS was removed from the surgical cohort because patients undergoing this procedure are typically admitted primarily for cardiovascular or medical care.
3. Updated CC map.
    a. Rationale: The ICD-9-CM CC map is updated annually to capture all relevant comorbidities coded in patient administrative claims data.

Appendix C. Planned Readmission Algorithm

Figure PR1 – Planned Readmission Algorithm Version 2.1 – Flowchart



*When the measure is used with all-payer data, readmissions for cesarean section or forceps, vacuum, or breech delivery are considered planned

**When the measure is used with all-payer data, readmissions for forceps or normal delivery are considered planned

Planned Readmission Algorithm Version 2.1 Tables

Table PR1 – Procedure Categories that are Always Planned (Version 2.1 – General Population)

Procedure CCS	Description
64	Bone marrow transplant
105	Kidney transplant
134	Cesarean section[1]
135	Forceps; vacuum; and breech delivery[1]
176	Other organ transplantation

Table PR2 – Diagnosis Categories that are Always Planned (Version 2.1 – General Population)

Diagnosis CCS	Description
45	Maintenance chemotherapy
194	Forceps delivery[1]
196	Normal pregnancy and/or delivery[1]
254	Rehabilitation

[1] CCS to be included only in all-payer settings, not intended for inclusion in CMS's claims-based readmission measures for Medicare fee-for-service beneficiaries aged 65+ years

Table PR3 – Potentially Planned Procedure Categories (Version 2.1 – General Population)

Procedure CCS	Description
3	Laminectomy; excision intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA)
47	Diagnostic cardiac catheterization; coronary arteriography
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator
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
62	Other diagnostic cardiovascular procedures
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
79	Local excision of large intestine lesion (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 CCS	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
157	Amputation of lower extremity
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
169	Debridement of wound; infection or burn
170	Excision of skin lesion
172	Skin graft
211	Therapeutic radiology for cancer treatment
224	Cancer chemotherapy
ICD-9 Codes	**Description**
30.1, 30.29, 30.3, 30.4, 31.74, 34.6	Laryngectomy, revision of tracheostomy, scarification of pleura (from Proc CCS 42- Other OR Rx procedures on respiratory system and mediastinum)
38.18	Endarterectomy leg vessel (from Proc CCS 60- Embolectomy and endarterectomy of lower limbs)
55.03, 55.04	Percutaneous nephrostomy with and without fragmentation (from Proc CCS 103- Nephrotomy and nephrostomy)
94.26, 94.27	Electroshock therapy (from Proc CCS 218- Psychological and psychiatric evaluation and therapy)

Table PR4 – Acute Diagnosis Categories (Version 2.1 – General Population)

Diagnosis CCS	Description
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
100	Acute myocardial infarction (with the exception of ICD-9 codes 410.x2)
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 TB or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis

Diagnosis CCS	Description
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

Diagnosis CCS	Description
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders
653	Delirium, dementia, and amnestic and other cognitive disorders
656	Impulse control disorders, NEC
658	Personality disorders
660	Alcohol-related disorders
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
ICD-9 codes	**Description**
Acute ICD-9 codes within Dx CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
03282	Diphtheritic myocarditis
03640	Meningococcal carditis nos
03641	Meningococcal pericarditis
03642	Meningococcal endocarditis
03643	Meningococcal myocarditis
07420	Coxsackie carditis nos
07421	Coxsackie pericarditis
07422	Coxsackie endocarditis
07423	Coxsackie myocarditis
11281	Candidal endocarditis
11503	Histoplasma capsulatum pericarditis
11504	Histoplasma capsulatum endocarditis
11513	Histoplasma duboisii pericarditis
11514	Histoplasma duboisii endocarditis
11593	Histoplasmosis pericarditis
11594	Histoplasmosis endocarditis
1303	Toxoplasma myocarditis
3910	Acute rheumatic pericarditis
3911	Acute rheumatic endocarditis

Diagnosis CCS	Description
3912	Acute rheumatic myocarditis
3918	Acute rheumatic heart disease nec
3919	Acute rheumatic heart disease nos
3920	Rheumatic chorea w heart involvement
3980	Rheumatic myocarditis
39890	Rheumatic heart disease nos
39899	Rheumatic heart disease nec
4200	Acute pericarditis in other disease
42090	Acute pericarditis nos
42091	Acute idiopath pericarditis
42099	Acute pericarditis nec
4210	Acute/subacute bacterial endocarditis
4211	Acute endocarditis in other diseases
4219	Acute/subacute endocarditis nos
4220	Acute myocarditis in other diseases
42290	Acute myocarditis nos
42291	Idiopathic myocarditis
42292	Septic myocarditis
42293	Toxic myocarditis
42299	Acute myocarditis nec
4230	Hemopericardium
4231	Adhesive pericarditis
4232	Constrictive pericarditis
4233	Cardiac tamponade
4290	Myocarditis nos
Acute ICD-9 codes within Dx CCS 105: Conduction disorders	
4260	Atrioventricular
42610	Atrioventricular block nos
42611	Atrioventricular block-1st degree
42612	Atrioventricular block-mobitz ii
42613	Atrioventricular block-2nd degree nec
4262	Left bundle branch hemiblock
4263	Left bundle branch block nec
4264	Right bundle branch block
42650	Bundle branch block nos
42651	Right bundle branch block/left posterior fascicular block
42652	Right bundle branch block/left ant fascicular block
42653	Bilateral bundle branch block nec
42654	Trifascicular block
4266	Other heart block
4267	Anomalous atrioventricular excitation
42681	Lown-ganong-levine syndrome

Diagnosis CCS	Description
42682	Long qt syndrome
4269	Conduction disorder nos
Acute ICD-9 codes within Dx CCS 106: Dysrhythmia	
4272	Paroxysmal tachycardia nos
7850	Tachycardia nos
42789	Cardiac dysrhythmias nec
4279	Cardiac dysrhythmia nos
42769	Premature beats nec
Acute ICD-9 codes within Dx CCS 108: Congestive heart failure; nonhypertensive	
39891	Rheumatic heart failure
4280	Congestive heart failure
4281	Left heart failure
42820	Unspecified systolic heart failure
42821	Acute systolic heart failure
42823	Acute on chronic systolic heart failure
42830	Unspecified diastolic heart failure
42831	Acute diastolic heart failure
42833	Acute on chronic diastolic heart failure
42840	Unspec combined syst & dias heart failure
42841	Acute combined systolic & diastolic heart failure
42843	Acute on chronic combined systolic & diastolic heart failure
4289	Heart failure nos

Appendix D. Common Terms

Case Mix: The particular illness severity and age characteristics of the patients with index admissions at a given hospital.

Cohort: The index admissions included in the measure after the inclusion and exclusion criteria have been applied.

Complications: Medical conditions that likely occurred as a consequence of care rendered, rather than as an expected outcome of the patient's condition or a condition that the patient had upon presentation to the hospital.

Comorbidities: Medical conditions that the patient had in addition to their primary disease.

Condition Categories (CCs): Groupings of ICD-9-CM diagnosis codes in clinically relevant categories, from the Hierarchical Condition Categories (HCCs) system. CMS uses the grouping but not the hierarchical logic of the system to create risk factor variables. Description of the Condition Categories can be found at http://www.cms.hhs.gov/Reports/downloads/pope_2000_2.pdf.

Discharge Condition Category: A group of related discharge diagnosis ICD-9 codes (principal diagnoses), as grouped by the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification Software (CCS).

Expected readmissions: The number of readmissions expected on the basis of average hospital performance with a given hospital's case mix.

Hierarchical model: A widely accepted statistical method that enables fair evaluation of relative hospital performance by taking into account patient risk factors as well as the number of patients that a hospital treats. This statistical model accounts for the structure of the data (patients clustered within hospitals) and calculates: (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 intercept: A measure of the hospital quality of care. It is calculated based on the hospital's actual readmission rate relative to hospitals with similar patients – considering how many patients it served, what its patients' risk factors were, and how many were readmitted. 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 confidence interval. The interval estimate is a range of probable values for the estimate that characterizes the amount of uncertainty associated with the estimate. For example, a 95% interval estimate for a readmission rate indicates that CMS is 95% confident that the true value of the rate lies between the lower limit and the upper limit of the interval.

Medicare fee-for-service (FFS): Original Medicare plan. 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.

Outcome: The result of a broad set of healthcare activities that affect patients' well-being. For the HWR measure, the outcome is readmission within 30 days of discharge.

Planned readmission: A readmission within 30 days of discharge from an acute care hospital that is a scheduled part of the patient's plan of care. Planned readmissions are not counted as outcomes in these measures.

Predicted readmissions: The number of readmissions within 30 days predicted on the basis of the hospital's performance with its observed case mix, also referred to as "adjusted actual" readmissions.

Procedure Category: A group of related procedure codes, as grouped by the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification Software (CCS).

Risk-adjustment variables: Patient demographics and comorbidities that are used to standardize rates for differences in case 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 condition categories or procedure categories; this measure includes five cohorts, each with its own risk model.

Unplanned readmission: An acute clinical event experienced by a patient that requires urgent rehospitalization. Unplanned readmissions are counted as outcomes in these measures.

Appendix E. Memorandum

MEMORANDUM

From: RTI International
To: CMS/CCSQ
Date: December 24, 2012

Subject: Overview of update of mappings of ICD-9-CM codes to CC groups for risk adjustment of hospital mortality and readmission models, changes related to FY2012 codes. This is in the context of creating a mapping covering FY2008 – FY2012 to the CC diagnosis clusters.

Overview

Each year the CDC National Center for Health Statistics and the Centers for Medicare & Medicaid Services oversee the changes and modifications to the ICD-9-CM system made through the Coordination and Maintenance Committee. The committee is a joint public-private effort to update and improve the coding system.

RTI has developed and supported a classification system that uses these codes as the basis for risk adjustment systems. The Hierarchical Condition Category (HCC) system groups the ICD-9-CM codes into larger groups that are used in a model to predict medical care utilization, spending, mortality or other related measures. The condition categories (CCs) may also be used without applying the hierarchies that are used to categorize a person's medical conditions into the highest severity category of a set of related conditions. For this project the full set of 189 CCs in version 12 were updated for FY2012 changes and the changes were documented.

New ICD-9 codes generally become effective October 1 of each year, though there is a round of changes that may be made in an April announcement. Each calendar year of diagnosis data encompasses 2 years of codes. In the new mappings codes valid in FY2008 through FY2012 are all mapped to CCs. This allows the mapping to fully cover data from October 1, 2007 through September 30, 2012. These codes span CY2008 through CY2011 and the first nine months of 2012. The last three months of 2012 fall into FY2013.

Method

Additions and deletions

When the code changes are announced each year there may be both additions, deletions and changes to the descriptions of codes. We map only the valid codes, those of highest specificity, each year. ICD-9-CM codes have a minimum of three characters, mostly digits, and a maximum of five characters. The form is XXX, XXX.X or XXX.XX. [2] Code numbers after the decimal point are subclasses of the 3-digit main classes. An addition of new codes may be at any level from a new 3-digit class to new 4 and 5 digit subclasses. Deletions from ICD-9 may be explicit, the removal of a code from the code book. But deletions from our mapping occur more often because new, more specific, subcodes are introduced.

[2] In the Medicare data and our mappings the decimal points are omitted and all codes are left justified to remove ambiguity. The first character of a code may be an E or V as well as a digit.

Introduction of a new code of higher specificity than the code it sprang from does not remove the original 3- or 4- digit code from the ICD-9 book, but since coding is supposed to be done to the highest specificity, we remove the more general code from the mapping in the year it is superseded. If the new high specificity code is just an addition to an existing subset of codes of similar specificity, the new code is added but there would be no change in the status of the more general code. That code would have previously been superseded by higher specificity codes.

As an example, in 2012, code 0414, Bacterial infection in conditions classified elsewhere and of unspecified site, Escherichia coli [E.coli] was split into:

ICD-9	Short ICD-9 label
04141	Shiga txn-produce E.coli
04142	Shiga txn prod E.coli NEC
04143	Shiga txn prod E.coli NOS
04149	E.coli infection NEC/NOS

The new 5-digit codes were added to our mapping and were assigned to the same CC that 0414 was assigned to. The old 4-digit code would have been removed, except that 0414 was valid in 2008, 2009, 2010 and 2011. Since our mapping is intended to allow valid codes from those years, 0414 was retained.

In 2012 there were 168 codes added to ICD-9-CM. None were new 3-digit codes. Although there were a few 4-digit codes, the majority were of 5-digit specificity. The new 4-digit code groups were added with 5-digit detail. Among these there were 17 V-codes added but no E-codes. The V codes are for medical encounters but are not actual diagnoses of current conditions. The new 5-digit codes added more specificity within existing diagnostic code groups. In addition to the 0414 changes above another example is the 5 new codes in the ICD-9 code 5128 group, specifying particular types of pneumothorax. These were all mapped to the CC for "Pleural Effusion/Pneumothorax," where the nonspecific code was mapped previously. A more complicated situation is described in the *Mapping* section, below.

In FY 2012 there were 45 4-digit codes that were no longer at the highest specificity and are invalid starting that year. There was also one 3-digit code removed. However, the 46 codes are retained in our mapping because they were valid in the prior years covered by this mapping.

Mapping

Mapping of the new codes is done by review of the annual changes by RTI staff and clinical consultants. In most cases the codes of higher specificity are mapped to the same CC as the more general code that was split. This does not always occur. For example the ICD-9 code 9980 4-digit group was made invalid by the creation of 5-digit more specific codes. These are:

ICD-9	Short ICD-9 label	New CC	CC label
99800	Postoperative shock, NOS	164	Major Complications of Medical Care and Trauma
99801	Postop shock, cardiogenic	79	Cardio-Respiratory Failure and Shock
99802	Postop shock, septic	2	Septicemia/Shock
99809	Postop shock, other	164	Major Complications of Medical Care and Trauma

The original 4-digit code was assigned to CC 164. The more specific codes are not all assigned to that same CC. There is enough specificity to assign them to more specific CCs.

The general practice in maintaining the mappings for this work has been to maintain the existing structure of the CCs and to map the new codes to the location they would have gone to in prior years. However, sometimes the new specificity makes clear enough distinctions that new related codes do not all logically go to one place. Some new codes require judgment calls to be made. Our decision committee brings together both the people who maintain the integrity of the system and the people who provide the clinical expertise. The changes for FY2012 did not create a need for major changes but there were a few new 5-digit splits that did not all get assigned to the same CC.