RESPECIFYING THE HOSPITAL 30-DAY ACUTE MYOCARDIAL INFARCTION, HEART FAILURE, AND TOTAL HIP/KNEE ARTHROPLASTY READMISSION MEASURES BY ADDING A PLANNED READMISSION ALGORITHM

Submitted By Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE)

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Background

The Centers for Medicare & Medicaid Services (CMS) has developed hospital risk-standardized readmission measures for acute myocardial infarction (AMI), heart failure (HF), and elective total hip and/or knee arthroplasty (THA/TKA). These measures have been approved by the National Quality Forum (NQF)[1]. CMS has contracted with Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE) to update these measures to identify and remove additional planned readmissions from the measure outcomes. This report describes the change to each measure for consideration by NQF.

Readmission measures are intended to capture unplanned readmissions that arise from acute clinical events requiring urgent rehospitalization within 30 days of discharge. Higher than expected unplanned readmission rates suggest lower quality of hospital and post-discharge care and are the focus of hospital quality measurement as part of efforts to promote quality improvement. In contrast, planned readmissions are generally not a signal of quality of care. Furthermore, there is concern that including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients who are scheduled for elective or necessary procedures unrelated to the prior admissions.

During development of the readmission measures, YNHHSC/CORE clinicians, additional clinical consultants, and technical expert panels identified readmissions for each measure that are typically scheduled as follow-up care within 30 days of discharge. For the AMI and THA/TKA measures, some types of readmissions were identified as follow-up care and were not counted in the outcome. There has been growing interest in identifying and excluding from the outcome planned readmissions for procedures and treatments such as chemotherapy, which are not directly related to the index admission, but were also likely planned.

To more broadly identify planned readmissions, CMS contracted with YNHHSC/CORE to develop a planned readmission "algorithm" (a set of criteria) for classifying readmissions as planned using claims data. The algorithm identifies admissions that are typically planned and may occur within 30 days of discharge from the hospital. The planned readmission algorithm was developed for a hospital-wide cohort of patients regardless of the index admission diagnosis. Since it identifies commonly planned readmissions for all types of patients, it is a more comprehensive definition of planned readmissions that includes procedures and conditions that are not considered follow-up care for the specific condition or procedure that is the focus of the measure (e.g. elective cholecystectomy following admission for AMI). The planned readmission algorithm therefore can be used to enhance the identification of planned readmissions in the readmission measures.

We have updated the readmission measures by replacing our previous approach to identifying planned readmissions with this planned readmission algorithm. In this report we present: (1) an overview of the planned readmission algorithm; (2) our approach to applying the planned readmission algorithm to each

[1] Measure numbers are: AMI - 0505, HF - 0330, and THA/TKA - 1551.

readmission measure; (3) an impact analysis of how this change in each measure affects the readmissions identified as planned, the rate of planned readmissions, model performance, and the distribution of hospital rates; and (4) a summary of the measure updates.

1. Planned Readmission Algorithm Overview

We based the planned readmission algorithm on three principles:

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

Clinicians in our internal working group reviewed the full list of Agency for Healthcare Research and Quality (AHRQ) Procedure Clinical Classification Software (Proc CCS) codes and identified procedure categories that are commonly planned based on these principles. The full preliminary list of planned readmissions and acute diagnoses was posted as part of two public comment periods for the Hospital-Wide Readmission measure. The details of the resulting algorithm are presented in Appendix A. In brief, the algorithm uses a flow chart (Figure A 1) and four tables of specific procedure categories and discharge diagnosis categories to classify readmissions as planned. Specifically:

1. Table A 1 lists four procedure categories that are always planned regardless of diagnosis;
2. Table A 2 lists four diagnosis categories that are always planned regardless of procedure;
3. Table A 3 presents the list of potentially planned procedure categories (readmissions with these procedures are considered planned if not accompanied by an acute discharge diagnosis); and
4. Table A 4 presents the acute diagnosis categories that disqualify a potentially planned readmission from being considered planned.

2. Applying the Planned Readmission Algorithm

Approach to applying the planned readmission algorithm

Since we developed the planned readmission algorithm in a hospital-wide cohort of patients, our first step in applying it to a condition-specific measure was to review the potentially planned procedures in the algorithm (Table A 3) and identify any procedures that should be added or removed to adapt the algorithm for each cohort of patients. Specifically, we took the following steps:

1. We applied the algorithm to each readmission measure, and examined the procedures and associated diagnoses that were identified as being potentially planned.
2. YNHHSC/CORE clinicians reviewed the results for face validity and determined whether any procedures considered planned by the algorithm were likely unplanned among each patient population.

3. Our team of clinicians also determined whether any additional procedures not identified as potentially planned by the algorithm should in fact be considered planned for each patient group. In particular, we reviewed any procedures identified as planned in the original, NQF-endorsed measures and noted whether they were included in the algorithm.
4. Based on these considerations, we finalized the algorithm for each readmission measure.

3. Impact Analyses

AMI Measure

Based on our review, we have applied the planned readmission algorithm without adaptation to the AMI readmission measure by replacing the definition of planned procedures in the original, NQF-endorsed measure. In reviewing the planned readmission algorithm for use in the AMI readmission measure (**step 2**), our clinicians did not identify any procedure categories that should be removed from the algorithm because they would unlikely be planned in this patient population. In **step 3**, clinician review confirmed that all of those procedures identified as planned in the original, NQF-endorsed measure are also included in the planned readmission algorithm as potentially planned procedures. The original, NQF-endorsed measure identified readmissions as planned for procedures that are related to follow-up care after an AMI. These were coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) unless accompanied by one of five acute primary discharge diagnoses.

After applying the planned readmission algorithm, we compared the results of the original, NQF-endorsed and updated measures to assess the effect of updating the measure with the planned readmission algorithm.

Data

The measures were applied to admissions during the period between July 2008 and June 2011. There were 521,551 index admissions for AMI at 4,519 hospitals.

Readmissions identified as planned in the updated measure

The updated measure identified 11,518 planned readmissions. The top 10 procedures among planned readmissions identified by the updated measure are presented in Table 1.

Table 1: Top 10 Planned Procedures among Planned Readmissions Following AMI Discharge

Procedure CCS	Procedure Description	Number of Planned Procedures
47	Diagnostic cardiac catheterization; coronary arteriography	4,812
44	Coronary artery bypass graft (CABG)	1,821
45	Percutaneous transluminal coronary angioplasty (PTCA)	1,424
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	950
49	Other OR heart procedures	343
62	Other diagnostic cardiovascular procedures	220
84	Cholecystectomy and common duct exploration	187
157	Amputation of lower extremity	172
169	Debridement of wound; infection or burn	159
43	Heart valve procedures	130

Rate of planned readmissions identified by the original NQF-endorsed and updated measures
Using the original, NQF-endorsed measure, the crude 30-day unplanned readmission rate was 19.7% and the planned readmission rate was 1.6%. The updated measure decreased the number of readmissions counted in the outcome by identifying additional readmissions as planned. For the updated measure, the crude 30-day unplanned readmission rate was 19.0%. Thus, the updated measure increases the rate of planned readmissions to 2.3%, an absolute increase of 0.7% from the original, NQF-endorsed measure.

Although the rate of planned readmissions was higher for the updated measure, some readmissions considered as planned in the original, NQF-endorsed measure were identified as unplanned by the updated measure because the adapted planned readmission algorithm contains a more complete list of acute diagnosis categories (Table A 4) that disqualify some readmissions with a potentially planned procedure from being considered planned. Roughly 1% of readmissions identified as planned in the original, NQF-endorsed measure were no longer considered planned in the updated measure. This represents 1,397 admissions for planned procedures that were accompanied by a diagnosis that is considered acute in the planned readmission algorithm, such as complication of surgery.

Comparison of model performance
To assess potential change in model performance, we calculated the c-statistic for the Original NQF-endorsed measure and the updated measure. The c-statistic changed negligibly from 0.636 to 0.635.

We also examined the odds ratios for the risk factors and their 95% confidence intervals (CIs) to determine whether this update substantially changed model variables, suggesting they should be re-selected. The odds ratios for the original, NQF-endorsed measure and for the updated measure are in Appendix B in Table B 1. The odds ratios are nearly identical, indicating that the risk factors have a similar magnitude of effect regardless of whether or not the additional planned readmissions are counted in the readmission outcome.

Impact on distribution of RSRRs and relative performance of hospitals
To assess the effect on hospitals' relative performance, we examined the distribution of the Risk-Standardized Readmission Rates (RSRR) in the original, NQF-endorsed measure and the updated measure. The distribution of RSRRs shifted slightly downward from the original, NQF-endorsed measure (Figure 1) for the updated measure (Figure 2). This is expected given that the updated crude 30-day unplanned readmission rate decreased from 19.7% to 19.0%.

We then examined the distribution of the difference in hospitals' RSRR values (RSRR of the original, NQF-endorsed measure subtracted from the RSRR of the updated measure). A narrow distribution would suggest that the relative performance of hospitals is not substantially affected by the change. The distribution of the difference in hospital RSRRs centered on -0.2 and is relatively narrow; for most hospitals, the difference is between -1.4 and 0.0. (Figure 3)

Figure 1: Distribution of Hospital RSRRs for the Original NQF-endorsed AMI Readmission Measure

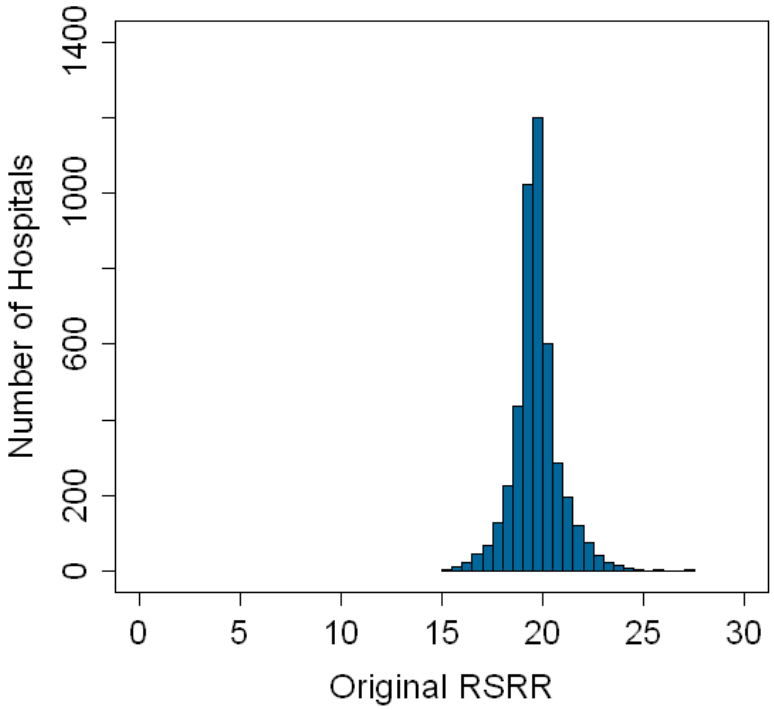


Figure 2: Distribution of Hospital RSRRs for the Updated AMI Readmission Measure

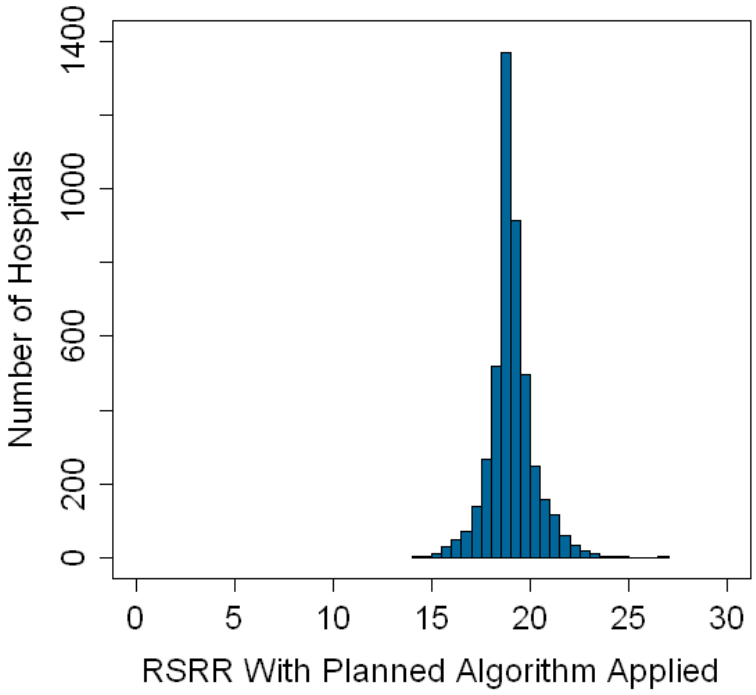
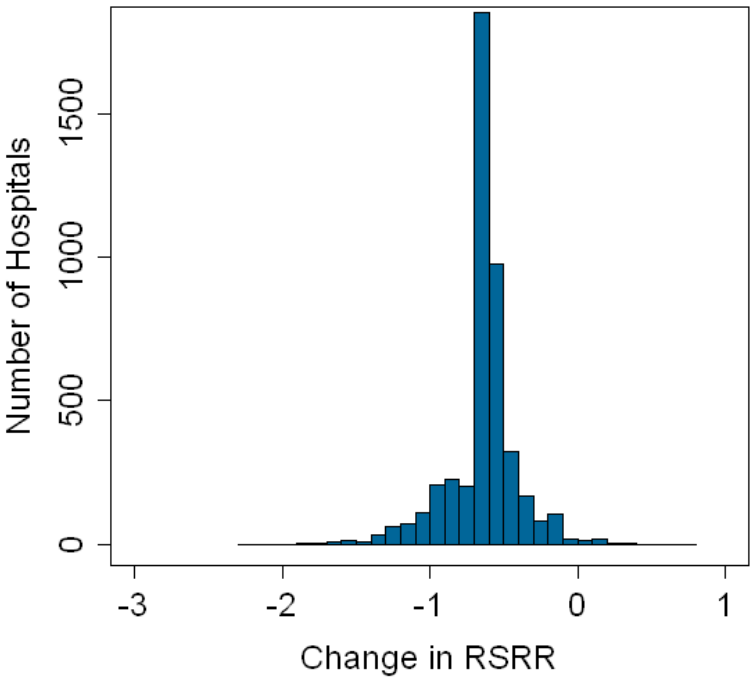


Figure 3: Distribution of Hospitals' Change in RSRR for AMI after Applying the Planned Readmission Algorithm



HF Measure

Based on our review, we updated the HF readmission measure by applying the planned readmission algorithm without any adaptation. In reviewing the planned readmission algorithm for use in the HF readmission measure (**step 2**), our clinicians did not identify any procedure categories that should be removed from the algorithm because they would unlikely be planned in this patient population. The previously original, NQF-endorsed measure did not identify any planned readmissions (**step 3**).

We compared the results of the original, NQF-endorsed and updated readmission measures to assess the effect of updating the measure with the planned readmission algorithm.

Data

The measures were applied to admissions during the period between July 2008 and June 2011. There were 1,297,008 index admissions for HF at 4,829 hospitals.

Readmissions identified as planned in the updated measure

The updated measure identified 16,395 planned readmissions. The top 10 procedures among planned readmissions identified by the updated measure are presented in Table 2.

Table 2: Top 10 Planned Procedures among Planned Readmissions Following HF Discharge

Procedure CCS	Procedure Description	Number of Planned Procedures
47	Diagnostic cardiac catheterization; coronary arteriography	4557
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	3240
49	Other OR heart procedures	1081
44	Coronary artery bypass graft (CABG)	818
62	Other diagnostic cardiovascular procedures	709
43	Heart valve procedures	635
157	Amputation of lower extremity	510
84	Cholecystectomy and common duct exploration	477
169	Debridement of wound; infection or burn	444
43	Percutaneous transluminal coronary angioplasty (PTCA)	349

Rate of planned readmissions identified by the original NQF-endorsed and updated measures

Using the original, NQF-endorsed measure, the crude 30-day unplanned readmission rate was 24.7%. The updated measure decreased the number of readmissions counted in the outcome by identifying some readmissions as planned. For the updated measure, the crude 30-day unplanned readmission rate was 23.5%. Thus, the updated measure has a planned readmission rate of roughly 1.2%.

Comparison of model performance

To assess potential change in model performance, we calculated the c-statistic for the original, NQF-endorsed measure and the updated measure. The c-statistic changed negligibly from 0.603 to 0.609.

We also examined the odds ratios for the risk factors and their 95% confidence intervals (CIs) to determine whether this update substantially changed model variables, suggesting they should be re-selected. The odds ratios for the original, NQF-endorsed measure and for the updated HF readmission measure are in Appendix B in Table B 2. The odds ratios are nearly identical, indicating that the risk factors have a similar magnitude of effect regardless of whether or not the additional planned readmissions are counted in the readmission outcome.

Impact on distribution of RSRRs and relative performance of hospitals

To assess the effect on hospitals' relative performance, we examined the distribution of the Risk-Standardized Readmission Rates (RSRR) in the original, NQF-endorsed measure and the updated measure. The distribution of RSRRs shifted slightly downward from the original, NQF-endorsed measure (Figure 4) for the updated measure (Figure 5). This is expected given that the updated crude 30-day unplanned readmission rate decreased from 24.7% to 23.5%.

We then examined the distribution of the difference in hospitals' RSRR values (RSRR of the original, NQF-endorsed measure subtracted from the RSRR of the updated measure). A narrow distribution would suggest that the relative performance of hospitals is not substantially affected by the change. Because the original, NQF-endorsed measure did not account for any planned readmissions, the distribution of the difference in hospital RSRRs centered on -1.2. All hospitals experienced a decrease in their rate and, for most, the difference was between -2.2 and -0.6. (Figure 6)

Figure 4: Distribution of Hospital RSRRs for the Original NQF-endorsed HF Readmission Measure

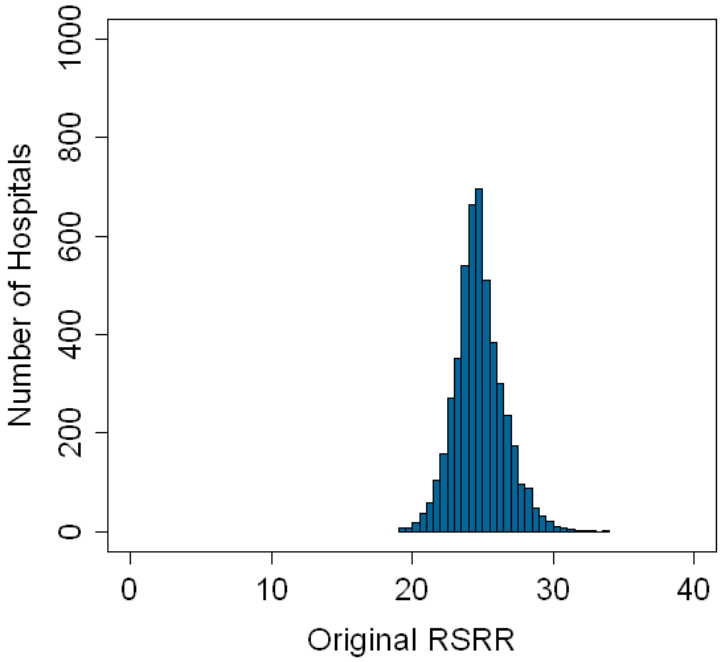


Figure 5: Distribution of Hospital RSRRs for the Updated HF Readmission Measure

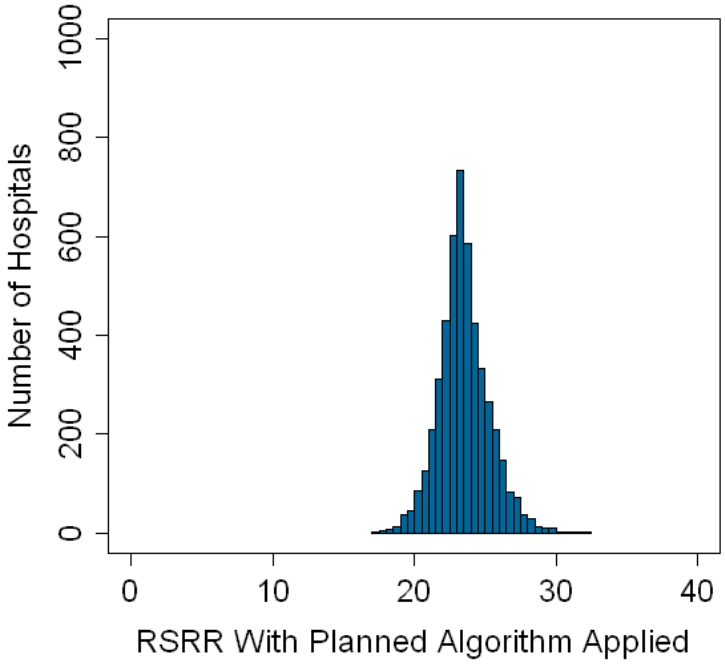
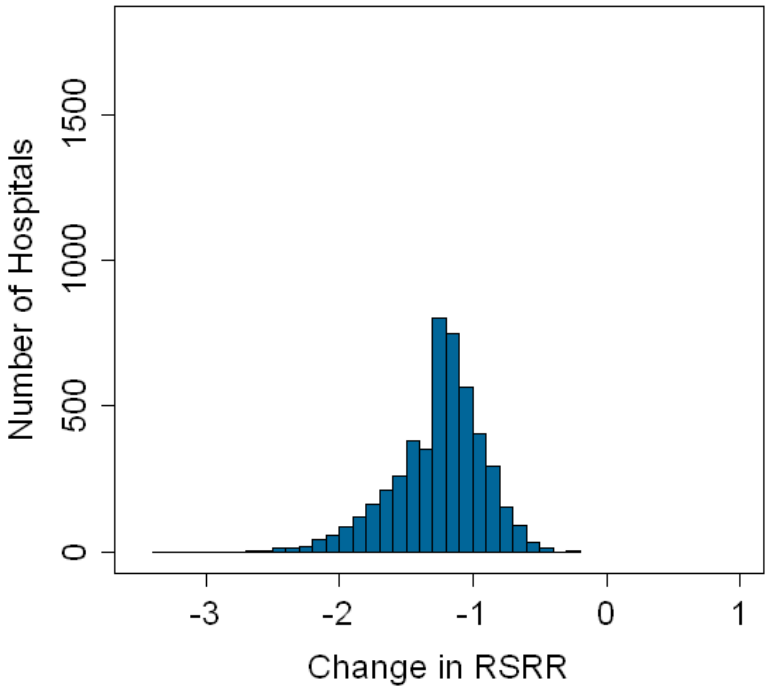


Figure 6: Distribution of Hospitals' Change in RSRR for HF after Applying the Planned Readmission Algorithm



THA/TKA Measure

Based on our review, we have applied the planned readmission algorithm to the THA/TKA readmission measure with minor adaptation. In reviewing the planned readmission algorithm for use in the THA/TKA measure (**step 2**), clinicians identified procedure categories that the planned readmission algorithm categorized as planned that would unlikely be planned in a cohort of patients that had recently undergone an elective THA or TKA procedure. We modified the algorithm for this measure to delete these procedures from the list of potentially planned procedure categories (Table A 3). Specifically, we deleted:

1. Proc CCS 55 – Peripheral vascular bypass
2. Proc CCS 142 – Partial excision of bone
3. Proc CCS 157 - Amputation of lower extremity
4. ICD-9 Code 38.18 - Endarterectomy leg vessel

Additionally, clinicians identified five diagnosis categories that were not in the planned readmission algorithm as acute diagnoses that would likely be acute conditions in this cohort of patients. Thus we added these five additional diagnosis categories to the list of acute diagnoses that disqualify readmissions with potentially planned procedures as planned (Table A 4). Specifically, we added:

1. Diag CCS 201 - Infective arthritis and osteomyelitis
2. Diag CCS 204 - Other non-traumatic joint injury
3. Diag CCS 207 - Pathological fractures
4. Diag CCS 231 - Other fractures
5. Diag CCS 236 - Open wounds of extremities

Hence, all readmissions for potentially planned procedures accompanied by the five diagnoses above will be counted as unplanned, given that they are not likely planned when they occur within 30 days of discharge from and admission for an elective THA or TKA.

In **step 3**, clinician review confirmed that all of the procedures that were considered planned in the original, NQF-endorsed readmission measure were also included in the planned readmission algorithm as potentially planned.

Therefore, the planned readmission algorithm has been adapted for the THA/TKA readmission measure by removing the four procedure categories listed above from the list of potentially planned procedures (Table A 3) and adding the five diagnosis categories listed above to the list of acute diagnoses that disqualify a procedure from being considered planned (Table A 4). We updated the THA/TKA readmission measure by replacing the definition of planned procedures in the original, NQF-endorsed measure with the adapted planned readmission algorithm for THA/TKA.

After applying the algorithm, we compared the results of the original, NQF-endorsed and updated THA/TKA readmission measure to assess the effect of updating the measure with the planned readmission algorithm.

Data

The measures were applied to admissions during calendar years 2008-2010. There were 897,321 index admissions for THA/TKA at 3,497 hospitals.

Readmissions identified as planned in the updated measure

The updated measure identified 4,216 planned readmissions. This includes all 1,402 planned readmissions identified in the original, NQF-endorsed measure. The top 10 procedures among planned readmissions identified by the updated measure are presented in Table 3.

Table 3: Top 10 Planned Procedures among Planned Readmissions Following THA/TKA Discharge

Procedure CCS	Procedure Description	Number of Planned Procedures
998	Rehabilitation care; fitting of prostheses; and adjustment of devices	1,358
152	Arthroplasty knee	1,186
84	Cholecystectomy and common duct exploration	346
47	Diagnostic cardiac catheterization; coronary arteriography	336
153	Hip replacement; total and partial[2]	175
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	114
113	Transurethral resection of prostate (TURP)	106
5	Insertion of catheter or spinal stimulator and injection into spinal canal	68
86	Other hernia repair	62
78	Colorectal resection	60

Rate of planned readmissions identified by the original, NQF-endorsed and updated measures

Using the original, NQF-endorsed readmission measure, the crude 30-day unplanned readmission rate was 5.7% and the planned readmission rate was 0.2%. The updated measure decreased the number of readmissions counted in the outcome by identifying additional readmissions as planned. For the updated THA/TKA readmission measure, the crude 30-day unplanned readmission rate was 5.5% and increases the rate of planned readmissions to 0.4%, an absolute increase of 0.2% from the original, NQF-endorsed measure.

[2] As originally specified, these include only those procedures associated with a principle discharge diagnosis of osteoarthritis, rheumatoid arthritis, osteonecrosis, or arthropathy excluding septic arthropathy

Comparison of model performance

To assess potential change in model performance, we calculated the c-statistic for the original, NQF-endorsed measure and the updated measure. The c-statistic changed negligibly from 0.64 to 0.65.

We also examined the odds ratios for the risk factors and their 95% confidence intervals (CIs) to determine whether this update substantially changed model variables, suggesting they should be re-selected. The odds ratios for the original, NQF-endorsed measure and for the updated measure are in Appendix B in Table B3. The odds ratios are nearly identical, indicating that the risk factors have a similar magnitude of effect regardless of whether or not the additional planned readmissions are counted in the readmission outcome.

Impact on distribution of RSRRs and relative performance of hospitals

To assess the effect on hospitals' relative performance, we examined the distribution of the Risk-Standardized Readmission Rates (RSRR) in the original, NQF-endorsed measure and the updated measure. The distribution of RSRRs shifted slightly downward from the original, NQF-endorsed measure (Figure 7) for the updated measure (Figure 8). This is expected given that the updated crude 30-day unplanned readmission rate decreased from 5.7% to 5.5%.

We then examined the distribution of the difference in hospitals' RSRR values (RSRR of the original, NQF-endorsed measure subtracted from the RSRR of the updated measure). A narrow distribution would suggest that the relative performance of hospitals is not substantially affected by the change. The distribution of the difference in hospital RSRRs centered on -0.2 and is relatively narrow; for most hospitals, the difference is between -0.5 and -0.1 (Figure 9).

Figure 7: Distribution of Hospital RSRRs for the Original NQF-endorsed THA/TKA Readmission Measure

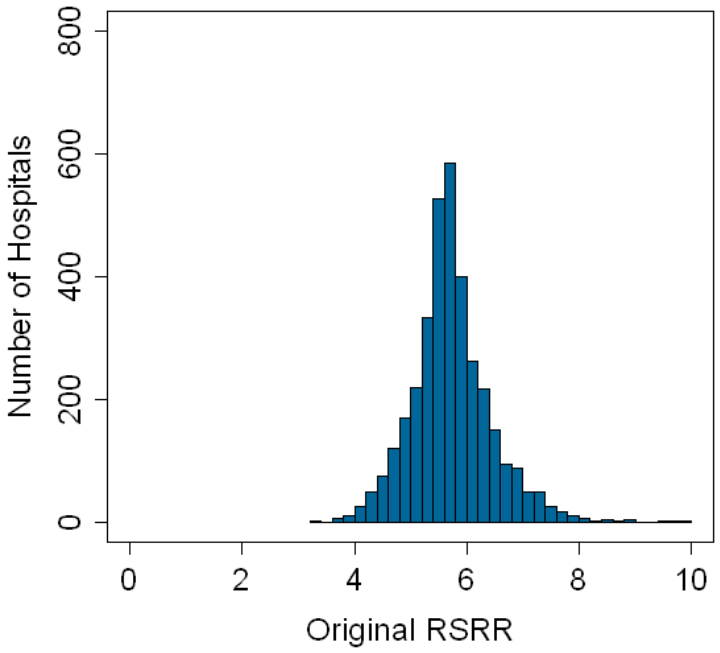


Figure 8: Distribution of Hospital RSRRs for the Updated THA/TKA Readmission Measure

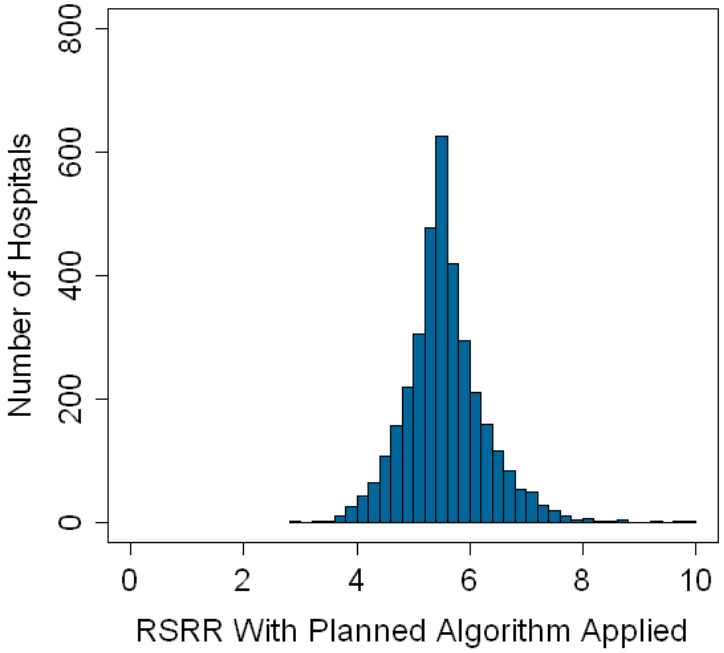
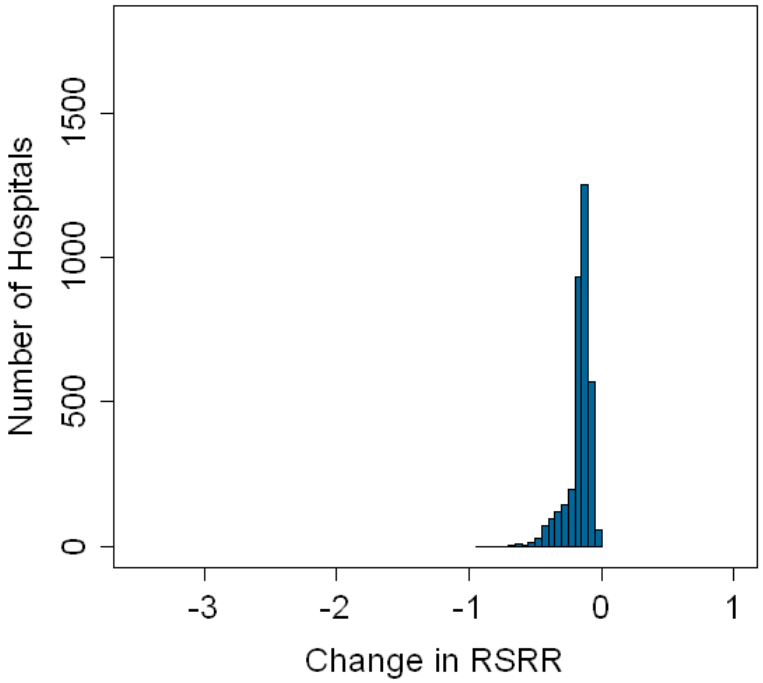


Figure 9: Distribution of Hospitals' Change in RSRR for THA/TKA after Applying the Planned Readmission Algorithm



4. Summary of Measure Updates

For the AMI readmission measure, we replaced the planned readmission definition in the original, NQF-endorsed measure with the planned readmission algorithm. The updated measure with the planned readmission algorithm expanded the number of index admissions followed by a planned readmission to 2.3% and lowered the measured crude readmission rate to 19.0%.

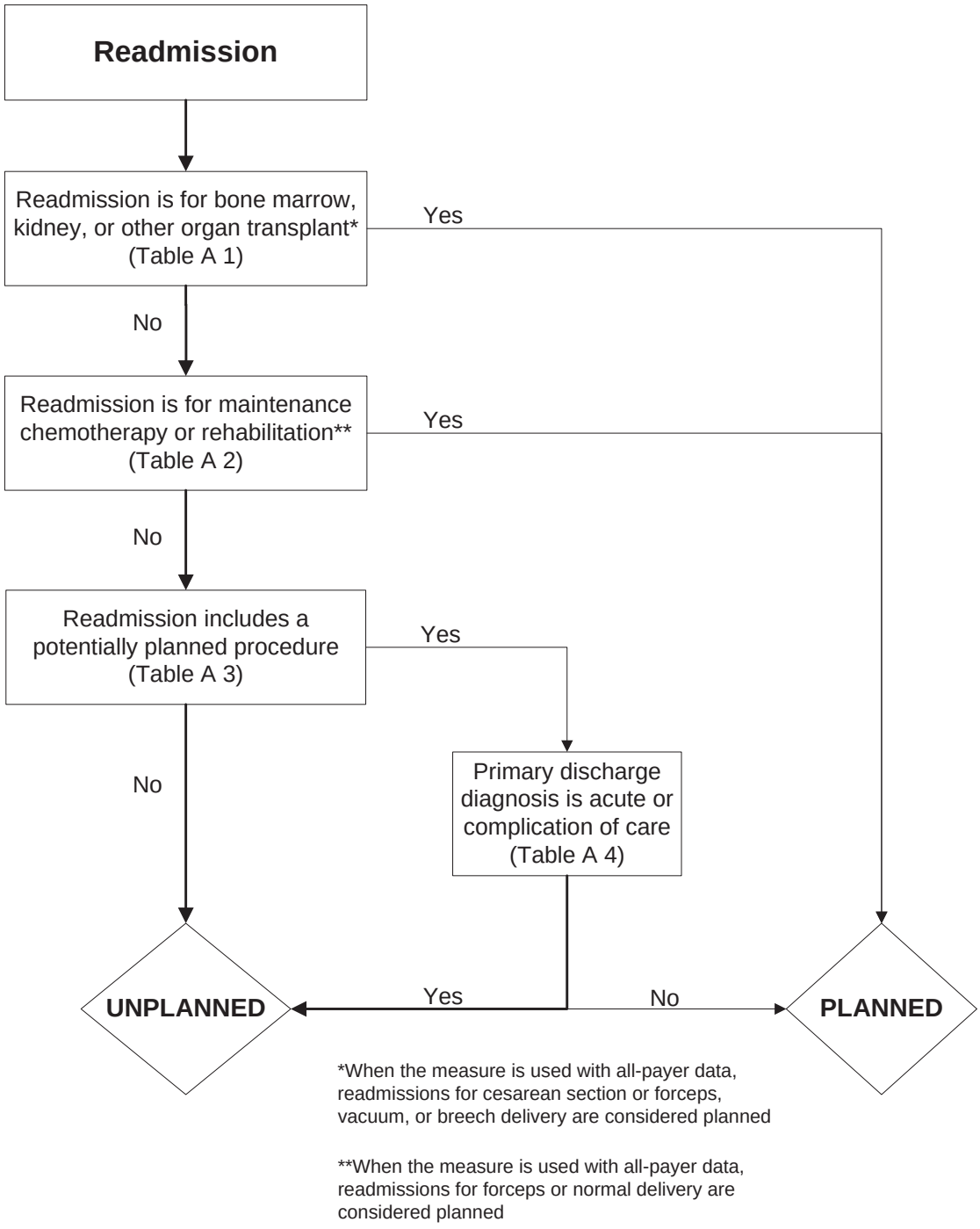
For the HF readmission measure, we applied the planned readmission algorithm without adaptations to the original, NQF-endorsed measure. In the updated measure, the measured crude readmission rate was 23.5%.

For the THA/TKA readmission measure, we replaced the planned readmission definition in the original, NQF-endorsed measure with an adapted version of the planned readmission algorithm specific to this patient population. The updated measure with the planned readmission algorithm expanded the number of index admissions followed by a planned readmission to 0.4% and lowered the measured crude readmission rate to 5.5%.

Using the planned readmission algorithm improves the way the readmission measures identify planned readmissions. These measure updates further strengthen the measures' validity and minimize any incentive on the part of hospitals to postpone appropriate care for patients who are scheduled for elective or necessary procedures.

Appendix A

Figure A 1: Planned Readmission Algorithm



Planned Readmission Algorithm

1. There are several procedures (Table A 1) and diagnoses (Table A 2) for which readmissions are always considered planned

Table A 1: Procedure Categories that are Always Planned regardless of Diagnosis

Procedure CCS[3]	Description
64	Bone marrow transplant
105	Kidney transplant
134	Cesarean section[4]
135	Forceps; vacuum; and breech delivery[4]
176	Other organ transplantation

Table A 2: Diagnosis Categories that are Always Planned regardless of Procedure

Diagnosis CCS[3]	Description
45	Maintenance chemotherapy
194	Forceps delivery[4]
196	Normal pregnancy and/or delivery[4]
254	Rehabilitation

[3] CCS: Clinical Classification Software, developed by the Agency for Healthcare Research and Quality (AHRQ). The software creates clinically-coherent, mutually-exclusive condition categories (diagnosis groups) and procedure categories.

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

2. Readmissions that include any typically scheduled or elective procedures are considered planned *if the readmission is not for an acute diagnosis*

    - The algorithm identifies a finite list of typically scheduled or elective procedures

    - The list includes 60 AHRQ procedure categories from among 231 AHRQ procedure categories, plus 11 individual ICD-9 procedure codes (Table A 3)
        Examples: total hip replacement; hernia repair

    - Readmissions with these specific procedures are considered planned unless the readmission diagnosis is acute
        Example: hip replacement is considered unplanned if hip fracture is the discharge diagnosis

3. Readmissions for acute diagnoses or complications of care are not considered planned

    - The algorithm identifies a finite list of acute diagnoses (Table A 4)

    - The list includes 99 diagnosis groups from among 285 AHRQ condition categories, plus 4 groupings of individual ICD-9 diagnosis codes that represent cardiac diagnoses that would not be associated with a planned readmission
        Examples: sepsis, acute myocardial infarction, fracture, ischemic stroke, pneumonia

    - No readmissions with these specific discharge diagnoses are considered planned (unless a procedure always considered planned, such as transplant or obstetrical delivery, occurred)

Table A 3: List of Potentially Planned Procedure Categories for the AMI, HF and Hip/Knee Measures

Procedure CCS[5]	Description
3	Laminectomy; excision intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA)
47	Diagnostic cardiac catheterization; coronary arteriography
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
55	Peripheral vascular bypass[6]
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
62	Other diagnostic cardiovascular procedures
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
79	Local excision of large intestine lesion (not endoscopic)
84	Cholecystectomy and common duct exploration
85	Inguinal and femoral hernia repair
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract

[5] CCS: Clinical Classification Software, developed by the Agency for Healthcare Research and Quality (AHRQ). The software creates clinically-coherent, mutually-exclusive condition categories (diagnosis groups) and procedure categories.

[6] This Proc CCS does not apply to the THA/TKA readmission measure.

Procedure CCS[5]	Description
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault
132	Other OR therapeutic procedures; female organs
142	Partial excision bone[7]
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
157	Amputation of lower extremity[8]
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
169	Debridement of wound; infection or burn
172	Skin graft
211	Therapeutic radiology for cancer treatment
ICD-9 Codes	**Description**
30.1, 30.29, 30.3, 30.4, 31.74, 34.6	Laryngectomy, revision of tracheostomy, scarification of pleura (from Proc CCS 42- Other OR Rx procedures on respiratory system and mediastinum)
38.18	Endarterectomy leg vessel (from Proc CCS 60- Embolectomy and endarterectomy of lower limbs)[9]
55.03, 55.04	Percutaneous nephrostomy with and without fragmentation (from Proc CCS 103- Nephrotomy and nephrostomy)
94.26, 94.27	Electroshock therapy (from Proc CCS 218- Psychological and psychiatric evaluation and therapy)

[7] This Proc CCS does not apply to the THA/TKA readmission measure.
[8] This Proc CCS does not apply to the THA/TKA readmission measure.
[9] This ICD-9 code does not apply to the THA/TKA readmission measure.

Table A 4: Acute Diagnosis Categories that Disqualify a Readmission from Being Considered Planned for the AMI, HF, and THA/TKA Measures

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

[10] CCS: Clinical Classification Software, developed by the Agency for Healthcare Research and Quality (AHRQ). The software creates clinically-coherent, mutually-exclusive condition categories (diagnosis groups) and procedure categories.

Diagnosis CCS[10]	Description
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
169	Debridement of wound; infection or burn
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
201	Infective arthritis and osteomyelitis[11]
204	Other non-traumatic joint injury[12]
207	Pathological Fractures[13]
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
231	Other fractures[14]
232	Sprains and strains

[11] This diagnosis category applies to the algorithm for the THA/TKA readmission measure only.
[12] This diagnosis category applies to the algorithm for the THA/TKA readmission measure only.
[13] This diagnosis category applies to the algorithm for the THA/TKA readmission measure only.
[14] This diagnosis category applies to the algorithm for the THA/TKA readmission measure only.

Diagnosis CCS[10]	Description
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
236	Open wounds of extremities[15]
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders
653	Delirium, dementia, and amnestic and other cognitive disorders
656	Impluse control disorders, NEC
658	Personality disorders
660	Alcohol-related disorders
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
ICD-9 codes	**Description**
Acute ICD-9 codes within Dx CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
03282	Diphtheritic myocarditis
03640	Meningococcal carditis nos
03641	Meningococcal pericarditis
03642	Meningococcal endocarditis
03643	Meningococcal myocarditis
07420	Coxsackie carditis nos

[15] This diagnosis category applies to the algorithm for the THA/TKA readmission measure only.

Diagnosis CCS[10]	Description
07421	Coxsackie pericarditis
07422	Coxsackie endocarditis
07423	Coxsackie myocarditis
11281	Candidal endocarditis
11503	Histoplasma capsulatum pericarditis
11504	Histoplasma capssulatum endocarditis
11513	Histoplasma duboisii pericarditis
11514	Histoplasma duboisii endocarditis
11593	Histoplasmosis pericarditis
11594	Histoplasmosis endocarditis
1303	Toxoplasma myocarditis
3910	Acute rheumatic pericarditis
3911	Acute rheumatic endocarditis
3912	Acute rheumatic myocarditis
3918	Acute rheumatic heart disease nec
3919	Acute rheumatic heart disease nos
3920	Rheumatic chorea w heart involvement
3980	Rheumatic myocarditis
39890	Rheumatic heart disease nos
39899	Rheumatic heart disease nec
4200	Acute pericarditis in other disease
42090	Acute pericarditis nos
42091	Acute idiopath pericarditis
42099	Acute pericarditis nec
4210	Acute/subacute bacterial endocarditis
4211	Acute endocarditis in other diseases
4219	Acute/subacute endocarditis nos
4220	Acute myocarditis in other diseases
42290	Acute myocarditis nos
42291	Idiopathic myocarditis
42292	Septic myocarditis
42293	Toxic myocarditis
42299	Acute myocarditis nec
4230	Hemopericardium
4231	Adhesive pericarditis
4232	Constrictive pericarditis
4233	Cardiac tamponade
4290	Myocarditis nos
Acute ICD-9 codes within Dx CCS 105: Conduction disorders	
4260	Atrioventricular block complete
42610	Atrioventricular block nos
42611	Atrioventricular block-1st degree
42612	Atrioventricular block-mobitz ii

Diagnosis CCS[10]	Description
42613	Atrioventricular block-2nd degree nec
4262	Left bundle branch hemiblock
4263	Left bundle branch block nec
4264	Right bundle branch block
42650	Bundle branch block nos
42651	Right bundle branch block/left posterior fascicular block
42652	Right bundle branch block/left ant fascicular block
42653	Bilateral bundle branch block nec
42654	Trifascicular block
4266	Other heart block
4267	Anomalous atrioventricular excitation
42681	Lown-ganong-levine syndrome
42682	Long qt syndrome
4269	Conduction disorder nos
Acute ICD-9 codes within Dx CCS 106: Dysrhythmia	
4272	Paroxysmal tachycardia nos
7850	Tachycardia nos
42789	Cardiac dysrhythmias nec
4279	Cardiac dysrhythmia nos
42769	Premature beats nec
Acute ICD-9 codes within Dx CCS 108: Congestive heart failure; nonhypertensive	
39891	Rheumatic heart failure
4280	Congestive heart failure
4281	Left heart failure
42820	Unspecified systolic heart failure
42821	Acute systolic heart failure
42823	Acute on chronic systolic heart failure
42830	Unspecified diastolic heart failure
42831	Acute diastolic heart failure
42833	Acute on chronic diastolic heart failure
42840	Unpec combined syst & dias heart failure
42841	Acute combined systolic & diastolic heart failure
42843	Acute on chronic combined systolic & diastolic heart failure
4289	Heart failure nos

Appendix B

Table B 1: AMI Odds Ratios and 95% Confidence Intervals

AMI Effect	Original NQF-endorsed Measure OR (Lower CI - Upper CI)	Updated Measure OR (Lower CI - Upper CI)	diff
Demographic			
Age-65 (years above 65, continuous)	1.02 (1.01 - 1.04)	1.03 (1.01 - 1.04)	-0.01
Male	0.94 (0.92 - 0.95)	0.93 (0.91 - 0.94)	0.01
Cardiovascular			
History of PTCA	0.88 (0.86 - 0.90)	0.89 (0.87 - 0.92)	-0.01
History of CABG	0.93 (0.90 - 0.96)	0.96 (0.94 - 0.99)	-0.03
Congestive heart failure (CC 80)	1.23 (1.21 - 1.25)	1.23 (1.21 - 1.26)	0.00
Acute coronary syndrome (CC 81-82)	1.02 (1.01 - 1.04)	1.03 (1.01 - 1.04)	-0.01
Anterior myocardial infarction (ICD-9 codes 410.00 410.19)	1.17 (1.14 - 1.20)	1.20 (1.17 - 1.23)	-0.03
Other location myocardial infarction (ICD-9 codes 410.20-410.69)	0.93 (0.91 - 0.95)	0.95 (0.92 - 0.97)	-0.02
Angina pectoris, old MI (CC 83)	1.01 (0.99 - 1.02)	1.02 (1.00 - 1.04)	-0.01
Coronary atherosclerosis (CC 84)	0.92 (0.91 - 0.94)	0.93 (0.92 - 0.95)	-0.01
Valvular or rheumatic heart disease (CC 86)	1.11 (1.10 - 1.13)	1.10 (1.09 - 1.12)	0.01
Specified arrhythmias (CC 92-93)	1.09 (1.08 - 1.11)	1.08 (1.06 - 1.10)	0.01
Comorbidity			
History of infection (CC 1, 3-6)	1.04 (1.02 - 1.05)	1.04 (1.02 - 1.06)	0.00
Metastatic cancer or acute leukemia (CC 7)	1.24 (1.18 - 1.29)	1.23 (1.17 - 1.28)	0.01
Cancer (CC 8-12)	1.03 (1.02 - 1.05)	1.03 (1.01 - 1.05)	0.00
Diabetes mellitus (DM) or DM complications (CC 15-20, 119-120)	1.20 (1.18 - 1.22)	1.21 (1.19 - 1.22)	-0.01
Protein-calorie malnutrition (CC 21)	1.13 (1.10 - 1.17)	1.13 (1.10 - 1.16)	0.00
Disorders of fluid, electrolyte, acid-base (CC 22-23)	1.12 (1.10 - 1.14)	1.13 (1.11 - 1.15)	-0.01
Iron deficiency or other anemias and blood disease (CC 47)	1.18 (1.16 - 1.19)	1.19 (1.17 - 1.21)	-0.01
Dementia or other specified brain disorders (CC 49-50)	0.96 (0.95 - 0.98)	0.98 (0.96 - 1.00)	-0.02
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)	1.07 (1.04 - 1.10)	1.08 (1.05 - 1.11)	-0.01
Stroke (CC 95-96)	1.03 (1.00 - 1.06)	1.05 (1.02 - 1.07)	-0.02
Cerebrovascular disease (CC 97-99, 103)	1.06 (1.04 - 1.08)	1.05 (1.03 - 1.07)	0.01
Vascular or circulatory disease (CC 104-106)	1.09 (1.08 - 1.11)	1.10 (1.08 - 1.11)	-0.01
Chronic obstructive pulmonary disease (CC 108)	1.24 (1.22 - 1.25)	1.25 (1.23 - 1.27)	-0.01
Asthma (CC 110)	1.01 (0.99 - 1.04)	1.01 (0.98 - 1.04)	0.00
Pneumonia (CC 111-113)	1.18 (1.16 - 1.20)	1.20 (1.18 - 1.22)	-0.02
End stage renal disease or dialysis (CC 129-130)	1.35 (1.30 - 1.41)	1.34 (1.29 - 1.39)	0.01
Renal failure (CC 131)	1.19 (1.16 - 1.21)	1.18 (1.16 - 1.21)	0.01
Other urinary tract disorders (CC 136)	1.08 (1.06 - 1.10)	1.07 (1.05 - 1.09)	0.01
Decubitus ulcer or chronic skin ulcer (CC 148-149)	1.11 (1.08 - 1.14)	1.08 (1.05 - 1.10)	0.03

Table B 2: HF Odds Ratios and 95% Confidence Intervals

HF Effect	Original NQF-endorsed Measure OR (Lower CI - Upper CI)	Updated Measure OR (Lower CI - Upper CI)	diff
Demographic			
Age-65 (years above 65, continuous)	1.00 (1.00 - 1.00)	1.00 (1.00 - 1.00)	0.00
Male	1.02 (1.01 - 1.03)	1.00 (0.99 - 1.01)	0.02
Cardiovascular			
History of CABG	0.90 (0.89 - 0.92)	0.92 (0.91 - 0.94)	-0.02
Cardio-respiratory failure or shock (CC 79)	1.11 (1.10 - 1.12)	1.11 (1.10 - 1.13)	0.00
Congestive heart failure (CC 80)	1.10 (1.08 - 1.11)	1.12 (1.11 - 1.14)	0.02
Acute coronary syndrome (CC 81-82)	1.13 (1.11 - 1.14)	1.12 (1.11 - 1.13)	0.01
Coronary atherosclerosis or angina (CC 83-84)	1.07 (1.06 - 1.08)	1.06 (1.05 - 1.07)	0.01
Valvular or rheumatic heart disease (CC 86)	1.07 (1.07 - 1.08)	1.05 (1.04 - 1.05)	0.02
Specified arrhythmias (CC 92-93)	1.06 (1.05 - 1.07)	1.07 (1.06 - 1.08)	-0.01
Other or unspecified heart disease (CC 94)	1.04 (1.03 - 1.05)	1.04 (1.03 - 1.05)	0.00
Vascular or circulatory disease (CC 104-106)	1.07 (1.06 - 1.08)	1.07 (1.06 - 1.08)	0.00
Comorbidity			
Metastatic cancer or acute leukemia (CC 7)	1.16 (1.13 - 1.19)	1.15 (1.12 - 1.18)	0.01
Cancer (CC 8-12)	1.02 (1.01 - 1.03)	1.00 (0.99 - 1.02)	0.02
Diabetes or DM complications (CC 15-20, 119-120)	1.08 (1.07 - 1.09)	1.10 (1.09 - 1.11)	-0.02
Protein-calorie malnutrition (CC 21)	1.10 (1.08 - 1.12)	1.10 (1.09 - 1.12)	0.00
Disorders of fluid, electrolyte, acid-base (CC 22-23)	1.13 (1.12 - 1.14)	1.14 (1.13 - 1.15)	-0.01
Liver or biliary disease (CC 25-30)	1.07 (1.06 - 1.09)	1.08 (1.07 - 1.10)	-0.01
Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 34)	1.06 (1.05 - 1.08)	1.07 (1.05 - 1.08)	-0.01
Other gastrointestinal disorders (CC 36)	1.05 (1.04 - 1.06)	1.05 (1.04 - 1.06)	0.00
Severe hematological disorders (CC 44)	1.15 (1.13 - 1.17)	1.18 (1.16 - 1.20)	-0.03
Iron deficiency or other anemias and blood disease (CC 47)	1.08 (1.07 - 1.09)	1.09 (1.08 - 1.10)	-0.01
Dementia or other specified brain disorders (CC 49-50)	1.00 (0.99 - 1.01)	1.01 (1.00 - 1.02)	-0.01
Drug/alcohol abuse/dependence/psychosis (CC 51-53)	1.10 (1.09 - 1.12)	1.11 (1.09 - 1.12)	-0.01
Major psychiatric disorders (CC 54-56)	1.04 (1.02 - 1.05)	1.06 (1.04 - 1.07)	-0.02
Depression (CC 58)	1.02 (1.01 - 1.04)	1.03 (1.01 - 1.04)	-0.01
Other psychiatric disorders (CC 60)	1.08 (1.06 - 1.09)	1.08 (1.06 - 1.09)	0.00
Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)	1.04 (1.02 - 1.06)	1.04 (1.03 - 1.06)	0.00
Stroke (CC 95-96)	1.02 (1.01 - 1.03)	1.02 (1.01 - 1.04)	0.00
Chronic obstructive pulmonary disease (CC 108)	1.14 (1.13 - 1.15)	1.17 (1.16 - 1.18)	-0.03
Fibrosis of lung or other chronic lung disorders (CC 109)	1.05 (1.04 - 1.06)	1.05 (1.04 - 1.06)	0.00
Asthma (CC 110)	1.02 (1.00 - 1.03)	1.02 (1.00 - 1.03)	0.00

Pneumonia (CC 111-113)	1.10 (1.09 - 1.11)	1.11 (1.10 - 1.12)	-0.01
End stage renal disease or dialysis (CC 129-130)	1.14 (1.12 - 1.17)	1.12 (1.10 - 1.15)	0.02
Renal failure (CC 131)	1.19 (1.17 - 1.20)	1.20 (1.19 - 1.22)	-0.01
Nephritis (CC 132)	1.10 (1.07 - 1.12)	1.10 (1.08 - 1.13)	0.00
Other urinary tract disorders (CC 136)	1.06 (1.05 - 1.07)	1.07 (1.06 - 1.08)	-0.01
Decubitus ulcer or chronic skin ulcer (CC 148-149)	1.10 (1.08 - 1.11)	1.09 (1.08 - 1.10)	0.01

Table B 3: THA/TKA Odds Ratios and 95% Confidence Intervals

THA/TKA Effect	Original NQF-endorsed Measure OR (Lower CI - Upper CI)	Updated Measure OR (Lower CI - Upper CI)	diff
Demographic			
Age-65 (years above 65, continuous)	1.03 (1.03 – 1.04)	1.03 (1.03 – 1.04)	0.00
Male	1.12 (1.10 – 1.14)	1.12 (1.10 – 1.14)	0.00
THA/TKA Procedure			
THA Procedure	1.13 (1.10 – 1.15)	1.13 (1.10 – 1.15)	0.00
Number of Procedures (two vs. one)	1.32 (1.26 – 1.40)	1.32 (1.26 – 1.39)	0.00
Comorbidity			
Skeletal deformities (ICD-9 code 755.63)	1.10 (0.88 – 1.38)	1.10 (0.87 – 1.38)	0.00
Post traumatic osteoarthritis (ICD-9 codes 716.15, 716.16)	0.95 (0.83 – 1.09)	0.95 (0.83 – 1.09)	0.00
Morbid obesity (ICD-9 code 278.01)	1.30 (1.24 – 1.36)	1.30 (1.25 – 1.36)	0.00
History of Infection (CC 1, 3-6)	1.11 (1.08 – 1.13)	1.10 (1.08 – 1.13)	0.01
Metastatic cancer or acute leukemia (CC 7)	1.18 (1.06 – 1.31)	1.18 (1.06 – 1.31)	0.00
Cancer (CC 8-12)	0.98 (0.96 – 1.01)	0.98 (0.96 – 1.01)	0.00
Diabetes mellitus (DM) or DM complications (CC 15-20, 119,120)	1.13 (1.11 – 1.15)	1.13 (1.11 – 1.15)	0.00
Protein-calorie malnutrition (CC 21)	1.30 (1.20 – 1.42)	1.31 (1.20 – 1.42)	-0.01
Disorders of fluid, electrolyte, acid-base (CC 22-23)	1.15 (1.12 – 1.18)	1.15 (1.12 – 1.18)	0.00
Rheumatoid arthritis and inflammatory connective tissue disease (CC 38)	1.13 (1.10 – 1.17)	1.13 (1.10 – 1.17)	0.00
Severe hematological disorders (CC 44)	1.41 (1.30 – 1.53)	1.42 (1.31 – 1.54)	-0.01
Dementia and senility (CC 49-50)	1.22 (1.17 – 1.26)	1.22 (1.17 – 1.26)	0.00
Major Psychiatric Disorders (CC 54-56)	1.32 (1.26 – 1.37)	1.32 (1.27 – 1.37)	0.00
Hemiplegia, paraplegia, paralysis, functional disability (CC 66, 67, 100-102, 177, 178)	1.10 (1.03 – 1.17)	1.09 (1.03 – 1.16)	0.01
Polyneuropathy (CC 71)	1.14 (1.10 – 1.18)	1.14 (1.10 – 1.18)	0.00
Congestive heart failure (CC 80)	1.27 (1.23 – 1.30)	1.27 (1.23 – 1.30)	0.00
Chronic Atherosclerosis(CC 83, 84)	1.24 (1.21 – 1.26)	1.24 (1.21 – 1.26)	0.00
Chronic Atherosclerosis(CC 83, 84)	1.24 (1.21 – 1.26)	1.24 (1.21 – 1.26)	0.00
Hypertension (CC 89, 91)	1.20 (1.17 – 1.23)	1.20 (1.16 – 1.23)	0.00
Arrhythmias (CC 92, 93)	1.16 (1.13 – 1.18)	1.16 (1.13 – 1.18)	0.00
Stroke (CC 95, 96)	1.08 (1.02 – 1.13)	1.08 (1.02 – 1.13)	0.00
Vascular or circulatory disease (CC 104-106)	1.14 (1.11 – 1.16)	1.14 (1.11 – 1.16)	0.00
Chronic obstructive pulmonary disease (CC 108)	1.32 (1.28 – 1.35)	1.32 (1.29 – 1.35)	0.00
Pneumonia (CC 111-113)	1.14 (1.10 – 1.19)	1.14 (1.10 – 1.18)	0.00
End stage renal disease or dialysis (CC 129-130)	1.68 (1.44 – 1.96)	1.69 (1.45 – 1.97)	-0.01
Renal failure (CC 131)	1.27 (1.24 – 1.31)	1.27 (1.23 – 1.31)	0.00
Decubitus ulcer or chronic skin ulcer (CC 148-149)	1.16 (1.11 – 1.22)	1.16 (1.11 – 1.22)	0.00
Cellulitis, local skin infection (CC 152)	1.12 (1.09 – 1.16)	1.12 (1.09 – 1.16)	0.00
Other Injuries (CC 162)	1.11 (1.08 – 1.13)	1.11 (1.09 – 1.13)	0.00
Major symptoms, abnormalities (CC 166)	1.17 (1.15 – 1.20)	1.17 (1.15 – 1.20)	0.00