Hospital-Wide (All-Condition) 30-Day Risk-Standardized Readmission Measure

DRAFT Measure Methodology Report

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GLOSSARY OF TERMS

Term	Definition
Index admission	Any eligible admission to an acute care hospital assessed in the measure for the outcome (readmitted or not within 30 days). (See **Section 2.3.2**)
Readmission	An admission to an acute care hospital within 30 days of discharge from an acute care hospital. (See **Section 2.2**). A readmission may in turn serve as an index admission.
Planned readmission	An intentional 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 this measure (see **Section 2.2.1**).
Discharge diagnosis	ICD-9 level code of the principal reason for hospitalization.
Discharge condition category	A group of related discharge diagnosis ICD-9 codes, as grouped by the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification Software (CCS). (See **Section 2.3.1**).
Cohort	A group of admissions for patients with related condition categories or procedure categories; this measure includes seven cohorts, each with its own risk model (see **Section 2.4.3**).
Measure population	The full set of admissions eligible for inclusion in the measure.
Procedure category	A group of related procedure codes, as grouped by the Agency for Healthcare Research and Quality Clinical Classification Software (CCS) (see **Section 2.4.3**).
Risk variable	A variable in the risk-adjustment model intended to account for patient comorbid conditions or age. A risk variable may include multiple conditions. Each condition is a group of ICD-9 diagnosis codes, as defined by the Centers for Medicare and Medicaid Services Condition Category groups (CCs) (see **Section 2.5.2**).
Case mix	The variation among hospitals in illness severity and age of their patients.
Service mix	The variation among hospitals in the types of conditions they care for and procedures they provide.

1. INTRODUCTION

1.1 Overview of Measure

Readmission following hospitalization is a costly and often preventable event. During 2003 and 2004, almost one-fifth of Medicare beneficiaries – over 2.3 million patients – were rehospitalized within 30 days of discharge.[1] Jencks estimated that readmissions within 30 days of discharge cost Medicare more than $17 billion dollars annually.[1] A 2006 Commonwealth Fund report estimated that if national readmission rates were lowered to the levels achieved by the top-performing regions, Medicare would save $1.9 billion annually. [2]

Currently, the Centers for Medicare and Medicaid Services (CMS) publicly reports risk-standardized readmission rates for heart failure, pneumonia and acute myocardial infarction. [3-9] CMS has also developed hospital readmission measures for stroke and for hip and knee replacement, and is developing them for chronic obstructive pulmonary disease and vascular procedures. While it is helpful to assess readmission rates for specific groups of patients, these conditions account for only a small minority of total readmissions.[10] By contrast, a hospital-wide, all-condition readmission measure could provide a broader assessment of the quality of care at hospitals. Therefore, CMS has contracted with Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE) to develop a claims-based, risk adjusted hospital-wide readmission (HWR) measure for public reporting that reflects the quality of care for hospitalized patients in the United States.

In this technical report we provide detailed information on the development of the HWR measure. Briefly, we developed the measure as an all-condition measure designed to capture unplanned readmissions within 30 days of discharge. The HWR measure complies with accepted standards for outcomes measure development, including appropriate risk adjustment and transparency of specifications. The measure includes all admissions except those for which a subsequent readmission would not be considered a quality signal. The measure does not count planned readmissions in the measure outcome, since they do not represent a quality signal. The overall risk-standardized readmission rate is derived from a composite of seven statistical models built for groups of admissions that are clinically related. The seven risk adjustment models will be tested for reliability in a split sample dataset combining two calendar years (2007 and 2008), and the stability of the measure over time will be tested using data from 2009. Although we developed the measure using Medicare data, the measure will also be tested in and adapted for all-payer datasets.

1.2 Hospital-wide Readmission as a Quality Indicator

Hospital readmission, for any reason, is disruptive to patients and caregivers, costly to the healthcare system, and puts patients at additional risk of hospital-acquired infections and complications. Readmissions are also a major source of patient and family stress and may

contribute substantially to loss of functional ability, particularly in older patients. Some readmissions are unavoidable and result from inevitable progression of disease or worsening of chronic conditions. However, readmissions may also result from poor quality of care or inadequate transitional care. Transitional care includes effective discharge planning, transfer of information at the time of discharge, patient assessment and education, and coordination of care and monitoring in the post-discharge period. Numerous studies have found an association between quality of inpatient or transitional care and early (typically 30-day) readmission rates for a wide range of conditions. [11-18] Therefore, while readmission rates would never be expected to be zero, *variation* in readmission rates for a broad spectrum of conditions is related to quality of care. Furthermore, randomized controlled trials have shown that improvement in the following areas can directly reduce readmission rates: quality of care during the initial admission; improvement in communication with patients, their caregivers and their clinicians; patient education; predischarge assessment; and coordination of care after discharge.[20-35] Evidence that hospitals have been able to reduce readmission rates through these quality-of-care initiatives illustrates the degree to which hospital practices can affect readmission rates. Successful randomized trials have reduced 30-day readmission rates by 20-40%.

Widespread application of these clinical trial interventions to general practice has also been encouraging. Since 2008, 14 Medicare Quality Improvement Organizations have been funded to focus on care transitions, applying lessons learned from clinical trials. Several have been notably successful in reducing readmissions within 30 days.[36]

Given that studies have shown readmissions within 30-days to be related to quality of care, and that interventions have been able to reduce 30-day readmission rates, it is reasonable to consider an all-condition 30-day readmission rate as a quality measure.

1.3 Approach to Measure Development

We developed this measure in consultation with national guidelines for publicly reported outcomes measures, consistent with the technical approach to outcomes measurement set forth in National Quality Forum (NQF) guidance for outcomes measures,[37] CMS Measure Management System guidance, and the guidance articulated in the American Heart Association scientific statement, "Standards for Statistical Models Used for Public Reporting of Health Outcomes."[3] These standards include adequate risk adjustment and transparency. We are obtaining expert input during measure development, both through CMS and consultation with clinical and statistical experts. We are now soliciting comments from the general public via a public comment period.

2. METHODS

2.1 Overview

We developed a hospital-wide 30-day readmission measure. This measure reports the hospital-level, risk-standardized rate of unplanned all-cause readmission after admission for any condition within 30 days of hospital discharge. The measure comprises a single summary score, derived from the results of seven different models, one for each of the following cohorts (groups of discharge condition categories or procedure categories): general medicine, surgery/gynecology, cardiorespiratory, cardiovascular, neurology, oncology, and psychiatry, each of which will be described in greater detail below. The measure uses one year of data.

We developed the measure in the Medicare fee-for-service (FFS) population age 65 and older discharged from any non-Federal short-stay acute care hospital or critical access hospital in the United States, excluding PPS-exempt cancer hospitals. The measure covers 95% of hospitalizations occurring in 2008 in this population, and includes 88% of readmissions following those hospitalizations. Hospitalizations were eligible for inclusion if the patient was enrolled in FFS Medicare Part A for 12 months prior and one month after the admission, if the discharge disposition was not to another acute care hospital, and if the patient was alive upon discharge. We excluded admissions for which we considered readmission not to be a signal of quality of care (patients who leave against medical advice, or have a discharge condition category with very high post-discharge mortality). To compare readmission performance across hospitals, we accounted for differences in patient characteristics (patient case mix) as well as differences in mixes of services and procedures offered by hospitals (hospital service mix).

To develop the measure, we analyzed admissions among Medicare FFS beneficiaries 65 and older who were discharged during 2008. The datasets were restricted to inpatient data, and included data on each patient for the 12 months prior to the index admission and the 30 days following discharge. We used the Agency for Healthcare Research and Quality (AHRQ) Condition Classification System (CCS) to group hospitalizations into clinically-coherent, mutually-exclusive condition categories according to their principal diagnosis.

We collapsed these discharge condition categories into seven major cohorts according to care teams (hospital service lines) and built a separate model for each one of these cohorts. We used hierarchical generalized linear models (HGLMs) to adjust for differences in hospital case mix and to account for the clustering of patients within a hospital. We adjusted for case mix differences among hospitals by risk-adjusting for patients' comorbid conditions identified in inpatient episodes of care for the 12 months prior to the index admission as well as those present at admission. We did not risk-adjust for diagnoses that may have been a complication of care during the index admission. We used CMS Condition Category groups (CCs) to define the comorbid risk adjusters and used a fixed set of comorbid risk variables across models. We risk-adjusted for service mix differences

among hospitals by including indicators for discharge condition categories (as defined by AHRQ CCS) in each model.

Finally, we used each of the seven models to calculate predicted and expected numbers of readmissions (as defined below in **2.6.1**) for each hospital in each cohort. We then derived a single summary score from the results of the seven models by calculating the volume-weighted log average of the predicted over expected ratios from each model and multiplying the result by the average national readmission rate. This approach allowed us to take into account the variation in service mix across hospitals.

We evaluated the performance of the measure for various types of hospitals and groups of patients. We will test the reliability of the measure by randomly splitting combined 2007 and 2008 data and comparing the performance in each split sample. We will also test the measure's stability over time by comparing 2008 and 2009 performance.

2.2 Outcome Definition

The outcome for this measure is unplanned all-cause 30-day readmission after an admission for any condition. We define a readmission as a subsequent inpatient admission to any acute care facility which occurs within 30 days of the discharge date of an eligible index admission. Any readmission is eligible to be counted as an outcome except those that are considered planned.

2.2.1 Planned readmissions

Readmissions may be either unplanned or planned. Unplanned readmissions are acute clinical events experienced by a patient that require urgent hospital management. Higher than expected unplanned readmission rates suggest lower quality of care and are the focus of quality measurement as part of quality improvement efforts. Because planned readmissions are not a signal of quality of care, we chose to exclude planned readmissions from the numerator. In order to do this, we developed an algorithm for identifying "planned readmissions" in claims data that will not count as readmissions in the measure. The algorithm was based on two main principles:

1. We define "planned" readmissions as those in which one of a pre-specified list of procedures took place (which will be described in detail below), or those for maintenance chemotherapy. Although other readmissions may be planned for medical reasons, these are rare and there is no reliable means of identifying them in administrative claims data. Maintenance chemotherapy is a common planned medical readmission that is reliably distinguishable in the data.

2. Admissions for acute illness or for complications of care are not "planned." Even a typically planned procedure performed during an admission for an acute illness would not likely have been planned. We can identify readmissions as acute or non-acute by considering the principal discharge condition.

We therefore developed an algorithm that uses procedure codes and discharge diagnosis categories for each readmission to identify planned readmissions. Readmissions that occur for planned procedures (listed below) and which are not for acute diagnoses or complications of care (listed below) are identified as planned.

The following examples illustrate this point:

Example 1:

- A readmission with a discharge condition category of biliary tract disease that included a cholecystectomy would be considered **planned**
- A readmission with a discharge condition category of septicemia that included a cholecystectomy would be considered **unplanned**
- A readmission with a discharge condition category of "complications of surgical procedures or medical care" would be considered **unplanned**

Example 2:

- A readmission with a discharge condition category of coronary atherosclerosis that included a percutaneous coronary intervention (PCI) would be considered **planned**
- A readmission with a discharge condition category of acute myocardial infarction that included PCI would be considered **unplanned**

Therefore, the HWR measure defines planned readmissions as any readmission that was either:

1. A **non-acute** readmission in which one of 32 typically planned procedures occurs

or

2. A readmission for maintenance chemotherapy

All other readmissions are considered unplanned and are counted as readmissions in the measure.

List of planned procedures

In order to develop a list of planned procedures, we reviewed the full AHRQ Clinical Classification System (CCS) procedure category list and identified 32 procedures that are typically planned and require an inpatient stay (**Table 1**). Readmissions in which any of these procedures are performed are considered planned if the discharge condition category is not acute or a complication of care.

Table 1 – Planned procedure list

AHRQ Procedure CC	Procedure	Readmissions without an acute diagnosis or a complication of care		All readmissions	
		Number	Percent	Number	Percent
45	Percutaneous transluminal coronary angioplasty (PTCA)	23,085	12.74	37,115	12.84
84	Cholecystectomy and common duct exploration	15,405	8.5	17,868	6.18
Condition CCS 45	Maintenance chemotherapy	14,329	7.91	14,329	4.96
157	Amputation of lower extremity	13,131	7.25	19,085	6.60
51	Endarterectomy; vessel of head and neck	11,569	6.38	12,411	4.29
78	Colorectal resection	11,522	6.36	20,004	6.92
44	Coronary artery bypass graft (CABG)	11,119	6.14	13,311	4.61
152	Arthroplasty knee	10,475	5.78	13,959	4.83
113	Transurethral resection of prostate (TURP)	7,909	4.36	9,150	3.17
153	Hip replacement; total and partial	5,694	3.14	22,803	7.89
211	Therapeutic radiology for cancer treatment	5,422	2.99	7,479	2.59
158	Spinal fusion	5,383	2.97	7,176	2.48
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	5,313	2.93	43,432	15.03
3	Laminectomy; excision intervertebral disc	5,172	2.85	6,541	2.26
36	Lobectomy or pneumonectomy	4,567	2.52	5,347	1.85
55	Peripheral vascular bypass	4,346	2.40	5,739	1.99
43	Heart valve procedures	4,133	2.28	4,863	1.68
52	Aortic resection; replacement or anastomosis	3,964	2.19	4,235	1.47
104	Nephrectomy; partial or complete	3,104	1.71	3,332	1.15
60	Embolectomy and endarterectomy of lower limbs	2,918	1.61	5,206	1.80
85	Inguinal and femoral hernia repair	2,387	1.32	2,785	0.96
124	Hysterectomy; abdominal and vaginal	2,143	1.18	2,223	0.77
167	Mastectomy	1,419	0.78	1,475	0.51
154	Arthroplasty other than hip or knee	1,189	0.66	2,570	0.89
74	Gastrectomy; partial and total	1,174	0.65	1,541	0.53
114	Open prostatectomy	1,035	0.57	1,069	0.37
119	Oophorectomy; unilateral and bilateral	1,005	0.55	1,275	0.44
10	Thyroidectomy; partial or complete	986	0.54	1,069	0.37
64	Bone marrow transplant	458	0.25	468	0.16
166	Lumpectomy; quadrantectomy of breast	322	0.18	471	0.16
105	Kidney transplant	240	0.13	245	0.08
176	Other organ transplantation	171	0.09	263	0.09
ICD-9 94.26, 94.27	Electroshock therapy	114	0.06	139	0.05
	Total	**181,203**			

Data from 2008 MedPAR file, incorporating all final inclusion and exclusion criteria for the measure

List of discharge condition categories that are acute or complications of care

According to our algorithm, admissions in which a planned procedure was performed are only considered "planned" if the patient was not admitted for an acute illness or complication of care. To develop a list of these acute and complication discharge condition categories, we reviewed the 10 most frequent discharge condition categories associated with each of our final set of 32 potentially planned procedures (**Appendix A**). From this set of 320 condition categories, we identified those which could be categorized as acute illnesses or complications of medical care. When a discharge condition category contained a mix of acute and chronic diagnoses, it was categorized as acute. Based on these criteria, we categorized 26 discharge condition categories as acute or complications of care, all listed within **Table 2**.

Table 2 – Discharge condition categories considered acute or complications of care

AHRQ CC	Discharge condition categories that are acute or complications of care and are associated with planned procedures	Number of 30-day readmissions with this condition and a planned procedure
100	Acute myocardial infarction	18328
237	Complication of device; implant or graft	11624
106	Cardiac dysrhythmias	10915
108	Congestive heart failure; nonhypertensive	5922
105	Conduction disorders	3663
146	Diverticulosis and diverticulitis	2322
2	Septicemia (except in labor)	2227
238	Complications of surgical procedures or medical care	1580
116	Aortic and peripheral arterial embolism or thrombosis	1427
	Fracture (207, 225, 226, 227, 229, 230, 231, 232)	1320
145	Intestinal obstruction without hernia	1134
201	Infective arthritis and osteomyelitis (except that caused by TB or sexually transmitted disease)	630
109	Acute cerebrovascular disease	595
97	Peri-; endo-; and myocarditis; cardiomyopathy	550
122	Pneumonia (except that caused by TB or sexually transmitted disease)	431
245	Syncope	287
127	Chronic obstructive pulmonary disease and bronchiectasis	248
131	Respiratory failure; insufficiency; arrest (adult)	232
55	Fluid and electrolyte disorders	229
159	Urinary tract infections	161
130	Pleurisy; pneumothorax; pulmonary collapse	154
157	Acute and unspecified renal failure	115
139	Gastroduodenal ulcer (except hemorrhage)	91
153	Gastrointestinal hemorrhage	89
160	Calculus of urinary tract	74
112	Transient cerebral ischemia	30

	All condition categories	**64,378**

We quantified the impact of our decisions regarding the definition of planned readmissions on readmission rates. In 2008, there were 181,203 planned readmissions, accounting for 12% of all readmissions.

2.2.2 Thirty-day timeframe

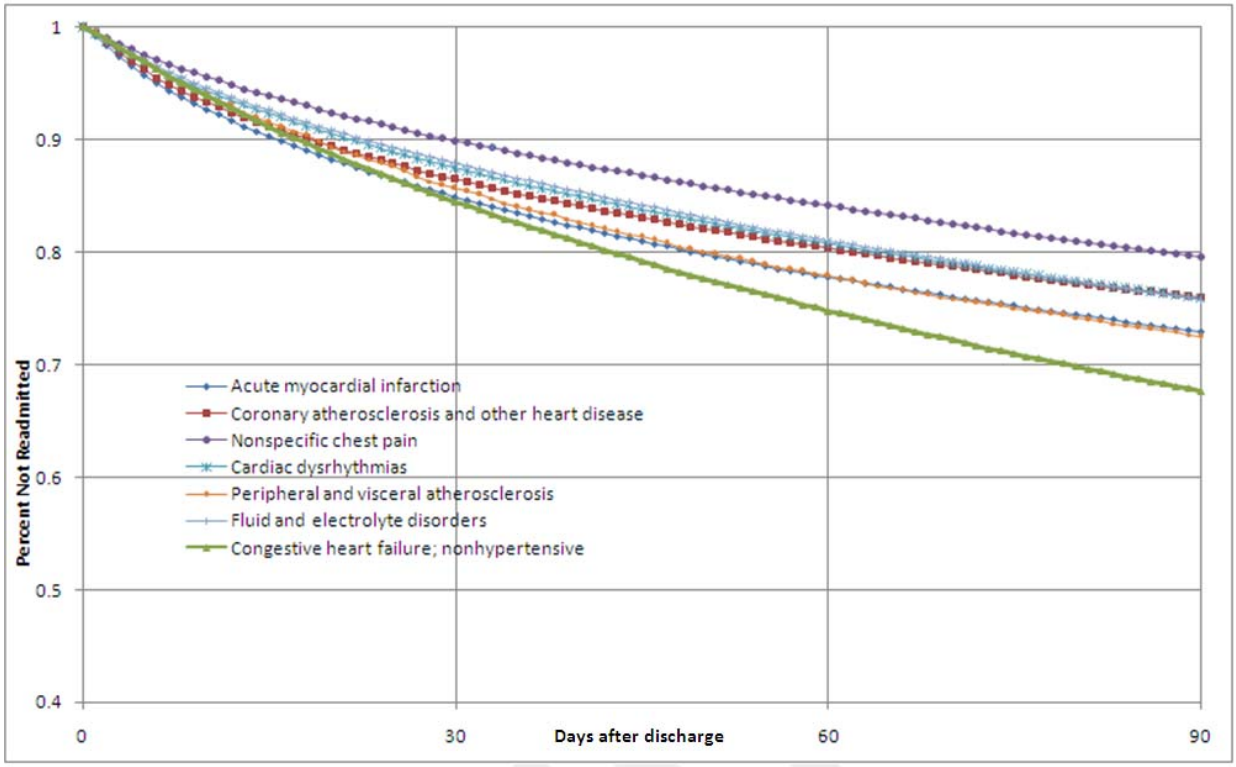
We considered 30 days as a clinically reasonable timeframe for multiple reasons:

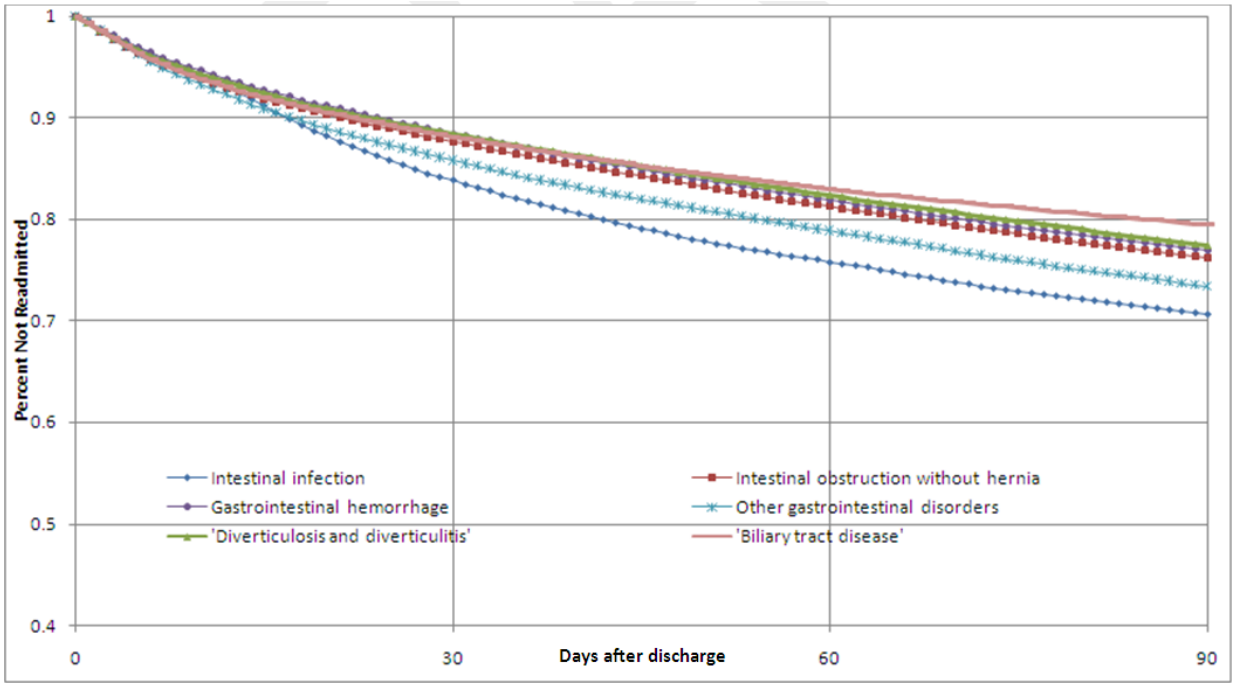
1) Within a 30-day time frame, readmissions are more likely attributable to care received during the index hospitalization and during the transition to the outpatient setting. A number of studies have demonstrated that improvements in care at the time of patient discharge can reduce 30-day readmission rates.[20,21,23,28-35,38] Hospitals, in collaboration with their medical communities, can take a number of actions to reduce readmissions: ensure patients are clinically ready at discharge; reduce risk of infection; reconcile medications; improve communications among providers involved in transition of care; encourage strategies that promote disease management principles; and educate patients about symptoms to monitor, whom to contact with questions, and where and when to seek follow-up care.[20,21,23,28-35,38]

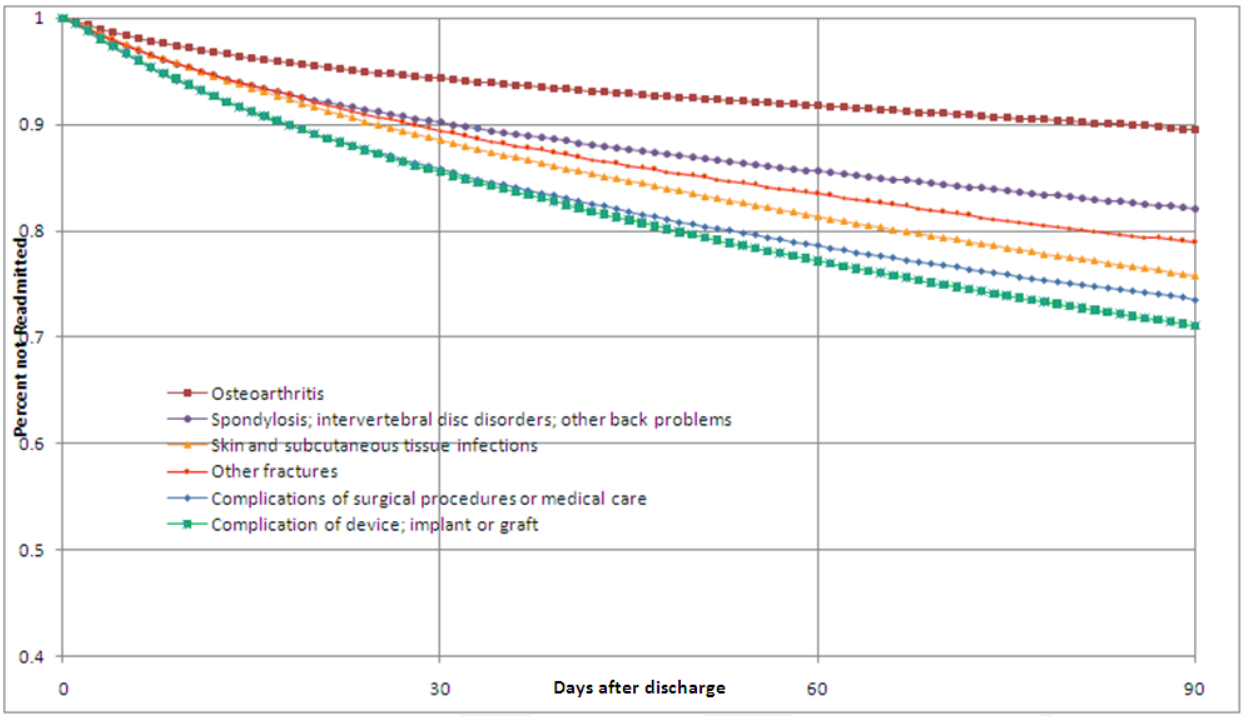
2) The 30-day timeframe is consistent with the other readmission measures approved by the National Quality Forum (NQF) and publicly reported by CMS.

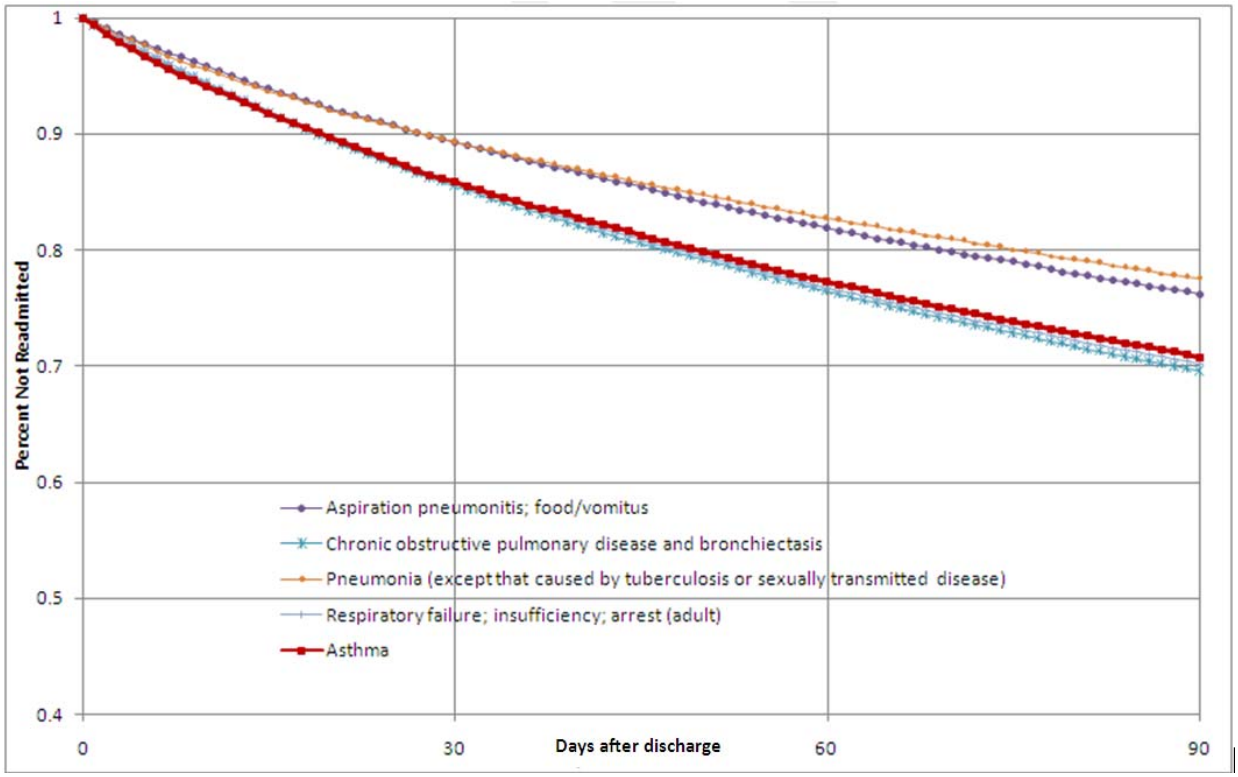
3) In addition to clinical judgment, we reviewed "time to event" curves of readmission over time to decide whether 30-day readmission is a quality signal. The readmission "time-to-event curves" showed a very similar pattern for all these discharge condition categories: a rapid early accrual of readmissions, with a stable and consistent readmission rate thereafter. Curves typically stabilized within 30 days of discharge, indicating that a 30-day cutoff is clinically reasonable. Time-to-event curves for the most common conditions are shown in **Figure 1**.

Figure 1 – Graphical representation of time to readmission






1
0.9
0.8
0.7
0.6
0.5
0.4
Percent not Readmitted
0
30
60
90
Days after discharge
Osteoarthritis
Spondylosis; intervertebral disc disorders; other back problems
Skin and subcutaneous tissue infections
Other fractures
Complications of surgical procedures or medical care
Complication of device; implant or graft


1
0.9
0.8
0.7
0.6
0.5
0.4
Percent Not Readmitted
0
30
60
90
Days after discharge
Aspiration pneumonitis; food/vomitus
Chronic obstructive pulmonary disease and bronchiectasis
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
Respiratory failure; insufficiency; arrest (adult)
Asthma

2.2.3 All-cause readmission

We defined the outcome as "all-cause" unplanned readmissions rather than readmissions related to the previous hospitalization for multiple reasons. First, from the patient perspective, readmission for any reason is likely to be an undesirable outcome of care. Furthermore, readmission for any reason exposes the patient to risks associated with hospitalization, such as iatrogenic errors. Second, there is no reliable way to determine whether a readmission is related to the previous hospitalization based on the documented cause of readmission. For example, a stroke patient who develops aspiration pneumonia may ultimately be readmitted for respiratory distress. It would be inappropriate to treat this readmission as unrelated to the care the patient received for stroke. Third, the range of potentially avoidable readmissions also includes those not directly related to the index condition category, such as those resulting from medication reconciliation errors, poor communication at discharge, or inadequate follow-up post-discharge. Creating a comprehensive list of potentially avoidable readmissions related to the previous hospitalization's condition category would be arbitrary and, ultimately, challenging to implement. Fourth, all existing CMS readmission measures report all-cause readmission, making this approach consistent with existing measures. Fifth, research shows that readmission reduction interventions can reduce all-cause readmission, not only condition-specific readmission. Finally, defining the outcome as all-cause readmissions may encourage hospitals to implement broader initiatives aimed at improving the overall care within the hospital and transitions from the hospital setting instead of limiting the focus to a narrow set of condition-specific approaches. The goal of this measure is not to reduce readmissions to zero, but to assess hospital performance relative to what is expected given the performance of other hospitals with similar case mixes.

2.3 Definition of Eligible Population

Our guiding principle for defining the eligible population was that the measure should capture as many unplanned readmissions as possible across a maximum number of acute care hospitals. Therefore we included in the measure all admissions except those for which full data was not available or for which 30-day readmission cannot reasonably be considered a signal of quality of care.

2.3.1 Grouping patients into clinically coherent discharge condition categories by using AHRQ Clinical Classification System (AHRQ-CCS)

For our previous claims-based condition- and procedure-specific outcomes measures we have used individual ICD-9 codes or CPT codes of the index admission to define the cohort. For the HWR measure, using ICD-9 codes would have been very impractical because there are potentially thousands of ICD-9 codes that would have to be included. Therefore, we aggregated ICD-9 codes into clinically coherent conditions.

To aggregate these codes, we chose the Agency for Healthcare Research and Quality's Clinical Classifications Software (CCS). We selected CCS because 1) it is well-known and widely used, 2) it is based on the principal diagnosis and not on complications or events that occur during hospitalization (unlike the Medicare Severity Diagnosis Related Groups [MS-DRGs]), and 3) because the groups of ICD-9 codes within each category are more clinically homogenous than other available groupers (MS-DRGs and CMS Condition Categories) and have relatively similar readmission rates. AHRQ CCS has been used by managed care plans, insurers and researchers for a variety of functions, such as assessing resource use, predicting future expenses, comparing procedure or condition rates among payers or hospitals, or profiling patients. There are a total of 285 mutually exclusive AHRQ condition categories, most of which are single, homogenous diseases such as pneumonia or acute myocardial infarction. Some are aggregates of conditions, such as "other bacterial infections." Mental health and substance abuse categories are included. In addition, AHRQ provides 231 mutually exclusive procedure categories to group procedures a patient might have had during hospitalization.

2.3.2 Inclusion / exclusion criteria

Admissions are eligible for inclusion in the measure if:

i. Patient is alive upon discharge
Rationale: Patients who die during the initial hospitalization cannot be readmitted.

ii. Patient is not transferred to another acute care hospital upon discharge
Rationale: In an episode of care in which patient is transferred among hospitals, responsibility for the readmission is assigned to the final discharging hospital. Therefore these intermediate admissions within a single episode of care are not eligible for inclusion.

iii. Patient is 65 or older
Rationale: Younger Medicare patients represent a distinct population with dissimilar characteristics and outcomes.

iv. Patient has at least 30 days of post-discharge enrollment in FFS Medicare or died within the 30-day post-discharge period
Rationale: This is necessary in order to identify the outcome (readmission) in the dataset.

v. The admission is not to a PPS-exempt cancer hospital
Rationale: These hospitals care for a unique population of patients that is challenging to compare to other hospitals.

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These inclusion criteria are consistent with existing CMS publicly reported measures for readmission except for the final one, which is unique to the HWR measure.

We then applied several exclusion criteria to the measure population. The first two are consistent with existing measures; the remainder are unique to the HWR measure.

a. Patients not continuously enrolled in FFS Medicare for the 12 months prior to the index admission are excluded
Rationale: This is necessary to capture historical data for risk adjustment

b. Patients discharged against medical advice (AMA) are excluded
Rationale: Hospital had limited opportunity to implement high quality care

c. Admissions for "rehabilitation care; fitting of prostheses and adjustment devices" (CCS 254) are excluded
Rationale: These admissions are not for acute care or to acute care hospitals

d. Patients admitted for a condition category with high competing mortality risk in the post-discharge period are excluded. A "high competing mortality risk condition category" is one for which there were more patients who died post-discharge without being readmitted than there were patients who were readmitted.
    i) One condition category met this criteria for all cohorts:
        - Malignant neoplasm without specification of site (CCS 43)
    ii) Several condition categories met this criteria only for the cancer and medicine cohorts (that is, admissions in the surgical cohort with these conditions were not excluded):
        - Melanomas of skin (CCS 22)
        - Cancer of breast (CCS 24)
        - Cancer of colon (CCS 14)
        - Cancer of liver and intrahepatic bile duct (CCS 16)
        - Cancer of pancreas (CCS 17)
        - Secondary malignancies (CCS 42)
        - Cancer of bronchus, lung (CCS 19)
        - Cancer of other male genital organs (CCS 31)
        - Cancer; other and unspecified primary (CCS 41)
        - Fracture of neck of femur (hip) (CCS 226)
        - Cancer of ovary (CCS 27)

    Rationale: A high ratio of post-discharge deaths per readmissions reduces the opportunity for readmissions and interferes with the readmission quality signal. In addition the quality signal may be dwarfed by the unavoidable severity of illness.

2.4 Administrative Model Development

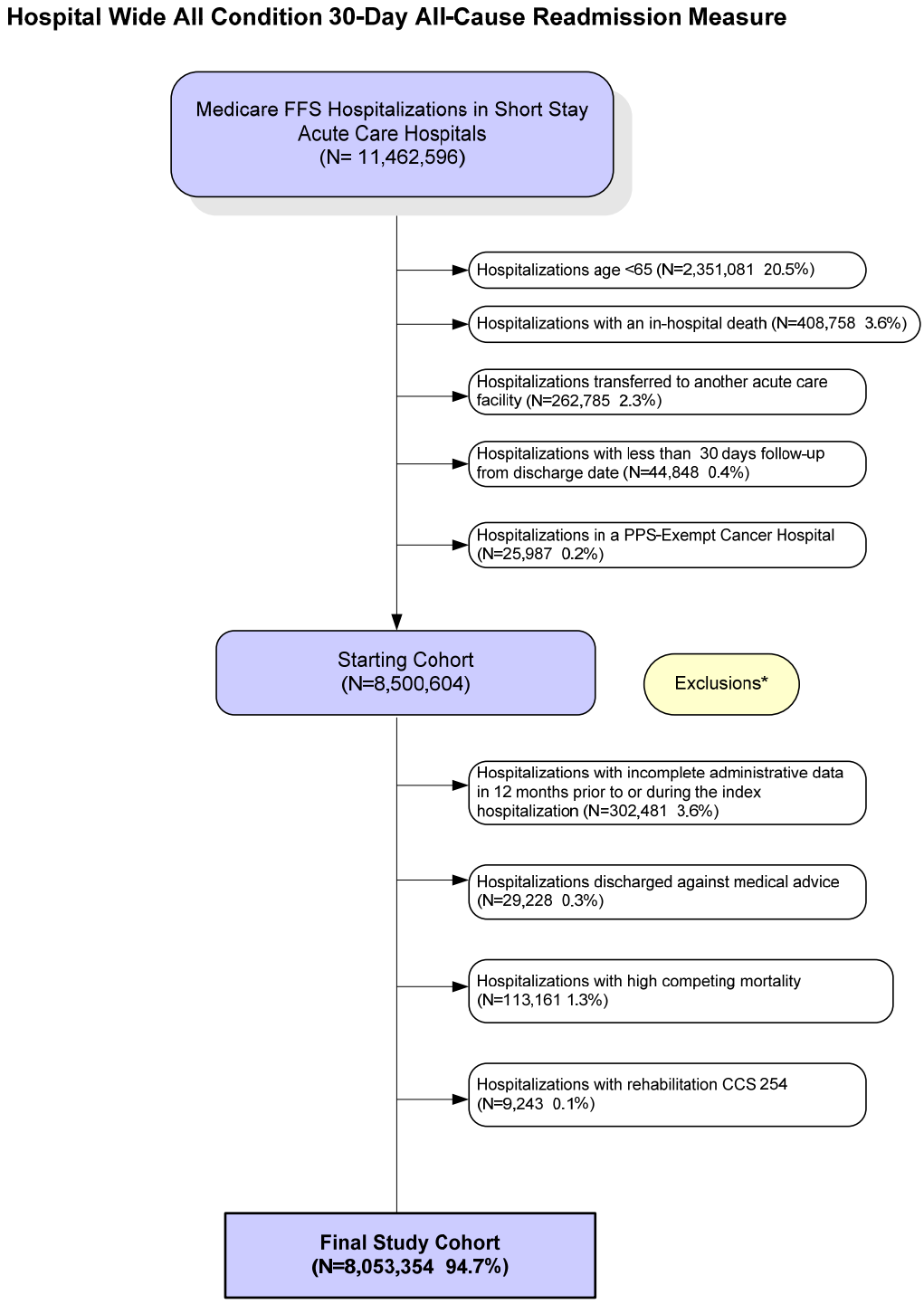
2.4.1 Data sources

To develop the measure, we constructed a dataset that contains administrative hospitalization data for fee-for-service (FFS) Medicare beneficiaries, 65 and older on admission, hospitalized in 2008. The dataset also includes data on each patient for the 12 months prior to the index admission and the 30 days following discharge. We obtained index admission, readmission, and in-hospital comorbidity data from the Medicare Provider Analysis and Review (MEDPAR) file. Enrollment and post-discharge mortality status were obtained from the Medicare Denominator file, which contains beneficiary demographic, benefit, coverage, and vital status information.

Comorbidities were assessed using data from the index admission and any admission in past year. The Medicare outpatient (Part B) data were not included because 1) this was technically cumbersome, and 2) it would make expanding the measure later to an all-payer population very difficult (all-payer data typically includes only data for hospitalized patients).

The final measure population is shown in **Figure 2**.

Figure 2 – Inclusion and exclusion criteria*



* Not mutually exclusive

*Based on 2008 MedPAR data

2.4.2 Multiple models

Because the risk of readmission varies with patient factors, including age and comorbidities, hospital comparisons using readmission rates need to account for differences in these factors. To adjust for such "case mix" differences we used regression analysis. Rather than assume that effect of risk factors would be homogeneous across all discharge condition categories, we assessed the performance of a single model versus multiple models. Our analyses showed consistently that a single model did not perform as well as multiple models, independently of how we defined the multiple models. The multiple models approach showed better discrimination and predictive ability for readmission risk.

The risk of readmission also varies according to the mix of conditions and procedures at a hospital (service mix). A multiple models approach better captures these variations. Finally, dividing the measure into several models may increase the practical utility of the measure by providing actionable information to hospitals.

2.4.3 Models are defined by care team (service line) or clinical coherence

In this step we organized admissions into seven mutually exclusive cohorts: general medicine, surgery/gynecology, cardiorespiratory, cardiovascular, neurology, oncology, and psychiatry. We built a separate model for each cohort.

a) **Rationale:** We expect the hospital component of readmission risk to be in part related to the care provided by a team of doctors, nurses, care coordinators, pharmacists, etc. Conditions typically cared for by the same team of clinicians would therefore be expected to experience similar added (or reduced) levels of readmission risk. Therefore, we grouped discharge condition categories typically cared for by the same group of clinicians into six cohorts: medicine, surgery, cardiovascular, neurology, oncology and psychiatry. Organizing results by care team (service line) in this way will allow hospitals to identify areas of strength and weakness if the results of each component model are reported separately.

b) Approach to individual cohorts:
    i. Surgical/gynecology. This cohort includes admissions likely cared for by surgical or gynecologic teams. We used AHRQ *procedure* categories (rather than AHRQ condition categories) to identify these patients. We reviewed the list of AHRQ CCS procedures and identified those which could typically result in surgical or gynecological teams caring for the patient. Minor procedures that would not have required a patient to be on the surgical service were not included in the list (for example: breast biopsy). Procedures that would generally accompany other, more major, procedures were also not included in the list on the assumption that patients undergoing these procedures would also undergo another procedure on the list (for example, intraoperative cholangiogram). The full

list of procedures assigned to the surgical/gynecology cohort is summarized in **Appendix B**. We will consult surgeons from various specialties to confirm our list of surgical procedures. Any admission during which a procedure from the final list was performed was assigned to the surgical/gynecology cohort.

ii. Cardiorespiratory. This cohort includes several conditions with very high readmission rates – pneumonia, chronic obstructive pulmonary disease, and heart failure – as well as admissions for other condition categories related to these three (asthma, acute bronchitis, pulmonary heart disease, and respiratory failure). We combined these patients into a single cohort because patients with these diseases are often clinically indistinguishable, are typically treated by the same care teams, and are often simultaneously treated for several of these diagnoses.

iii. Cardiovascular. This cohort includes cardiovascular condition categories such as acute myocardial infarction that in large hospitals might be cared for by a separate cardiac or cardiovascular team.

iv. Neurology. This cohort includes neurologic condition categories such as stroke that in large hospitals might be cared for by a separate neurologic team.

v. Oncology. This cohort includes medical admissions for cancer treatment. Patients with cancer diagnoses who undergo eligible surgical procedures (for example, a patient with a colon cancer diagnosis who undergoes a colectomy during hospitalization) are assigned to the surgical cohort.

vi. Psychiatry. This cohort includes admissions with primary psychiatric condition categories.

c) Assignment of admissions to cohorts

i. Admissions are first screened for the presence of an eligible surgical procedure category. Admissions with any of these procedures are assigned to the surgical cohort, regardless of the diagnosis code of the admission.

ii. All remaining admissions are assigned to cohorts on the basis of the discharge condition category. The AHRQ procedure categories for the surgical cohort are shown in **Appendix B**. The AHRQ discharge condition categories for the medical groups are shown in **Appendix C**.

Summary results for the seven cohorts are shown in **Table 3**.

Table 3 – Admissions, readmissions and mortality for the seven cohorts (2008)

Model Group	Admits	Unplanned Readmits	Unadjusted Unplanned 30-Day Readmit Rate	Deaths Without Readmit	30-Day Death Rate Without Readmit	Planned Readmits	Unadj. Planned 30-Day Readmit Rate	% Readmits that are Planned
Cardio-vascular	843,373	129,896	15.4%	22,118	2.6%	25,731	3.1%	17%
Cancer	82,394	20,616	25.0%	11,009	13.4%	14,587	17.7%	41%
Cardio-respiratory	1,405,271	299,275	21.3%	74,619	5.3%	16,867	1.2%	5%
Medicine	3,009,835	549,935	18.3%	150,082	5.0%	59,209	2.0%	10%
Neurology	459,189	68,000	14.8%	30,276	6.6%	8,176	1.8%	11%
Psychiatry	89,859	14,225	15.8%	3,942	4.4%	829	0.9%	6%
Surgical	2,163,433	275,329	12.7%	37,685	1.7%	55,804	2.6%	17%
Total	8,053,354	1,357,276	16.9%	329,731	4.1%	181,203	2.3%	12%

2.5 Risk Adjustment

The goal of risk adjustment is to account for differences across hospitals in patient demographic and clinical characteristics that might be related to the outcome but are unrelated to quality of care. Risk adjustment for this measure is complicated by the fact that it includes many different discharge condition categories. We must therefore adjust both for case mix differences (clinical status of the patient, accounted for by adjusting for comorbidities) and service mix differences (the types of conditions/procedures cared for by the hospital, accounted for by adjusting for the discharge condition category). Consistent with NQF guidelines, we did not adjust for socioeconomic status, gender, race, or ethnicity because hospitals should not be held to different standards of care based on the demographics of their patients. We did not adjust for patients' admission source or discharge disposition (e.g. skilled nursing facility) because these factors are associated with structure of the health care system, and may reflect the quality of care delivered by the system.

2.5.1 Complications of hospitalization

Complications occurring during hospitalization are not comorbid illnesses, may reflect hospital quality of care, and therefore should **not** be used for risk adjustment. Although adverse events during hospitalization may increase the risk of readmission, including them as covariates in a risk-adjusted model could attenuate the measure's ability to characterize the quality of care delivered by hospitals. CORE has previously reviewed every CMS Condition Category (CMS-CC) and identified those which, if they occur during the index hospitalization, would be considered potential complications rather than comorbidities. For example: fluid, electrolyte or base disorders; sepsis; and acute liver failure are all examples of CCs that could potentially be complications of care (see **Appendix D** for the complete list). For the HWR measure, we applied this pre-established list to all

potential risk variables. CCs on this list were not counted as a risk factor in our analyses if they appeared only on the index admission.

2.5.2 Case mix adjustment: risk variables

We used CMS-CCs, the grouper used in previous CMS risk-standardized outcomes measures, to group ICD-9-CM codes into risk adjustment variables, since four CMS condition-specific claims-based readmission models that use this grouper to define variables for risk adjustment have been validated against models that use chart-abstracted data for risk adjustment. [5,7,8] We decided to use a fixed, common set of variables in all our models for simplicity and ease of data collection and analysis. We describe below the steps for variable selection:

a. We developed a "starter" set of 30 variables drawn from previous readmission measures (AMI, heart failure, pneumonia, hip and knee arthroplasty, and stroke). In many cases, these variables included multiple CMS-CCs each

b. Next we reviewed all the remaining CMS-CCs and determined on a clinical basis whether they were likely to be relevant to an all-condition measure. We selected 11 additional variables to consider. (See **Appendix E** for complete set of starter variables).

c. Using data from the index admission and any admission in the prior 12 months, we ran a standard logistic regression model for every discharge condition category with the full set of candidate risk adjustment variables. We compared odds ratios for different variables across different condition categories (excluding condition categories with fewer than 700 events in order to be able to fit the models). We selected the final set of risk variables based on the following principles:

   i. We excluded risk factors that were statistically significant for very few condition categories, given that they would not contribute much to the overall models.

   ii. We excluded risk factors that behaved in clinically incoherent ways. For example, we dropped risk factors that sometimes increased risk and sometimes decreased risk, when we could not identify a clinical rationale for the differences.

   iii. We excluded risk factors that were predominantly protective when we felt this protective effect was not clinically reasonable but more likely reflected coding factors. For example, hypertension (CC 91), drug/alcohol abuse without dependence (CC 53) and delirium and encephalopathy (CC 48) were all protective for readmission risk although clinically they should increase patients' severity of illness. It is possible these factors appeared falsely protective because they were coded more often in healthier patients

who had few other comorbidities than in sicker patients who had more competing comorbidities to include in the billing form.

iv. Where possible, we grouped together risk factors that were clinically coherent and carried similar risks across condition categories. For example, we combined coronary artery disease (CCs 83-84) with cerebrovascular disease (CCs 98, 99, and 103).

v. We examined risk factors that had been combined in previous CMS publicly reported measures, and in one instance separated them: for cancers, the previous measures generally pool 5 categories of cancers (CCs 8 to12), together. In our analysis, lung cancer (CC 8) and other severe cancers (CC 9) carried higher risks, so we separated them into a distinct risk factor and grouped other major cancers (CC 10), benign cancers (CC 11), and cancers of the urinary and GI tracts (CC 12) together. Consistent with other publicly-reported measures, we also left metastatic cancer/leukemia (CC 7) as a separate risk factor.

The final list containing 74 CMS CCs, grouped into 31 risk variables, is shown in **Appendix F**.

2.5.3 Service mix adjustment

For all condition categories with sufficient volume (defined as those with more than 1,000 admissions nationally each year), we include a condition-specific indicator in the model.

Rationale: Condition categories differ in their baseline readmission risks and hospitals will differ in their relative distribution of these condition categories within each cohort (service mix). When comparing hospitals it is thus best to compare hospitals with similar service mix. Where this is not feasible, comparison is made more accurate by using an indicator variable for the discharge condition category in addition to risk variables for comorbid conditions.

2.6 Statistical Approach to Model Development

We used a full year of admission data from 2008, with 12 months history data (i.e., 2007), to create the condition cohorts and select risk variables. To assess reliability of the model performance, we combined 2007 and 2008 data, randomly split this dataset and ran the model on each split sample. To assess the stability of the model over time we compared estimates based on 2008 data to estimates based on 2009 data.

2.6.1 Models for each cohort of conditions

Due to the natural clustering of observations within hospitals, we used hierarchical generalized linear models (HGLMs) to model the log-odds of readmission for each

of the 7 cohorts.[39] Readmission within 30 days was modeled as a function of patient-level demographic and clinical characteristics and a random hospital-level intercept. This model specification accounts for within-hospital correlation of the observed outcomes and models the assumption that underlying differences in quality among the health care facilities being evaluated lead to systematic differences in outcomes. We estimated a separate logistic HGLM model for each cohort of condition categories.

We used the results of each HGLM 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 HGLM, 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.

Specifically, for a given cohort, we estimate a hierarchical generalized linear 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.,,,.7} 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:

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

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

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. The HGLM for each cohort was estimated using the SAS software system (GLIMMIX procedure).

Then, to calculate the predicted number of admissions pred_{Aj} for index admissions in cohort C=1,...,7 at hospital *j*, we used

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

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_{Aj} we used

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

Then, as a measure of excess or reduced readmissions among index admissions in cohort C at hospital *j*, we calculated the risk-adjusted readmission ratio R_{Cj} as

$$R_{Cj} = \text{pred}_{Cj}/\text{exp}_{Cj} \qquad (4)$$

2.6.2 Hospital performance reporting

The previous section describes how the risk-standardized readmission ratio for each hospital and each cohort is estimated using a separate HGLM for that cohort. To report a single readmission score, the separate risk-standardized readmission ratios 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 $C \subseteq \{1,...,7\}$, calculate the risk-standardized readmission ratio as described above for each condition 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 $R_{cj} = 1$. Then, calculate the volume-weighted logarithmic mean:

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

where the sums are over all condition 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 R_j. **This value, R_j , is the risk-standardized hospital-wide readmission ratio**. To improve interpretation, this ratio is then multiplied by the overall national readmission rate for all index admissions in all cohorts, Y, to produce **the risk-standardized hospital-wide readmission rate**.

$$RSRR_j = R_j \quad (6)$$

2.6.3 Creating interval estimates

Because the statistic described in Equation (5) is a complex function of parameter estimates, we will use re-sampling and simulation techniques to derive an interval estimate for the final risk-standardized rate. The bootstrapping simulation has the advantage of avoiding unnecessary distributional assumptions.

2.6.4 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 seven cohort HGLMs 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; $\{\alpha_j^{(b)}$, $\text{var}[\alpha_j^{(b)}] : j = 1,2,\ldots,M\}$

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 $\alpha_j^{(b^*)} \sim N(\alpha_j^{(b)}$, $\text{var}[\alpha_j^{(b)}])$ 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 R^*_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).

3. RESULTS

Figure 3 – Distribution of 30-day hospital-wide readmission rates

Figure 3a –Unadjusted rate

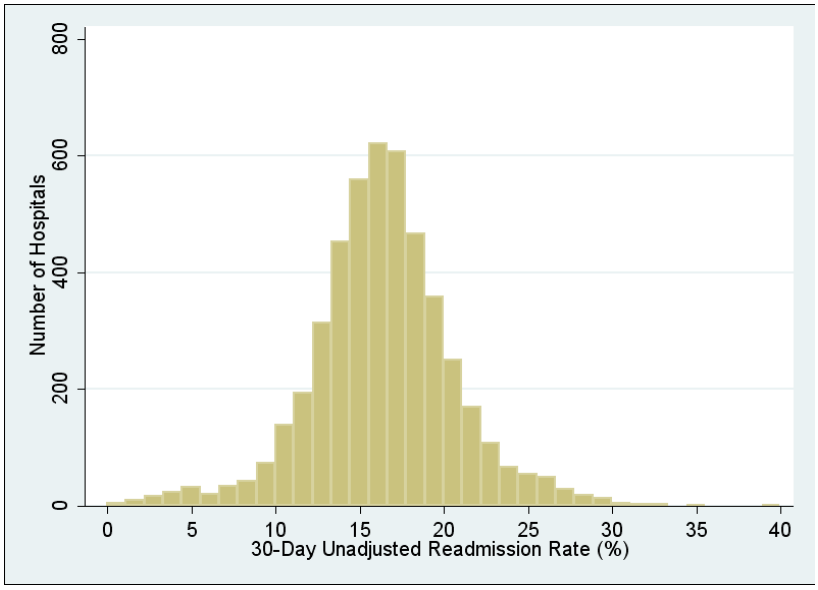


Figure 3b –Risk-standardized rate

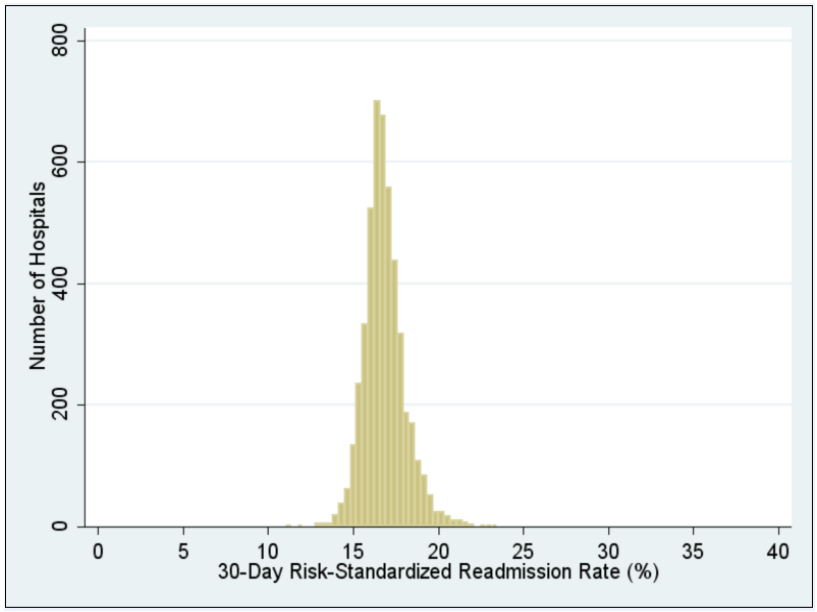


Table 4 – Frequency of hospitals in each cohort (Number of hospitals = 4919)

Cohort	Frequency	Percent
Medicine	4860	98.8
Surgical	4272	86.85
Cancer	3784	76.93
Cardiovascular	4633	94.19
Cardiorespiratory	4746	96.48
Psychiatry	4306	87.54
Neurology	4639	94.31

Table 5 – Number of hospitals based on number of models to which they contribute

Total Cohorts	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	64	1.3	64	1.3
2	122	2.48	186	3.78
3	102	2.07	288	5.85
4	157	3.19	445	9.05
5	337	6.85	782	15.9
6	646	13.13	1428	29.03
7	3491	70.97	4919	100

Table 6 – C-statistic for each model

Cohort	C-statistic
Medicine	0.640
Surgical	0.676
Cancer	0.604
Cardiovascular	0.654
Cardiorespiratory	0.629
Psych	0.605
Neurology	0.614

4. SUMMARY

In this draft measure methodology report, we present a measure for 30-day readmission following hospitalization for any condition that is based on administrative claims data for FFS Medicare beneficiaries 65 years and older. The measure is comprised of seven hierarchical logistic regression models, each of which includes a clinically coherent group of admissions. The measure includes adjustment for case mix (patient comorbidity) and service mix (types of conditions and procedures cared for by the hospital). The measure excludes planned readmissions. Our approach to model development and risk adjustment is consistent with quality measure methods recommendations for publicly-reported outcomes measures from NQF, CMS, and the American Heart Association scientific statement.

Results to date show that this measure captures 95% of eligible Medicare admissions and 88% of readmissions following those admissions, that most hospitals (71%) have admissions in every cohort, and that c-statistics for performance of each model are consistent with other public report measures. Reliability testing is under way. The measure will also be tested with all-payer data and modified as necessary to apply to the full spectrum of adult hospitalized patients. The measure will be completed in September, at which time we will provide full data on model performance and the final measure methodology.

We now seek public comment on the proposed methods, including inclusion/exclusion criteria, cohort definitions and definition of planned readmissions.

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6. APPENDIX – TABLES

Appendix A – Top 10 primary discharge diagnoses for planned procedures

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
2	**Insertion; replacement; or removal of extracranial ventricular shunt**		**Total**	**1,203**	**6,697**	**18.0%**
		81	Other hereditary and degenerative nervous system conditions	629	4,205	15.0%
		237	Complication of device; implant or graft	198	984	20.1%
		109	Acute cerebrovascular disease	173	734	23.6%
		233	Intracranial injury	45	167	26.9%
		42	Secondary malignancies	25	75	33.3%
		47	Other and unspecified benign neoplasm	21	71	29.6%
		238	Complications of surgical procedures or medical care	18	59	30.5%
		95	Other nervous system disorders	12	77	15.6%
		35	Cancer of brain and nervous system	9	43	20.9%
		2	Septicemia (except in labor)	8	24	33.3%
3	**Laminectomy; excision intervertebral disc**		**Total**	**8,904**	**103,340**	**8.6%**
		205	Spondylosis; intervertebral disc disorders; other back problems	6,535	85,978	7.6%
		209	Other acquired deformities	462	5,354	8.6%
		217	Other congenital anomalies	130	1,524	8.5%
		237	Complication of device; implant or graft	186	1,308	14.2%
		238	Complications of surgical procedures or medical care	228	1,157	19.7%
		231	Other fractures	129	768	16.8%
		212	Other bone disease and musculoskeletal deformities	109	766	14.2%
		207	Pathological fracture	125	647	19.3%
		81	Other hereditary and degenerative nervous system conditions	149	634	23.5%
		42	Secondary malignancies	131	463	28.3%
10	**Thyroidectomy; partial or complete**		**Total**	**802**	**11,084**	**7.2%**
		48	Thyroid disorders	241	5,121	4.7%
		36	Cancer of thyroid	292	2,848	10.3%
		47	Other and unspecified benign neoplasm	74	1,739	4.3%
		51	Other endocrine disorders	31	354	8.8%
		11	Cancer of head and neck	25	123	20.3%
		42	Secondary malignancies	15	82	18.3%
		38	Non-Hodgkin`s lymphoma	14	66	21.2%
		131	Respiratory failure; insufficiency; arrest (adult)	10	56	17.9%
		2	Septicemia (except in labor)	7	43	16.3%
		101	Coronary atherosclerosis and other heart disease	8	32	25.0%
36	**Lobectomy or pneumonectomy**		**Total**	**3,883**	**28,904**	**13.4%**
		19	Cancer of bronchus; lung	2,679	19,827	13.5%
		133	Other lower respiratory disease	274	2,793	9.8%
		42	Secondary malignancies	216	2,075	10.4%
		130	Pleurisy; pneumothorax; pulmonary collapse	154	1,019	15.1%
		122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	94	545	17.2%
		127	Chronic obstructive pulmonary disease and bronchiectasis	64	362	17.7%
		101	Coronary atherosclerosis and other heart disease	36	172	20.9%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
		238	Complications of surgical procedures or medical care	30	172	17.4%
		38	Non-Hodgkin`s lymphoma	21	148	14.2%
		4	Mycoses	20	131	15.3%
43	**Heart valve procedures**		**Total**	**9,348**	**41,913**	**22.3%**
		96	Heart valve disorders	6,610	30,925	21.4%
		101	Coronary atherosclerosis and other heart disease	1,018	4,257	23.9%
		100	Acute myocardial infarction	449	1,672	26.9%
		108	Congestive heart failure; nonhypertensive	375	1,313	28.6%
		237	Complication of device; implant or graft	305	1,260	24.2%
		115	Aortic; peripheral; and visceral artery aneurysms	197	813	24.2%
		97	Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transm	120	460	26.1%
		213	Cardiac and circulatory congenital anomalies	60	394	15.2%
		106	Cardiac dysrhythmias	66	246	26.8%
		99	Hypertension with complications and secondary hypertension	22	64	34.4%
44	**Coronary artery bypass graft (CABG)**		**Total**	**17,449**	**93,852**	**18.6%**
		101	Coronary atherosclerosis and other heart disease	9,754	58,416	16.7%
		100	Acute myocardial infarction	3,639	17,656	20.6%
		96	Heart valve disorders	2,655	11,993	22.1%
		237	Complication of device; implant or graft	334	1,717	19.5%
		108	Congestive heart failure; nonhypertensive	379	1,247	30.4%
		106	Cardiac dysrhythmias	126	505	25.0%
		115	Aortic; peripheral; and visceral artery aneurysms	121	469	25.8%
		97	Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transm	49	176	27.8%
		238	Complications of surgical procedures or medical care	32	131	24.4%
		114	Peripheral and visceral atherosclerosis	27	80	33.8%
45	**Percutaneous transluminal coronary angioplasty (PTCA)**		**Total**	**36,600**	**239,412**	**15.3%**
		101	Coronary atherosclerosis and other heart disease	17,349	133,645	13.0%
		100	Acute myocardial infarction	12,841	72,027	17.8%
		237	Complication of device; implant or graft	2,382	17,465	13.6%
		108	Congestive heart failure; nonhypertensive	1,138	4,091	27.8%
		106	Cardiac dysrhythmias	568	2,775	20.5%
		131	Respiratory failure; insufficiency; arrest (adult)	216	764	28.3%
		2	Septicemia (except in labor)	140	528	26.5%
		127	Chronic obstructive pulmonary disease and bronchiectasis	148	469	31.6%
		122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	131	468	28.0%
		99	Hypertension with complications and secondary hypertension	110	468	23.5%
48	**Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/**		**Total**	**27,971**	**185,737**	**15.1%**
		106	Cardiac dysrhythmias	10,102	74,614	13.5%
		105	Conduction disorders	3,663	31,993	11.4%
		108	Congestive heart failure; nonhypertensive	3,957	21,542	18.4%
		237	Complication of device; implant or graft	2,012	14,114	14.3%
		101	Coronary atherosclerosis and other heart disease	1,585	11,237	14.1%
		100	Acute myocardial infarction	1,270	5,389	23.6%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
	defibrillator	97	Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transm	381	2,954	12.9%
		96	Heart valve disorders	609	2,624	23.2%
		245	Syncope	287	2,174	13.2%
		109	Acute cerebrovascular disease	265	1,466	18.1%
51	**Endarterectomy; vessel of head and neck**		**Total**	**6,017**	**59,461**	**10.1%**
		110	Occlusion or stenosis of precerebral arteries	4,940	53,549	9.2%
		109	Acute cerebrovascular disease	326	2,471	13.2%
		101	Coronary atherosclerosis and other heart disease	257	1,212	21.2%
		100	Acute myocardial infarction	65	276	23.6%
		112	Transient cerebral ischemia	30	201	14.9%
		96	Heart valve disorders	54	185	29.2%
		106	Cardiac dysrhythmias	32	148	21.6%
		114	Peripheral and visceral atherosclerosis	25	111	22.5%
		237	Complication of device; implant or graft	15	109	13.8%
		108	Congestive heart failure; nonhypertensive	38	90	42.2%
52	**Aortic resection; replacement or anastomosis**		**Total**	**3,705**	**27,182**	**13.6%**
		115	Aortic; peripheral; and visceral artery aneurysms	3,345	25,354	13.2%
		237	Complication of device; implant or graft	137	893	15.3%
		96	Heart valve disorders	36	154	23.4%
		114	Peripheral and visceral atherosclerosis	20	103	19.4%
		101	Coronary atherosclerosis and other heart disease	23	88	26.1%
		238	Complications of surgical procedures or medical care	15	44	34.1%
		100	Acute myocardial infarction	10	39	25.6%
		108	Congestive heart failure; nonhypertensive	10	32	31.3%
		106	Cardiac dysrhythmias	6	25	24.0%
		2	Septicemia (except in labor)	6	23	26.1%
55	**Peripheral vascular bypass**		**Total**	**6,468**	**29,739**	**21.7%**
		114	Peripheral and visceral atherosclerosis	2,735	15,179	18.0%
		115	Aortic; peripheral; and visceral artery aneurysms	556	3,117	17.8%
		248	Gangrene	1,042	3,017	34.5%
		237	Complication of device; implant or graft	631	2,647	23.8%
		116	Aortic and peripheral arterial embolism or thrombosis	415	2,144	19.4%
		50	Diabetes mellitus with complications	510	1,614	31.6%
		117	Other circulatory disease	95	425	22.4%
		238	Complications of surgical procedures or medical care	81	314	25.8%
		2	Septicemia (except in labor)	42	125	33.6%
		201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted di	28	86	32.6%
60	**Embolectomy and endarterectomy of lower limbs**		**Total**	**4,229**	**18,918**	**22.4%**
		114	Peripheral and visceral atherosclerosis	1,447	7,997	18.1%
		116	Aortic and peripheral arterial embolism or thrombosis	796	3,349	23.8%
		237	Complication of device; implant or graft	448	1,854	24.2%
		115	Aortic; peripheral; and visceral artery aneurysms	333	1,848	18.0%
		248	Gangrene	422	1,182	35.7%
		50	Diabetes mellitus with complications	167	522	32.0%
		238	Complications of surgical procedures or medical care	82	405	20.2%
		117	Other circulatory disease	42	200	21.0%
		101	Coronary atherosclerosis and other heart disease	53	198	26.8%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
		100	Acute myocardial infarction	54	182	29.7%
64	**Bone marrow transplant**		**Total**	**268**	**1,102**	**24.3%**
		40	Multiple myeloma	83	466	17.8%
		38	Non-Hodgkin`s lymphoma	85	316	26.9%
		39	Leukemias	58	168	34.5%
		45	Maintenance chemotherapy; radiotherapy	12	37	32.4%
		37	Hodgkin`s disease	4	28	14.3%
		44	Neoplasms of unspecified nature or uncertain behavior	13	25	52.0%
		58	Other nutritional; endocrine; and metabolic disorders	4	18	22.2%
		237	Complication of device; implant or graft	2	7	28.6%
		250	Nausea and vomiting	2	2	100.0%
		106	Cardiac dysrhythmias	1	2	50.0%
74	**Gastrectomy; partial and total**		**Total**	**1,294**	**6,355**	**20.4%**
		13	Cancer of stomach	590	2,925	20.2%
		12	Cancer of esophagus	93	430	21.6%
		139	Gastroduodenal ulcer (except hemorrhage)	91	413	22.0%
		153	Gastrointestinal hemorrhage	89	338	26.3%
		44	Neoplasms of unspecified nature or uncertain behavior	25	337	7.4%
		141	Other disorders of stomach and duodenum	62	296	20.9%
		47	Other and unspecified benign neoplasm	42	280	15.0%
		238	Complications of surgical procedures or medical care	37	142	26.1%
		17	Cancer of pancreas	34	135	25.2%
		143	Abdominal hernia	24	112	21.4%
75	**Small bowel resection**		**Total**	**4,697**	**24,425**	**19.2%**
		145	Intestinal obstruction without hernia	1,212	6,861	17.7%
		143	Abdominal hernia	635	3,722	17.1%
		155	Other gastrointestinal disorders	404	2,074	19.5%
		114	Peripheral and visceral atherosclerosis	327	1,459	22.4%
		14	Cancer of colon	228	1,195	19.1%
		42	Secondary malignancies	256	1,040	24.6%
		146	Diverticulosis and diverticulitis	161	1,038	15.5%
		238	Complications of surgical procedures or medical care	187	829	22.6%
		2	Septicemia (except in labor)	178	635	28.0%
		237	Complication of device; implant or graft	141	603	23.4%
78	**Colorectal resection**		**Total**	**16,436**	**102,473**	**16.0%**
		14	Cancer of colon	5,035	36,222	13.9%
		146	Diverticulosis and diverticulitis	2,230	15,600	14.3%
		47	Other and unspecified benign neoplasm	1,075	10,139	10.6%
		15	Cancer of rectum and anus	1,691	9,298	18.2%
		145	Intestinal obstruction without hernia	943	4,634	20.4%
		155	Other gastrointestinal disorders	862	4,629	18.6%
		147	Anal and rectal conditions	313	2,374	13.2%
		114	Peripheral and visceral atherosclerosis	570	2,249	25.3%
		2	Septicemia (except in labor)	500	1,912	26.2%
		238	Complications of surgical procedures or medical care	326	1,677	19.4%
80	**Appendectomy**		**Total**	**2,894**	**24,117**	**12.0%**
		142	Appendicitis and other appendiceal conditions	1,285	14,041	9.2%
		145	Intestinal obstruction without hernia	155	1,145	13.5%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
		14	Cancer of colon	159	1,113	14.3%
		146	Diverticulosis and diverticulitis	133	1,016	13.1%
		27	Cancer of ovary	122	694	17.6%
		47	Other and unspecified benign neoplasm	69	667	10.3%
		155	Other gastrointestinal disorders	96	592	16.2%
		2	Septicemia (except in labor)	104	520	20.0%
		32	Cancer of bladder	136	511	26.6%
		15	Cancer of rectum and anus	83	484	17.1%
84	**Cholecystectomy and common duct exploration**		**Total**	**12,476**	**95,087**	**13.1%**
		149	Biliary tract disease	7,825	67,494	11.6%
		152	Pancreatic disorders (not diabetes)	861	7,090	12.1%
		2	Septicemia (except in labor)	633	3,590	17.6%
		14	Cancer of colon	259	1,876	13.8%
		17	Cancer of pancreas	326	1,436	22.7%
		18	Cancer of other GI organs; peritoneum	252	1,124	22.4%
		42	Secondary malignancies	140	915	15.3%
		145	Intestinal obstruction without hernia	134	843	15.9%
		143	Abdominal hernia	122	762	16.0%
		47	Other and unspecified benign neoplasm	133	722	18.4%
85	**Inguinal and femoral hernia repair**		**Total**	**2,193**	**17,933**	**12.2%**
		143	Abdominal hernia	1,588	13,922	11.4%
		238	Complications of surgical procedures or medical care	53	399	13.3%
		29	Cancer of prostate	21	388	5.4%
		145	Intestinal obstruction without hernia	57	290	19.7%
		14	Cancer of colon	23	183	12.6%
		149	Biliary tract disease	22	174	12.6%
		2	Septicemia (except in labor)	31	124	25.0%
		237	Complication of device; implant or graft	20	100	20.0%
		114	Peripheral and visceral atherosclerosis	21	91	23.1%
		32	Cancer of bladder	26	84	31.0%
103	**Nephrotomy and nephrostomy**		**Total**	**3,089**	**11,493**	**26.9%**
		160	Calculus of urinary tract	491	2,989	16.4%
		2	Septicemia (except in labor)	421	1,474	28.6%
		157	Acute and unspecified renal failure	438	1,363	32.1%
		161	Other diseases of kidney and ureters	270	1,068	25.3%
		32	Cancer of bladder	301	900	33.4%
		159	Urinary tract infections	168	545	30.8%
		237	Complication of device; implant or graft	127	412	30.8%
		42	Secondary malignancies	118	404	29.2%
		238	Complications of surgical procedures or medical care	108	380	28.4%
		29	Cancer of prostate	60	216	27.8%
104	**Nephrectomy; partial or complete**		**Total**	**1,766**	**16,132**	**10.9%**
		33	Cancer of kidney and renal pelvis	1,130	11,079	10.2%
		161	Other diseases of kidney and ureters	98	1,097	8.9%
		47	Other and unspecified benign neoplasm	77	1,060	7.3%
		34	Cancer of other urinary organs	91	826	11.0%
		32	Cancer of bladder	45	208	21.6%
		159	Urinary tract infections	34	179	19.0%
		42	Secondary malignancies	22	158	13.9%
		215	Genitourinary congenital anomalies	19	136	14.0%
		99	Hypertension with complications and secondary hypertension	24	127	18.9%
		237	Complication of device; implant or graft	26	88	29.5%
105	**Kidney**		**Total**	**551**	**1,811**	**30.4%**

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
	transplant	99	Hypertension with complications and secondary hypertension	316	1,038	30.4%
		50	Diabetes mellitus with complications	144	445	32.4%
		158	Chronic renal failure	58	200	29.0%
		237	Complication of device; implant or graft	14	49	28.6%
		215	Genitourinary congenital anomalies	7	23	30.4%
		156	Nephritis; nephrosis; renal sclerosis	6	19	31.6%
		151	Other liver diseases	2	8	25.0%
		115	Aortic; peripheral; and visceral artery aneurysms	1	6	16.7%
		117	Other circulatory disease	1	4	25.0%
		157	Acute and unspecified renal failure	1	3	33.3%
113	**Transurethral resection of prostate (TURP)**		**Total**	**4,237**	**41,835**	**10.1%**
		164	Hyperplasia of prostate	2,319	28,747	8.1%
		29	Cancer of prostate	440	4,073	10.8%
		32	Cancer of bladder	175	1,362	12.8%
		162	Other diseases of bladder and urethra	93	1,065	8.7%
		160	Calculus of urinary tract	69	846	8.2%
		163	Genitourinary symptoms and ill-defined conditions	131	797	16.4%
		159	Urinary tract infections	127	583	21.8%
		238	Complications of surgical procedures or medical care	72	548	13.1%
		157	Acute and unspecified renal failure	110	507	21.7%
		2	Septicemia (except in labor)	95	362	26.2%
114	**Open prostatectomy**		**Total**	**1,010**	**20,783**	**4.9%**
		29	Cancer of prostate	771	18,482	4.2%
		164	Hyperplasia of prostate	137	1,763	7.8%
		32	Cancer of bladder	35	165	21.2%
		162	Other diseases of bladder and urethra	4	36	11.1%
		238	Complications of surgical procedures or medical care	5	31	16.1%
		160	Calculus of urinary tract	5	29	17.2%
		165	Inflammatory conditions of male genital organs	6	23	26.1%
		163	Genitourinary symptoms and ill-defined conditions	4	18	22.2%
		166	Other male genital disorders	4	18	22.2%
		15	Cancer of rectum and anus	4	15	26.7%
119	**Oophorectomy; unilateral and bilateral**		**Total**	**3,530**	**35,902**	**9.8%**
		25	Cancer of uterus	940	9,228	10.2%
		170	Prolapse of female genital organs	218	5,648	3.9%
		47	Other and unspecified benign neoplasm	302	4,165	7.3%
		27	Cancer of ovary	697	3,766	18.5%
		175	Other female genital disorders	117	2,009	5.8%
		172	Ovarian cyst	99	1,574	6.3%
		14	Cancer of colon	131	976	13.4%
		146	Diverticulosis and diverticulitis	92	659	14.0%
		18	Cancer of other GI organs; peritoneum	106	495	21.4%
		42	Secondary malignancies	102	491	20.8%
124	**Hysterectomy; abdominal and vaginal**		**Total**	**2,732**	**35,432**	**7.7%**
		170	Prolapse of female genital organs	430	12,633	3.4%
		25	Cancer of uterus	965	9,479	10.2%
		27	Cancer of ovary	427	2,429	17.6%
		47	Other and unspecified benign neoplasm	137	2,008	6.8%
		175	Other female genital disorders	97	1,960	4.9%
		46	Benign neoplasm of uterus	86	1,660	5.2%
		26	Cancer of cervix	61	699	8.7%
		18	Cancer of other GI organs; peritoneum	67	319	21.0%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
		42	Secondary malignancies	52	274	19.0%
		32	Cancer of bladder	56	195	28.7%
145	**Treatment; fracture or dislocation of radius and ulna**		**Total**	**2,048**	**18,197**	**11.3%**
		229	Fracture of upper limb	1,146	12,208	9.4%
		226	Fracture of neck of femur (hip)	369	2,325	15.9%
		230	Fracture of lower limb	51	435	11.7%
		231	Other fractures	49	373	13.1%
		233	Intracranial injury	68	367	18.5%
		237	Complication of device; implant or graft	43	326	13.2%
		212	Other bone disease and musculoskeletal deformities	19	206	9.2%
		245	Syncope	29	191	15.2%
		106	Cardiac dysrhythmias	22	119	18.5%
		238	Complications of surgical procedures or medical care	19	98	19.4%
147	**Treatment; fracture or dislocation of lower extremity (other than hip or femur)**		**Total**	**4,361**	**34,131**	**12.8%**
		230	Fracture of lower limb	3,223	26,133	12.3%
		237	Complication of device; implant or graft	345	2,302	15.0%
		203	Osteoarthritis	67	953	7.0%
		212	Other bone disease and musculoskeletal deformities	76	766	9.9%
		238	Complications of surgical procedures or medical care	70	426	16.4%
		225	Joint disorders and dislocations; trauma-related	41	351	11.7%
		229	Fracture of upper limb	32	279	11.5%
		207	Pathological fracture	50	277	18.1%
		226	Fracture of neck of femur (hip)	30	231	13.0%
		233	Intracranial injury	26	136	19.1%
148	**Other fracture and dislocation procedure**		**Total**	**4,064**	**31,991**	**12.7%**
		229	Fracture of upper limb	1,421	12,285	11.6%
		205	Spondylosis; intervertebral disc disorders; other back problems	448	4,687	9.6%
		237	Complication of device; implant or graft	503	3,957	12.7%
		231	Other fractures	194	1,252	15.5%
		225	Joint disorders and dislocations; trauma-related	152	1,237	12.3%
		212	Other bone disease and musculoskeletal deformities	127	1,222	10.4%
		226	Fracture of neck of femur (hip)	207	1,154	17.9%
		207	Pathological fracture	166	809	20.5%
		230	Fracture of lower limb	91	470	19.4%
		238	Complications of surgical procedures or medical care	77	450	17.1%
152	**Arthroplasty knee**		**Total**	**15,063**	**250,228**	**6.0%**
		203	Osteoarthritis	12,785	226,600	5.6%
		237	Complication of device; implant or graft	1,588	16,662	9.5%
		204	Other non-traumatic joint disorders	94	1,749	5.4%
		209	Other acquired deformities	141	1,171	12.0%
		202	Rheumatoid arthritis and related disease	71	982	7.2%
		225	Joint disorders and dislocations; trauma-related	54	666	8.1%
		212	Other bone disease and musculoskeletal deformities	42	603	7.0%
		230	Fracture of lower limb	91	534	17.0%
		238	Complications of surgical procedures or medical care	37	230	16.1%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
		201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted di	31	180	17.2%
153	**Hip replacement; total and partial**		**Total**	**20,643**	**184,630**	**11.2%**
		203	Osteoarthritis	5,349	86,059	6.2%
		226	Fracture of neck of femur (hip)	10,996	68,890	16.0%
		237	Complication of device; implant or graft	2,601	18,074	14.4%
		212	Other bone disease and musculoskeletal deformities	568	5,086	11.2%
		207	Pathological fracture	308	1,838	16.8%
		204	Other non-traumatic joint disorders	57	607	9.4%
		209	Other acquired deformities	62	440	14.1%
		230	Fracture of lower limb	50	285	17.5%
		229	Fracture of upper limb	39	255	15.3%
		231	Other fractures	51	217	23.5%
154	**Arthroplasty other than hip or knee**		**Total**	**1,669**	**30,007**	**5.6%**
		203	Osteoarthritis	622	15,818	3.9%
		229	Fracture of upper limb	406	4,817	8.4%
		211	Other connective tissue disease	103	2,093	4.9%
		237	Complication of device; implant or graft	153	1,983	7.7%
		204	Other non-traumatic joint disorders	75	1,491	5.0%
		212	Other bone disease and musculoskeletal deformities	79	914	8.6%
		232	Sprains and strains	35	792	4.4%
		225	Joint disorders and dislocations; trauma-related	34	541	6.3%
		202	Rheumatoid arthritis and related disease	16	381	4.2%
		230	Fracture of lower limb	29	232	12.5%
157	**Amputation of lower extremity**		**Total**	**10,822**	**39,698**	**27.3%**
		50	Diabetes mellitus with complications	3,243	12,591	25.8%
		248	Gangrene	3,065	10,053	30.5%
		201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted di	515	2,938	17.5%
		114	Peripheral and visceral atherosclerosis	810	2,937	27.6%
		2	Septicemia (except in labor)	621	2,056	30.2%
		238	Complications of surgical procedures or medical care	554	2,052	27.0%
		237	Complication of device; implant or graft	462	1,581	29.2%
		199	Chronic ulcer of skin	177	749	23.6%
		116	Aortic and peripheral arterial embolism or thrombosis	216	642	33.6%
		117	Other circulatory disease	132	387	34.1%
158	**Spinal fusion**		**Total**	**7,495**	**74,484**	**10.1%**
		205	Spondylosis; intervertebral disc disorders; other back problems	4,782	52,912	9.0%
		209	Other acquired deformities	853	8,999	9.5%
		217	Other congenital anomalies	224	2,710	8.3%
		237	Complication of device; implant or graft	303	2,413	12.6%
		231	Other fractures	344	2,086	16.5%
		212	Other bone disease and musculoskeletal deformities	206	1,573	13.1%
		207	Pathological fracture	201	919	21.9%
		227	Spinal cord injury	128	660	19.4%
		42	Secondary malignancies	136	536	25.4%
		201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted diseases)	56	252	22.2%

Proc CCS	Procedure CCS	CCS Diag	CCS- Diagnosis Description	30-Day Readmits	Total Admits	Obs 30-Day Rate
166	**Lumpectomy; quadrantectomy of breast**		**Total**	**483**	**4,422**	**10.9%**
		24	Cancer of breast	278	3,199	8.7%
		167	Nonmalignant breast conditions	31	207	15.0%
		238	Complications of surgical procedures or medical care	18	181	9.9%
		42	Secondary malignancies	12	61	19.7%
		106	Cardiac dysrhythmias	10	38	26.3%
		108	Congestive heart failure; nonhypertensive	7	26	26.9%
		2	Septicemia (except in labor)	9	18	50.0%
		122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	6	17	35.3%
		127	Chronic obstructive pulmonary disease and bronchiectasis	5	17	29.4%
		131	Respiratory failure; insufficiency; arrest (adult)	6	11	54.5%
167	**Mastectomy**		**Total**	**1,265**	**19,789**	**6.4%**
		24	Cancer of breast	1,154	18,854	6.1%
		167	Nonmalignant breast conditions	10	178	5.6%
		259	Residual codes; unclassified	6	113	5.3%
		238	Complications of surgical procedures or medical care	10	97	10.3%
		42	Secondary malignancies	11	73	15.1%
		106	Cardiac dysrhythmias	4	20	20.0%
		55	Fluid and electrolyte disorders	4	18	22.2%
		157	Acute and unspecified renal failure	4	7	57.1%
		109	Acute cerebrovascular disease	4	6	66.7%
		103	Pulmonary heart disease	3	5	60.0%
176	**Other organ transplantation**		**Total**	**232**	**677**	**34.3%**
		151	Other liver diseases	62	184	33.7%
		133	Other lower respiratory disease	35	101	34.7%
		108	Congestive heart failure; nonhypertensive	18	76	23.7%
		16	Cancer of liver and intrahepatic bile duct	16	64	25.0%
		127	Chronic obstructive pulmonary disease and bronchiectasis	31	56	55.4%
		663	Screening and history of mental health and substance abuse codes	19	48	39.6%
		6	Hepatitis	9	28	32.1%
		101	Coronary atherosclerosis and other heart disease	8	28	28.6%
		237	Complication of device; implant or graft	5	17	29.4%
		149	Biliary tract disease	7	9	77.8%
211	**Therapeutic radiology for cancer treatment**		**Total**	**7,089**	**22,957**	**30.9%**
		42	Secondary malignancies	1,572	5,271	29.8%
		19	Cancer of bronchus; lung	798	2,662	30.0%
		45	Maintenance chemotherapy; radiotherapy	743	1,456	51.0%
		29	Cancer of prostate	171	877	19.5%
		55	Fluid and electrolyte disorders	225	631	35.7%
		122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	200	598	33.4%
		38	Non-Hodgkin`s lymphoma	175	496	35.3%
		95	Other nervous system disorders	145	453	32.0%
		40	Multiple myeloma	144	407	35.4%
		2	Septicemia (except in labor)	143	387	37.0%

Appendix B – List of AHRQ procedure CCs defining the surgical/gynecological cohort

CC	Procedure	Maximum Admissions*	Maximum Readmissions*	Readmission Rate
1	Incision and excision of CNS	28,261	5,753	20.40%
2	Insertion; replacement; or removal of extracranial ventricular shunt	7,270	1,304	17.90%
3	Laminectomy; excision intervertebral disc	79,631	6,619	8.30%
9	Other OR therapeutic nervous system procedures	16,275	2,817	17.30%
10	Thyroidectomy; partial or complete	12,989	862	6.60%
12	Other therapeutic endocrine procedures	10,415	1,340	12.90%
13	Corneal transplant	157	16	10.20%
14	Glaucoma procedures	130	18	13.80%
15	Lens and cataract procedures	633	97	15.30%
16	Repair of retinal tear; detachment	292	33	11.30%
17	Destruction of lesion of retina and choroid	127	9	7.10%
20	Other intraocular therapeutic procedures	1,107	138	12.50%
21	Other extraocular muscle and orbit therapeutic procedures	1,163	150	12.90%
22	Tympanoplasty	140	14	10.00%
23	Myringotomy	450	99	22.00%
24	Mastoidectomy	273	29	10.60%
26	Other therapeutic ear procedures	2,002	263	13.10%
28	Plastic procedures on nose	1,790	213	11.90%
30	Tonsillectomy and/or adenoidectomy	333	43	12.90%
33	Other OR therapeutic procedures on nose; mouth and pharynx	8,040	913	11.40%
36	Lobectomy or pneumonectomy	32,065	4,350	13.60%
42	Other OR Rx procedures on respiratory system and mediastinum	16,452	3,453	21.00%
43	Heart valve procedures	45,477	10,398	22.90%
44	Coronary artery bypass graft (CABG)	82,527	14,548	17.60%
49	Other OR heart procedures	41,585	8,125	19.50%
51	Endarterectomy; vessel of head and neck	63,024	6,288	10.00%
52	Aortic resection; replacement or anastomosis	27,967	3,765	13.50%
53	'Varicose vein stripping; lower limb	245	33	13.50%
55	Peripheral vascular bypass	28,972	6,163	21.30%
56	Other vascular bypass and shunt; not heart	2,387	763	32.00%
59	Other OR procedures on vessels of head and neck	14,335	1,771	12.40%
60	Embolectomy and endarterectomy of lower limbs	9,770	2,292	23.50%
61	Other OR procedures on vessels other than head and neck	178,209	37,411	21.00%
66	Procedures on spleen	2,903	548	18.90%
67	Other therapeutic procedures; hemic and lymphatic	42,288	5,557	13.10%

CC	Procedure	Maximum Admissions*	Maximum Readmissions*	Readmission Rate
	system			
72	Colostomy; temporary and permanent	10,365	1,970	19.00%
73	Ileostomy and other enterostomy	5,592	1,805	32.3%
74	Gastrectomy; partial and total	6,507	1,305	20.10%
75	Small bowel resection	21,833	4,255	19.50%
78	Colorectal resection	105,467	16,702	15.80%
79	Local excision of large intestine lesion (not endoscopic)	368	50	13.60%
80	Appendectomy	19,326	1,851	9.60%
84	Cholecystectomy and common duct exploration	102,698	13,143	12.80%
85	Inguinal and femoral hernia repair	14,656	1,683	11.50%
86	Other hernia repair	33,253	3,887	11.70%
89	Exploratory laparotomy	2,981	611	20.50%
90	Excision; lysis peritoneal adhesions	36,415	6,278	17.20%
94	Other OR upper GI therapeutic procedures	31,731	4,334	13.70%
96	Other OR lower GI therapeutic procedures	33,387	5,846	17.50%
99	Other OR gastrointestinal therapeutic procedures	29,873	6,478	21.70%
101	Transurethral excision; drainage; or removal urinary obstruction	33225	6075	18.28%
103	Nephrotomy and nephrostomy	13,530	3,649	27.00%
104	Nephrectomy; partial or complete	19,504	2,338	12.00%
105	Kidney transplant	10,873	3,175	29.20%
106	Genitourinary incontinence procedures	8,819	351	4.00%
112	Other OR therapeutic procedures of urinary tract	17,650	3,688	20.90%
113	Transurethral resection of prostate (TURP)	42,523	4,259	10.00%
114	Open prostatectomy	23,965	1,158	4.80%
118	Other OR therapeutic procedures; male genital	6,005	835	13.90%
142	Partial excision bone	37,930	5,070	13.40%
143	Bunionectomy or repair of toe deformities	931	84	9.00%
144	Treatment; facial fracture or dislocation	1,968	204	10.40%
145	Treatment; fracture or dislocation of radius and ulna	14,471	1,466	10.10%
146	Treatment; fracture or dislocation of hip and femur	149,336	22,795	15.30%
147	Treatment; fracture or dislocation of lower extremity (other than hip or femur)	39,901	5,000	12.50%
148	Other fracture and dislocation procedure	23,019	2,900	12.60%
150	Division of joint capsule; ligament or cartilage	3,002	230	7.70%
151	Excision of semilunar cartilage of knee	1,381	181	13.10%
152	Arthroplasty knee	292,149	17,995	6.20%
153	Hip replacement; total and partial	207,011	23,096	11.20%
154	Arthroplasty other than hip or knee	32,597	1,772	5.40%
157	Amputation of lower extremity	51,213	13,548	26.50%

CC	Procedure	Maximum Admissions*	Maximum Readmissions*	Readmission Rate
158	Spinal fusion	106,703	10,307	9.70%
160	Other therapeutic procedures on muscles and tendons	32,254	4,998	15.50%
161	Other OR therapeutic procedures on bone	29,314	5,611	19.10%
162	Other OR therapeutic procedures on joints	25,661	4,125	16.10%
164	Other OR therapeutic procedures on musculoskeletal system	5,963	1,346	22.60%
166	Lumpectomy; quadrantectomy of breast	2,994	311	10.40%
167	Mastectomy	16,333	1,102	6.70%
172	Skin graft	13,987	2,508	17.90%
175	Other OR therapeutic procedures on skin and breast	6,626	879	13.30%
176	Other organ transplantation	2,483	855	34.40%
119	Oophorectomy; unilateral and bilateral	33,667	2,856	8.50%
120	Other operations on ovary	906	111	12.30%
121	Ligation or occlusion of fallopian tubes	228	13	5.70%
122	Removal of ectopic pregnancy	143	6	4.20%
123	Other operations on fallopian tubes	937	82	8.80%
124	Hysterectomy; abdominal and vaginal	48,236	3,515	7.30%
125	Other excision of cervix and uterus	1,062	131	12.30%
126	Abortion (termination of pregnancy)	39	10	25.60%
127	Dilatation and curettage (D&C); aspiration after delivery or abortion	298	26	8.70%
129	Repair of cystocele and rectocele; obliteration of vaginal vault	14,446	476	3.30%
131	Other non-OR therapeutic procedures; female organs	509	115	22.60%
132	Other OR therapeutic procedures; female organs	13,796	996	7.20%
133	Episiotomy	372	7	1.90%
134	Cesarean section	6,226	280	4.50%
135	Forceps; vacuum; and breech delivery	535	15	2.80%
136	Artificial rupture of membranes to assist delivery	1,510	37	2.50%
137	Other procedures to assist delivery	5,131	162	3.20%
139	Fetal monitoring	1,488	179	12.00%
140	Repair of current obstetric laceration	1,387	38	2.70%
141	Other therapeutic obstetrical procedures	166	10	6.00%
174	Female infertility	1	-	0.00%

Total 2008 admissions: 8,203,390

Total 2008 unique readmissions: 1,473,914

*Full Medicare data including those <65 years. Not mutually exclusive; multiple procedures may be performed during a single admission.

Appendix C – Condition categories assigned to the medical cohorts

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Cardiovascular	106	Cardiac dysrhythmias	315,298	50,117	15.9%
Cardiovascular	102	Nonspecific chest pain	142,883	15,522	10.9%
Cardiovascular	100	Acute myocardial infarction	116,810	25,221	21.6%
Cardiovascular	101	Coronary atherosclerosis and other heart disease	116,147	15,240	13.1%
Cardiovascular	117	Other circulatory disease	56,016	9,199	16.4%
Cardiovascular	105	Conduction disorders	33,899	3,783	11.2%
Cardiovascular	114	Peripheral and visceral atherosclerosis	27,169	4,294	15.8%
Cardiovascular	97	Peri-; endo-; and myocarditis; cardiomyopathy (except caused by TB/STD	13,241	2,756	20.8%
Cardiovascular	96	Heart valve disorders	9,920	1,812	18.3%
Cardiovascular	115	Aortic; peripheral; and visceral artery aneurysms	5,010	773	15.4%
Cardiovascular	116	Aortic and peripheral arterial embolism or thrombosis	2,570	446	17.4%
Cardiovascular	107	Cardiac arrest and ventricular fibrillation	2,009	362	18.0%
Cardiovascular	104	Other and ill-defined heart disease	1,749	253	14.5%
Cardiovascular	213	Cardiac and circulatory congenital anomalies	652	118	18.1%
Cardiovascular		Total	843,373	129,896	15.4%
Cancer	45	Maintenance chemotherapy; radiotherapy	21,522	4,842	22.5%
Cancer	44	Neoplasms of unspecified nature or uncertain behavior	10,160	3,170	31.2%
Cancer	38	Non-Hodgkin`s lymphoma	7,977	2,373	29.7%
Cancer	39	Leukemias	7,809	2,301	29.5%
Cancer	40	Multiple myeloma	4,624	1,380	29.8%
Cancer	35	Cancer of brain and nervous system	3,561	836	23.5%
Cancer	13	Cancer of stomach	3,467	820	23.7%
Cancer	29	Cancer of prostate	3,100	497	16.0%
Cancer	15	Cancer of rectum and anus	3,030	505	16.7%
Cancer	18	Cancer of other GI organs; peritoneum	2,974	792	26.6%
Cancer	12	Cancer of esophagus	2,533	604	23.8%
Cancer	11	Cancer of head and neck	2,515	681	27.1%
Cancer	33	Cancer of kidney and renal pelvis	1,863	397	21.3%
Cancer	32	Cancer of bladder	1,807	469	26.0%
Cancer	25	Cancer of uterus	1,132	196	17.3%
Cancer	36	Cancer of thyroid	879	76	8.6%
Cancer	21	Cancer of bone and connective tissue	763	181	23.7%
Cancer	20	Cancer; other respiratory and intrathoracic	632	108	17.1%
Cancer	23	Other non-epithelial cancer of skin	593	117	19.7%
Cancer	26	Cancer of cervix	586	88	15.0%
Cancer	28	Cancer of other female genital organs	326	57	17.5%
Cancer	34	Cancer of other urinary organs	301	54	17.9%
Cancer	37	Hodgkin`s disease	236	72	30.5%
Cancer	30	Cancer of testis	4	-	0.0%
Cancer		Total	82,394	20,616	25.0%

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Cardiorespiratory	108	Congestive heart failure; nonhypertensive	453,342	112,291	24.8%
Cardiorespiratory	122	Pneumonia (except that caused by TB/STD)	403,973	71,911	17.8%
Cardiorespiratory	127	Chronic obstructive pulmonary disease and bronchiectasis	297,736	64,450	21.6%
Cardiorespiratory	131	Respiratory failure; insufficiency; arrest (adult)	117,569	28,678	24.4%
Cardiorespiratory	128	Asthma	61,696	11,148	18.1%
Cardiorespiratory	103	Pulmonary heart disease	45,122	7,496	16.6%
Cardiorespiratory	125	Acute bronchitis	25,833	3,301	12.8%
Cardiorespiratory		Total	1,405,271	299,275	21.3%
Medicine	2	Septicemia (except in labor)	236,993	50,800	21.4%
Medicine	159	Urinary tract infections	232,590	41,833	18.0%
Medicine	55	Fluid and electrolyte disorders	178,808	33,032	18.5%
Medicine	157	Acute and unspecified renal failure	163,357	36,435	22.3%
Medicine	153	Gastrointestinal hemorrhage	135,891	23,065	17.0%
Medicine	197	Skin and subcutaneous tissue infections	111,670	17,171	15.4%
Medicine	245	Syncope	107,933	11,885	11.0%
Medicine	129	Aspiration pneumonitis; food/vomitus	88,296	19,365	21.9%
Medicine	145	Intestinal obstruction without hernia	88,193	14,840	16.8%
Medicine	146	Diverticulosis and diverticulitis	85,920	11,991	14.0%
Medicine	237	Complication of device; implant or graft	81,549	18,932	23.2%
Medicine	238	Complications of surgical procedures or medical care	81,398	14,994	18.4%
Medicine	59	Deficiency and other anemia	79,517	17,810	22.4%
Medicine	50	Diabetes mellitus with complications	74,976	14,418	19.2%
Medicine	135	Intestinal infection	70,077	16,274	23.2%
Medicine	231	Other fractures	69,105	10,273	14.9%
Medicine	99	Hypertension with complications and secondary hypertension	67,337	14,943	22.2%
Medicine	118	Phlebitis; thrombophlebitis and thromboembolism	48,254	7,098	14.7%
Medicine	205	Spondylosis; intervertebral disc disorders; other back problems	46,916	7,457	15.9%
Medicine	155	Other gastrointestinal disorders	44,151	9,008	20.4%
Medicine	133	Other lower respiratory disease	36,203	6,484	17.9%
Medicine	152	Pancreatic disorders (not diabetes)	34,779	5,541	15.9%
Medicine	149	Biliary tract disease	33,718	5,583	16.6%
Medicine	138	Esophageal disorders	33,354	4,778	14.3%
Medicine	154	Noninfectious gastroenteritis	33,236	4,775	14.4%
Medicine	259	Residual codes; unclassified	32,960	5,931	18.0%
Medicine	93	Conditions associated with dizziness or vertigo	30,934	2,358	7.6%
Medicine	130	Pleurisy; pneumothorax; pulmonary collapse	29,482	7,543	25.6%
Medicine	140	Gastritis and duodenitis	29,329	5,002	17.1%
Medicine	211	Other connective tissue disease	28,565	4,163	14.6%
Medicine	251	Abdominal pain	27,091	4,480	16.5%
Medicine	151	Other liver diseases	20,612	6,340	30.8%
Medicine	244	Other injuries and conditions due to external causes	20,470	3,104	15.2%
Medicine	98	Essential hypertension	18,409	2,142	11.6%

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Medicine	207	Pathological fracture	18,040	3,823	21.2%
Medicine	239	Superficial injury; contusion	17,651	2,710	15.4%
Medicine	141	Other disorders of stomach and duodenum	17,168	3,616	21.1%
Medicine	58	Other nutritional; endocrine; and metabolic disorders	16,379	3,416	20.9%
Medicine	199	Chronic ulcer of skin	16,350	3,425	20.9%
Medicine	51	Other endocrine disorders	16,343	3,200	19.6%
Medicine	229	Fracture of upper limb	15,309	2,506	16.4%
Medicine	252	Malaise and fatigue	14,677	2,443	16.6%
Medicine	63	Diseases of white blood cells	14,138	3,399	24.0%
Medicine	123	Influenza	14,096	1,689	12.0%
Medicine	7	Viral infection	13,805	2,200	15.9%
Medicine	230	Fracture of lower limb	13,448	2,049	15.2%
Medicine	246	Fever of unknown origin	13,079	2,323	17.8%
Medicine	242	Poisoning by other medications and drugs	12,394	1,934	15.6%
Medicine	160	Calculus of urinary tract	12,195	1,573	12.9%
Medicine	163	Genitourinary symptoms and ill-defined conditions	11,122	1,948	17.5%
Medicine	204	Other non-traumatic joint disorders	10,891	1,567	14.4%
Medicine	250	Nausea and vomiting	10,795	2,173	20.1%
Medicine	120	Hemorrhoids	10,365	1,628	15.7%
Medicine	62	Coagulation and hemorrhagic disorders	9,534	2,483	26.0%
Medicine	134	Other upper respiratory disease	9,068	1,592	17.6%
Medicine	234	Crushing injury or internal injury	8,329	1,224	14.7%
Medicine	201	Infective arthritis and osteomyelitis (except that caused by TB/STD	8,105	1,692	20.9%
Medicine	203	Osteoarthritis	7,984	1,061	13.3%
Medicine	144	Regional enteritis and ulcerative colitis	7,954	1,601	20.1%
Medicine	60	Acute posthemorrhagic anemia	7,768	1,588	20.4%
Medicine	4	Mycoses	7,739	2,144	27.7%
Medicine	126	Other upper respiratory infections	7,663	975	12.7%
Medicine	143	Abdominal hernia	7,410	1,430	19.3%
Medicine	139	Gastroduodenal ulcer (except hemorrhage)	7,378	1,117	15.1%
Medicine	47	Other and unspecified benign neoplasm	7,123	1,286	18.1%
Medicine	161	Other diseases of kidney and ureters	7,057	1,313	18.6%
Medicine	121	Other diseases of veins and lymphatics	6,969	1,258	18.1%
Medicine	232	Sprains and strains	6,531	895	13.7%
Medicine	54	Gout and other crystal arthropathies	6,150	1,007	16.4%
Medicine	84	Headache; including migraine	5,839	688	11.8%
Medicine	147	Anal and rectal conditions	5,116	1,010	19.7%
Medicine	212	Other bone disease and musculoskeletal deformities	4,926	752	15.3%
Medicine	158	Chronic renal failure	4,886	1,196	24.5%
Medicine	228	Skull and face fractures	4,632	596	12.9%
Medicine	165	Inflammatory conditions of male genital organs	4,222	474	11.2%
Medicine	52	Nutritional deficiencies	4,003	978	24.4%
Medicine	253	Allergic reactions	3,885	575	14.8%

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Medicine	162	Other diseases of bladder and urethra	3,850	707	18.4%
Medicine	137	Diseases of mouth; excluding dental	3,821	615	16.1%
Medicine	164	Hyperplasia of prostate	3,734	684	18.3%
Medicine	148	Peritonitis and intestinal abscess	3,663	909	24.8%
Medicine	48	Thyroid disorders	3,634	669	18.4%
Medicine	235	Open wounds of head; neck; and trunk	3,631	464	12.8%
Medicine	241	Poisoning by psychotropic agents	3,191	411	12.9%
Medicine	6	Hepatitis	3,042	830	27.3%
Medicine	202	Rheumatoid arthritis and related disease	2,806	486	17.3%
Medicine	8	Other infections; including parasitic	2,381	297	12.5%
Medicine	236	Open wounds of extremities	2,253	356	15.8%
Medicine	49	Diabetes mellitus without complication	2,198	316	14.4%
Medicine	198	Other inflammatory condition of skin	2,028	424	20.9%
Medicine	76	Meningitis (except that caused by TB/STD)	2,003	335	16.7%
Medicine	248	Gangrene	1,996	438	21.9%
Medicine	90	Inflammation; infection of eye (except that caused by by TB/STD)	1,994	276	13.8%
Medicine	132	Lung disease due to external agents	1,866	378	20.3%
Medicine	136	Disorders of teeth and jaw	1,602	194	12.1%
Medicine	89	Blindness and vision defects	1,550	164	10.6%
Medicine	210	Systemic lupus erythematosus and connective tissue disorders	1,466	353	24.1%
Medicine	243	Poisoning by nonmedicinal substances	1,424	114	8.0%
Medicine	3	Bacterial infection; unspecified site	1,386	261	18.8%
Medicine	240	Burns	1,373	223	16.2%
Medicine	77	Encephalitis (except that caused by by TB/STD)	1,361	242	17.8%
Medicine	91	Other eye disorders	1,344	144	10.7%
Medicine	175	Other female genital disorders	1,119	206	18.4%
Medicine	225	Joint disorders and dislocations; trauma-related	1,104	129	11.7%
Medicine	94	Other ear and sense organ disorders	1,005	117	11.6%
Medicine	119	Varicose veins of lower extremity	991	139	14.0%
Medicine	200	Other skin disorders	985	150	15.2%
Medicine	167	Nonmalignant breast conditions	977	124	12.7%
Medicine	257	Other aftercare	894	142	15.9%
Medicine	168	Inflammatory diseases of female pelvic organs	852	139	16.3%
Medicine	87	Retinal detachments; defects; vascular occlusion; and retinopathy	852	84	9.9%
Medicine	142	Appendicitis and other appendiceal conditions	803	100	12.5%
Medicine	209	Other acquired deformities	760	109	14.3%
Medicine	156	Nephritis; nephrosis; renal sclerosis	756	201	26.6%
Medicine	173	Menopausal disorders	748	117	15.6%
Medicine	1	Tuberculosis	735	138	18.8%
Medicine	64	Other hematologic conditions	730	149	20.4%
Medicine	92	Otitis media and related conditions	724	105	14.5%
Medicine	166	Other male genital disorders	714	150	21.0%
Medicine	5	HIV infection	611	178	29.1%

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Medicine	247	Lymphadenitis	456	88	19.3%
Medicine	249	Shock	451	112	24.8%
Medicine	9	Sexually transmitted infections (not HIV or hepatitis)	366	56	15.3%
Medicine	258	Other screening for suspected conditions (not mental or infectious)	328	41	12.5%
Medicine	217	Other congenital anomalies	312	59	18.9%
Medicine	214	Digestive congenital anomalies	305	50	16.4%
Medicine	170	Prolapse of female genital organs	257	52	20.2%
Medicine	215	Genitourinary congenital anomalies	239	43	18.0%
Medicine	124	Acute and chronic tonsillitis	221	10	4.5%
Medicine	61	Sickle cell anemia	203	49	24.1%
Medicine	57	Immunity disorders	158	54	34.2%
Medicine	206	Osteoporosis	148	22	14.9%
Medicine	10	Immunizations and screening for infectious disease	127	16	12.6%
Medicine	88	Glaucoma	124	20	16.1%
Medicine	172	Ovarian cyst	114	14	12.3%
Medicine	208	Acquired foot deformities	103	17	16.5%
Medicine	46	Benign neoplasm of uterus	102	15	14.7%
Medicine	53	Disorders of lipid metabolism	98	16	16.3%
Medicine	171	Menstrual disorders	68	11	16.2%
Medicine	86	Cataract	37	6	16.2%
Medicine	256	Medical examination/evaluation	30	5	16.7%
Medicine	255	Administrative/social admission	14	2	14.3%
Medicine	56	Cystic fibrosis	14	3	21.4%
Medicine	169	Endometriosis	13	2	15.4%
Medicine	174	Female infertility	1	-	0.0%
Medicine		Total	3,009,835	549,935	18.3%
Neurology	109	Acute cerebrovascular disease	197,598	28,961	14.7%
Neurology	112	Transient cerebral ischemia	82,499	9,272	11.2%
Neurology	95	Other nervous system disorders	58,486	10,406	17.8%
Neurology	83	Epilepsy; convulsions	38,034	6,115	16.1%
Neurology	233	Intracranial injury	35,366	5,963	16.9%
Neurology	81	Other hereditary and degenerative nervous system conditions	10,075	1,797	17.8%
Neurology	110	Occlusion or stenosis of precerebral arteries	9,091	1,298	14.3%
Neurology	79	Parkinson`s disease	6,651	921	13.8%
Neurology	113	Late effects of cerebrovascular disease	6,396	1,062	16.6%
Neurology	85	Coma; stupor; and brain damage	6,092	990	16.3%
Neurology	111	Other and ill-defined cerebrovascular disease	5,316	638	12.0%
Neurology	80	Multiple sclerosis	1,036	147	14.2%
Neurology	82	Paralysis	883	135	15.3%
Neurology	227	Spinal cord injury	832	144	17.3%
Neurology	78	Other CNS infection and poliomyelitis	786	139	17.7%
Neurology	216	Nervous system congenital anomalies	48	12	25.0%
Neurology		Total	459,189	68,000	14.8%

Model Group	CCS	Description	Admits	Unplanned 30 Day Readmits	Unplanned 30-Day Readmit Rate
Psych	653	Delirium, dementia, and amnestic and other cognitive disorders	44,266	6,581	14.9%
Psych	661	Substance-related disorders	11,050	1,942	17.6%
Psych	660	Alcohol-related disorders	8,578	1,270	14.8%
Psych	657	Mood disorders	7,874	1,197	15.2%
Psych	659	Schizophrenia and other psychotic disorders	7,849	1,253	16.0%
Psych	663	Screening and history of mental health and substance abuse codes	4,482	1,142	25.5%
Psych	651	Anxiety disorders	3,153	394	12.5%
Psych	670	Miscellaneous disorders	1,315	207	15.7%
Psych	654	Developmental disorders	594	123	20.7%
Psych	650	Adjustment disorders	399	67	16.8%
Psych	658	Personality disorders	127	21	16.5%
Psych	652	Attention-deficit, conduct, and disruptive behavior disorders	119	18	15.1%
Psych	656	Impulse control disorders, NEC	27	4	14.8%
Psych	655	Disorders usually diagnosed in infancy, childhood, or adolescence	16	4	25.0%
Psych	662	Suicide and intentional self-inflicted injury	10	2	20.0%
Psych		Total	89,859	14,225	15.8%

Appendix D – Conditions that are treated as complications if occurring during index admission

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
124	Other Eye Disorders	

CC	Label	Potential Complications
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

Appendix E –Candidate risk variables

Label	Pope et al. CCs	Description*
rf1	1, 3-5	History of Infection
rf2	6	Other infectious disease
rf3	7	Metastatic cancer/acute leukemia
rf4	8	Lung or other severe cancers
rf5	9	Other major cancers
rf6	10	Other major cancers
rf7	11	Cancer
rf8	12	Cancer
rf9	15,16,18-20, 119, 120	Diabetes mellitus or DM complications
rf10	21	Protein-calorie malnutrition
rf11	25, 26	Liver or biliary disease
rf12	44	Other hematologoical disorders
rf13	49, 50	Dementia or other specified brain disorders
rf14	52, 53	Drug/alcohol abuse/dependence/psychosis
rf15	54-56	Major psychiatric disorders
rf16	58	Depression
rf17	60	Other psychiatric disorders
rf18	67-69, 100-102, 177, 178	Hemiplegia, paraplegia, paralysis, functional disability
rf19	74	Seizure disorders and convulsions
rf20	80	CHF
rf21	83, 84	Coronary atherosclerosis or angina
rf22	86	Valvular or rheumatic heart disease
rf23	90	Hypertensive heart failure
rf24	92, 93	Specified arrhythmias
rf25	98, 99, 103	Cerebrovascular disease
rf26	108	COPD
rf27	109	Fibrosis of lung or other chronic lung disorders
rf28	110	Asthma
rf29	129, 130	End stage renal disease
rf30	149	Decubitus ulcer or chronic skin ulcer
rf31	2	Septicemia/Shock
rf32	22, 23	Disorders of fluid, electrolyte, acid-base
rf33	47	Iron deficiency
rf34	79	Cardio-respiratory failure or shock
rf35	81, 82	Acute coronary syndrome
rf36	95, 96	Stroke
rf37	104, 105, 106	Circulatory or vascular disease
rf38	111, 112, 113	Pneumonia
rf39	131	Renal failure
rf40	136	Other urinary tract disorders
rf41	148	Decubitus ulcer

Appendix F – Final risk-adjustment variables

Label	Pope et al. CCs	Description*	Not adjusted for if only present on index admission (complication)
Age	n/a	**Age (-65)**	
Cond. Ind.	n/a	**Condition indicator (AHRQ CCS)**	
rf1	1, 3-5	**Severe infection**	
	1	HIV/AIDS	
	3	Central nervous system infection	
	4	Tuberculosis	
	5	Opportunistic infections	
rf2	6, 111-113	**Other infectious disease & pneumonias**	
	6	Other infectious disease	x
	111	Aspiration and specified bacterial pneumonias	x
	112	Pneumococcal pneumonia, emphysema, lung abscess	x
	113	Viral and unspecified pneumonia, pleurisy	x
rf3	7	**Metastatic cancer/acute leukemia**	
rf4	8, 9	**Severe cancer**	
	8	Lung, upper digestive tract, and other severe cancers	
	9	Other major cancers	
rf6	10, 11, 12	**Other major cancers**	
	10	Breast, prostate, colorectal and other cancers and tumors	
	11	Other respiratory and heart neoplasms	
	12	Other digestive and urinary neoplasms	
rf9	15,16,18-20, 119, 120	**Diabetes mellitus**	
	15	Diabetes with renal manifestation	
	16	Diabetes with neurologic or peripheral circulatory manifestation	
	17	Diabetes with acute complications	x
	18	Diabetes with ophthalmologic manifestation	
	19	Diabetes with no or unspecified complications	
	20	Type I diabetes mellitus	
	119	Proliferative diabetic retinopathy and vitreous hemorrhage	
	120	Diabetic and other vascular retinopathies	
rf10	21	**Protein-calorie malnutrition**	
rf11	25, 26	**End-Stage liver disease**	
	25	End-Stage Liver Disease	

Label	Pope et al. CCs	Description*	Not adjusted for if only present on index admission (complication)
	26	Cirrhosis of Liver	
rf12	44	**Other hematologoical disorders**	
rf14	51-52	Drug and Alcohol disorders	
	52	Drug/alcohol dependence	
	51	Drug/alcohol psychosis	
rf15	54-56, 58, 60	**Psychiatric comorbidity**	
	54	Schizophrenia	
	55	Major depressive, bipolar, and paranoid disorders	
	56	Reactive and unspecified psychosis	
	58	Depression	
	60	Other psychiatric disorders	
rf18	67-69, 100-102, 177, 178	**Hemiplegia, paraplegia, paralysis, functional disability**	
	67	Quadriplegia, other extensive paralysis	
	68	Paraplegia	
	69	Spinal Cord Disorders/Injuries	
	100	Hemiplegia/hemiparesis	
	101	Diplegia (upper), monoplegia, and other paralytic syndromes	
	102	Speech, language, cognitive, perceptual	
	177	Amputation status, lower limb/amputation	
	178	Amputation status, upper limb	
rf19	74	**Seizure disorders and convulsions**	
rf20	80	**CHF**	x
rf21	81-84, 89, 98, 99, 103-106	**Coronary atherosclerosis or angina, cerebrovascular disease**	
	81	Acute myocardial infarction	x
	82	Unstable angina and other acute ischemic heart disease	x
	83	Angina pectoris/old myocardial infarction	
	84	Coronary atherosclerosis/other chronic ischemic heart disease	
	89	Hypertensive heart and renal disease or ensephalopathy	
	98	Cerebral atherosclerosis and aneurysm	
	99	Cerebrovascular disease, unspecified	
	103	Cerebrovascular disease late effects, unspecified	
	104	Vascular disease with complications	x
	105	Vascular disease	x

Label	Pope et al. CCs	Description*	Not adjusted for if only present on index admission (complication)
	106	Other circulatory disease	x
rf24	92, 93	**Specified arrhythmias**	
	92	Specified heart arrhythmias	
	93	Other heart rhythm and conduction disorders	
rf26	108	**Chronic obstructive pulmonary disease**	
rf27	109	**Fibrosis of lung or other chronic lung disorders**	
rf29	130	**Dialysis Status**	x
rf30	148-149	**Ulcers**	
	148	Decubitus ulcer	x
	149	Decubitus ulcer or chronic skin ulcer	
rf31	2	**Septicemia/shock**	x
rf32	22-23	**Disorders of fluid, electrolyte, acid-base**	
	22	Other significant endocrine and metabolic disorders	x
	23	Disorders of fluid/electrolyte/acid-base	x
rf33	47	**Iron deficiency**	x
rf34	79	**Cardio-respiratory failure or cardio-respiratory shock**	x
rf39	131	**Acute Renal failure**	x
rf40	32	**Pancreatic disease**	
rf41	38	**Rheumatoid arthritis and inflammatory connective tissue disease**	
rf42	77	**Respirator dependence/tracheostomy status**	
rf43	128, 174	**Transplants**	
	128	Kidney transplant status	
	174	Major organ transplant status	
rf44	46	**Coagulation defects and other specified hematological disorders**	
rf45	158	**Hip fracture/dislocation**	