

NATIONAL QUALITY FORUM

Measure Submission and Evaluation Worksheet 5.0

This form contains the information submitted by measure developers/stewards, organized according to NQF's measure evaluation criteria and process. The evaluation criteria, evaluation guidance documents, and a blank online submission form are available on the [submitting standards web page](#).

NQF #: 1551 NQF Project: Ad-hoc Review: Planned Readmissions
(for Endorsement Maintenance Review) Original Endorsement Date: Jan 31, 2012 Most Recent Endorsement Date: Jan 31, 2012 Last Updated Date: Oct 25, 2012
BRIEF MEASURE INFORMATION
De.1 Measure Title: Hospital-level 30-day, all-cause risk-standardized readmission rate (RSRR) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA)
Co.1.1 Measure Steward: Centers for Medicare & Medicaid Services (CMS)
De.2 Brief Description of Measure: This measure estimates hospital-level 30-day RSRRs following elective primary THA and/or TKA in patients 65 years and older. The outcome is defined as readmission for any cause within 30 days of the discharge date for the index hospitalization, excluding a specified set of planned readmissions. The primary updates to the measure since December 2011 NQF endorsement are: 1) Revision of cohort codes to exclude the following: - ICD-9 procedure codes for removal of old implanted devices/prosthesis (78.65, 78.66, 78.67, 80.05, 80.06, 80.09) [these codes use to define patients undergoing more technically complex procedures and who may be at higher risk for complications] - Additional ICD-9 codes for femur fractures (821.2, 821.20, 821.21, 821.22, 821.23, 821.29, 821.3, 821.30, 821.31, 821.32, 821.33, 821.39) [expands codes used to define patients with underlying fracture, who require more technically complex procedures and may be at higher risk for complications] - ICD-9 codes for malignant bony neoplasms (170.6, 170.7, 195.3, 198.5, 199.0) [patients with malignant bony neoplasms are at increased risk for readmission and the THA/TKA procedure may not be elective] This revision was based on additional clinical review in response to NQF public comments. 2) Expansion of the readmissions identified as planned. A detailed list of the changes to the measure specifications is provided in the document titled "2012 Updates to the THA-TKA readmission measure #1551.pdf".
2a1.1 Numerator Statement: This outcome measure does not have a traditional numerator and denominator like a core process measure (e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year); thus, we are using this field to define the readmission outcome. The outcome for this measure is a readmission to any acute care hospital, for any reason, with the exception of certain planned readmissions, occurring within 30 days of the discharge date of the index hospitalization. For more details on how planned readmissions were identified and removed from the outcome, please refer to the attached report, Re-specifying the Hospital 30-Day Acute Myocardial Infarction, Heart Failure, and Total Hip/Knee Arthroplasty Readmission Measures by adding a Planned Readmission Algorithm .
2a1.4 Denominator Statement: The target population for this measure includes admissions for patients at least 65 years of age undergoing elective primary THA and/or TKA procedures
2a1.8 Denominator Exclusions: In order to identify a cohort of elective THA and/or TKA procedures, the measure excludes admissions for patients: 1. With a femur, hip or pelvic fracture coded in the principal discharge diagnosis field for the index admission i.e. presence of one of the following diagnosis codes: 733.10, 733.14, 733.15, 733.19, 733.8, 733.81, 733.82, 733.95, 733.96, 733.97, 808.0, 808.1,

808.2, 808.3, 808.41, 808.42, 808.43, 808.49, 808.50, 808.51, 808.52, 808.53, 808.8, 820, 820.0, 820.00, 820.01, 820.02, 820.03, 820.09, 820.1, 820.10, 820.11, 820.12, 820.13, 820.19, 820.2, 820.20, 820.21, 820.22, 820.3, 820.30, 820.31, 820.32, 820.8, 820.9, 821, 821.0, 821.00, 821.01, 821.1, 821.10, 821.11, 821.2, 821.20, 821.21, 821.22, 821.23, 821.29, 821.3, 821.30, 821.31, 821.32, 821.33, 821.39

Rationale: THA procedures are not elective in these patients, and these patients are at higher risk for mortality, complication and readmission.

2. Undergoing revision procedures (with a concurrent THA/TKA)

Presence of one of the following procedure codes: 81.53, 81.55, 81.59, 00.70, 00.71, 00.72, 00.73, 00.80, 00.81, 00.82, 00.83, 00.84

Rationale: Revision procedures may be performed at a disproportionately small number of hospitals and such procedures carry a higher risk category for mortality, complication, and readmission.

3. Undergoing partial hip arthroplasty procedures (with a concurrent THA/TKA)

Presence of the following procedure code: 81.52

Rationale: Partial arthroplasties are primarily done for hip fractures and are typically performed on patients who are older, frailer, and have more comorbid conditions.

4. Undergoing resurfacing procedures (with a concurrent THA/TKA)

Presence of one of the following procedure codes: 00.85, 00.86, 00.87

Rationale: Resurfacing procedures are a different type of procedure involving only the joint's articular surface. Resurfacing procedures are typically performed on younger, healthier patients.

5. With a mechanical complication coded in the principal discharge diagnosis field of the index admission

Presence of one of the following procedure codes: 996.4, 996.40, 996.41, 996.42, 996.43, 996.44, 996.45, 996.46, 996.47, 996.49, 996.77, 996.78

Rationale: A complication coded as the principal discharge diagnosis suggests the procedure was more likely the result of a previous procedure and indicates the complication was present on admission. These patients may require more technically complex arthroplasty procedures, and may be at increased risk for complications, particularly mechanical complications.

6. With a procedure code for removal of implanted devices/prostheses

Presence of one of the following procedure codes: 78.65, 78.66, 78.67, 80.05, 80.06, 80.09

Rationale: Elective procedures performed in these patients may be more complicated.

7. With a malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field for the index admission

Presence of one of the following procedure codes: 170.6, 170.7, 170.9, 195.3, 195.5, 198.5, 199.0

Rationale: Patients with these malignant neoplasms are at increased risk for readmission, and the procedure may not be elective.

After excluding the above admissions to select elective primary THA/TKA procedures, the measure also excludes admissions for patients:

8. Without at least 12 months pre-index admission enrollment in Medicare FFS

Rationale: Appropriate risk adjustment requires uniform data availability of pre-operative comorbidity.

9. Without at least 30-days post-discharge enrolment in Medicare FFS

Rationale: The 30-day readmission outcome cannot be assessed for the standardized time period.

10. Who are transferred in to the index hospital

Rationale: If the patient is transferred from another acute care facility to the hospital where the index procedure occurs, it is likely that the procedure is not elective or that the admission is associated with an acute condition.

- 11. Who were admitted for the index procedure and subsequently transferred to another acute care facility
Rationale: Attribution of readmission to the index hospital would not be possible in these cases, since the index hospital performed the procedure but another hospital discharged the patient to the non-acute care setting.
- 12. Who leave against medical advice (AMA)
Rationale: Hospitals and physicians do not have the opportunity to provide the highest quality care for these patients.
- 13. With more than two THA/TKA procedures codes during the index hospitalization
Rationale: Although clinically possible, it is highly unlikely that patients would receive more than two elective THA/TKA procedures in one hospitalization and this may reflect a coding error.
- 14. Who die during the index admission
Rationale: Patients who die during the initial hospitalization are not eligible for readmission.

Additional otherwise qualifying THA and/or TKA admissions that occurred within 30 days of discharge date of an earlier index admission are not considered as index admissions (they are considered as potential planned readmissions and excluded from the outcome).

1.1 Measure Type: Outcome
2a1. 25-26 Data Source: Administrative claims
2a1.33 Level of Analysis: Facility

1.2-1.4 Is this measure paired with another measure? No

De.3 If included in a composite, please identify the composite measure (title and NQF number if endorsed):
This measure is not formally paired with another measure, however this measure is harmonized with a measure of hospital-level, risk-standardized complication rate following an elective primary THA and/or TKA hospitalization.

STAFF NOTES (issues or questions regarding any criteria)

Comments on Conditions for Consideration:

Is the measure untested? Yes No If untested, explain how it meets criteria for consideration for time-limited endorsement:

1a. Specific national health goal/priority identified by DHHS or NPP addressed by the measure (check De.5):
5. Similar/related endorsed or submitted measures (check 5.1):
Other Criteria:

Staff Reviewer Name(s):

1. IMPACT, OPPORTUNITY, EVIDENCE - IMPORTANCE TO MEASURE AND REPORT

Importance to Measure and Report is a threshold criterion that must be met in order to recommend a measure for endorsement. All three subcriteria must be met to pass this criterion. See [guidance on evidence](#).
Measures must be judged to be important to measure and report in order to be evaluated against the remaining criteria. (evaluation criteria)

1a. High Impact: H M L I
(The measure directly addresses a specific national health goal/priority identified by DHHS or NPP, or some other high impact aspect of healthcare.)

De.4 Subject/Topic Areas (Check all the areas that apply): Musculoskeletal : Joint Surgery, Musculoskeletal : Osteoarthritis,

Musculoskeletal : Rheumatoid Arthritis

De.5 Cross Cutting Areas (Check all the areas that apply): Care Coordination, Overuse, Population Health, Safety, Safety : Complications, Safety : Healthcare Associated Infections

1a.1 Demonstrated High Impact Aspect of Healthcare: Affects large numbers, Frequently performed procedure, High resource use, Patient/societal consequences of poor quality, Other

1a.2 If "Other," please describe: High cost

1a.3 Summary of Evidence of High Impact (Provide epidemiologic or resource use data):

Primary elective THA and TKA are beneficial procedures that greatly improve the quality of life for patients who choose to undergo these procedures (Hawker et al., 1998). However, these high volume procedures are expensive and are associated with significant readmission rates.

High Readmission Rate

We conducted analyses using 2008-2010 Medicare Part A inpatient claims data and found a median 30-day risk-standardized hospital unplanned readmission rate of 5.5%. This rate is high considering these are elective procedures typically and are often performed on younger, healthier patients, as compared to other Medicare patients.

High Volume

THA and TKA are priority areas for outcomes measure development, as they are commonly performed procedures in the US. In 2003 there were 202,500 primary hip arthroplasties and 402,100 primary total knee arthroplasties performed (Kurtz et al., 2007). The number of procedures performed has increased steadily over the past decade (Kurtz et al., 2007; Ong et al., 2006).

High Cost

Although these procedures can dramatically improve patient health-related quality-of-life, they are costly. In 2005 annual hospital charges totaled \$3.95 billion and \$7.42 billion for primary THA and TKA, respectively (Kurtz et al., 2007). These costs are projected to increase by 340% to 17.4 billion for THA and by 450% to 40.8 billion for TKA by 2015 (Kurtz et al., 2007). Medicare is the single largest payer for these procedures, covering approximately two-thirds of all THAs and TKAs performed in the US (Ong et al., 2006). THA and TKA procedures combined account for the largest procedural cost in the Medicare budget (Bozic et al., 2008).

1a.4 Citations for Evidence of High Impact cited in 1a.3: Bozic KJ, Rubash HE, Sculco TP, Berry DJ. An analysis of medicare payment policy for total joint arthroplasty. Journal of Arthroplasty. 2008;23(6 Suppl 1):133-138.

Hawker GJ, Wright J, Coyte P, Paul J, Dittus R, Croxford B, et al. Health-related quality of life after knee replacement. J Bone Joint Surg Am. 1998; 80:163-73.

Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. Apr 2007;89(4):780-785.

Kurtz SM, Ong KL, Schmier J, et al. Future clinical and economic impact of revision total hip and knee arthroplasty. J Bone Joint Surg Am. Oct 2007;89 Suppl 3:144-151.

Ong KL, Mowat FS, Chan N, Lau E, Halpern MT, Kurtz SM. Economic burden of revision hip and knee arthroplasty in Medicare enrollees. Clin Orthop Relat Res. May 2006;446:22-28.

1b. Opportunity for Improvement: H M L I

(There is a demonstrated performance gap - variability or overall less than optimal performance)

1b.1 Briefly explain the benefits (improvements in quality) envisioned by use of this measure:

THA and TKA are priority areas for outcomes measure development, as they are costly and commonly performed procedures. Hospital readmission is an outcome that is likely attributable to care processes and is an important outcome for patients. Measuring and reporting readmission rates will inform health care providers about opportunities to improve care, strengthen incentives for

quality improvement, and ultimately improve the quality of care received by Medicare patients. The measure will also provide patients with information that could guide their choices. Furthermore, the measure will increase transparency for consumers and has the potential to lower health care costs associated with readmissions.

1b.2 Summary of Data Demonstrating Performance Gap (*Variation or overall less than optimal performance across providers*):
[For Maintenance – Descriptive statistics for performance results for this measure - distribution of scores for measured entities by quartile/decile, mean, median, SD, min, max, etc.]

Readmission rates are high given these are elective procedures, and there is marked variation in rates across hospitals. Using data from calendar years 2008 to 2010, the median hospital RSRR for THA/TKA was 5.5%, with a range of 3.0% to 9.9%. The 5th percentile was 4.4% and the 95th percentile was 6.8%. Because these are elective procedures that are performed on relatively healthy patients, readmission rates are expected to be lower in these patients as compared to patients admitted for an emergent procedure. The literature also supports there is considerable variation in practice patterns, patient outcomes, and adherence to payer-defined practice guidelines for both THA and TKA (Bozic et al 2008; Ong et al 2008). Together, this variation likely indicates differences in the quality of care received across hospitals. These findings suggest that many readmissions could potentially be prevented.

1b.3 Citations for Data on Performance Gap: **[For Maintenance** – Description of the data or sample for measure results reported in 1b.2 including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included]
 Bozic KJ, Chiu V. Quality Measurement and Public Reporting in Total Joint Replacement. The Journal of Replacement. 2008; 23:146-149.

Ong K, Lau E, Manley M, Kurtz S. Effect of procedure duration on total hip arthroplasty and total knee arthroplasty survivorship in the United States Medicare population. J Arthroplasty. 2008; 23(6): 127-132.

1b.4 Summary of Data on Disparities by Population Group: **[For Maintenance** – Descriptive statistics for performance results for this measure by population group]

We conducted preliminary analyses to explore disparities by SES. We used Medicaid eligibility status identified in the Medicare claims enrollment database (EDB) as a proxy for SES. This approach is consistent with prior research as well as NQF recommendations (http://www.nysna.org/images/pdfs/practice/nqf_ana_outcomes_draft10.pdf). Patients were categorized into two groups, based on their eligibility status for Medicaid (yes/no). The Medicaid eligible population represents lower SES status. Preliminary analyses demonstrated that although SES is a significant predictor of readmission at the patient level, it does not affect overall hospital performance in the risk-adjusted readmission model. Consistent with NQF guidelines, this measure does not risk-adjust for SES factors.

1b.5 Citations for Data on Disparities Cited in 1b.4: **[For Maintenance** – Description of the data or sample for measure results reported in 1b.4 including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included]

N/A

1c. Evidence (*Measure focus is a health outcome OR meets the criteria for quantity, quality, consistency of the body of evidence.*)
 Is the measure focus a health outcome? Yes No **If not a health outcome, rate the body of evidence.**

Quantity: H M L I Quality: H M L I Consistency: H M L I

Quantity	Quality	Consistency	Does the measure pass subcriterion 1c?
M-H	M-H	M-H	Yes <input type="checkbox"/>
L	M-H	M	Yes <input type="checkbox"/> IF additional research unlikely to change conclusion that benefits to patients outweigh harms: otherwise No <input type="checkbox"/>
M-H	L	M-H	Yes <input type="checkbox"/> IF potential benefits to patients clearly outweigh potential harms: otherwise No <input type="checkbox"/>
L-M-H	L-M-H	L	No <input type="checkbox"/>

Health outcome – rationale supports relationship to at least one healthcare structure, process, intervention, or service	Does the measure pass subcriterion 1c? Yes <input type="checkbox"/> IF rationale supports relationship
<p>1c.1 Structure-Process-Outcome Relationship (Briefly state the measure focus, e.g., health outcome, intermediate clinical outcome, process, structure; then identify the appropriate links, e.g., structure-process-health outcome; process- health outcome; intermediate clinical outcome-health outcome): N/A This is an outcomes measure, not a process measure. The goal is to reduce readmission rates post hospitalization for elective THA/TKA.</p>	
<p>1c.2-3 Type of Evidence (Check all that apply): Other N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.4 Directness of Evidence to the Specified Measure (State the central topic, population, and outcomes addressed in the body of evidence and identify any differences from the measure focus and measure target population): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.5 Quantity of Studies in the Body of Evidence (Total number of studies, not articles): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.6 Quality of Body of Evidence (Summarize the certainty or confidence in the estimates of benefits and harms to patients across studies in the body of evidence resulting from study factors. Please address: a) study design/flaws; b) directness/indirectness of the evidence to this measure (e.g., interventions, comparisons, outcomes assessed, population included in the evidence); and c) imprecision/wide confidence intervals due to few patients or events): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.7 Consistency of Results across Studies (Summarize the consistency of the magnitude and direction of the effect): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.8 Net Benefit (Provide estimates of effect for benefit/outcome; identify harms addressed and estimates of effect; and net benefit - benefit over harms): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.9 Grading of Strength/Quality of the Body of Evidence. Has the body of evidence been graded? No</p>	
<p>1c.10 If body of evidence graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias: N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.11 System Used for Grading the Body of Evidence: Other</p>	
<p>1c.12 If other, identify and describe the grading scale with definitions: N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.13 Grade Assigned to the Body of Evidence: N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.14 Summary of Controversy/Contradictory Evidence: N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.15 Citations for Evidence other than Guidelines (Guidelines addressed below): N/A This is an outcomes measure, not a process measure.</p>	
<p>1c.16 Quote verbatim, the specific guideline recommendation (Including guideline # and/or page #): N/A This is an outcomes measure, not a process measure.</p>	

- 1c.17 Clinical Practice Guideline Citation: [N/A This is an outcomes measure, not a process measure.](#)
- 1c.18 National Guideline Clearinghouse or other URL: [N/A This is an outcomes measure, not a process measure.](#)
- 1c.19 Grading of Strength of Guideline Recommendation. Has the recommendation been graded? **No**
- 1c.20 If guideline recommendation graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias:
- 1c.21 System Used for Grading the Strength of Guideline Recommendation: **Other**
- 1c.22 If other, identify and describe the grading scale with definitions: [N/A This is an outcomes measure, not a process measure.](#)
- 1c.23 Grade Assigned to the Recommendation: [N/A This is an outcomes measure, not a process measure.](#)
- 1c.24 Rationale for Using this Guideline Over Others: [N/A This is an outcomes measure, not a process measure.](#)

Based on the NQF descriptions for rating the evidence, what was the developer's assessment of the quantity, quality, and consistency of the body of evidence?

1c.25 Quantity: **High** 1c.26 Quality: **High** 1c.27 Consistency: **High**

1c.28 Attach evidence submission form:

1c.29 Attach appendix for supplemental materials:

Was the threshold criterion, *Importance to Measure and Report*, met?

(1a & 1b must be rated moderate or high and 1c yes) Yes No

Provide rationale based on specific subcriteria:

For a new measure if the Committee votes NO, then STOP.

For a measure undergoing endorsement maintenance, if the Committee votes NO because of 1b. (no opportunity for improvement), it may be considered for continued endorsement and all criteria need to be evaluated.

2. RELIABILITY & VALIDITY - SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented. (**evaluation criteria**)

Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. Testing information and results should be entered in the appropriate field. Supplemental materials may be referenced or attached in item 2.1. See [guidance on measure testing](#).

S.1 **Measure Web Page** (*In the future, NQF will require measure stewards to provide a URL link to a web page where current detailed specifications can be obtained*). Do you have a web page where current detailed specifications for this measure can be obtained? **No**

S.2 If yes, provide web page URL:

2a. RELIABILITY. Precise Specifications and Reliability Testing: H M L I

2a1. Precise Measure Specifications. (*The measure specifications precise and unambiguous.*)

2a1.1 **Numerator Statement** (*Brief, narrative description of the measure focus or what is being measured about the target population, e.g., cases from the target population with the target process, condition, event, or outcome*):

[This outcome measure does not have a traditional numerator and denominator like a core process measure \(e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year\); thus, we are using this field to define the readmission outcome.](#)

The outcome for this measure is a readmission to any acute care hospital, for any reason, with the exception of certain planned readmissions, occurring within 30 days of the discharge date of the index hospitalization. For more details on how planned readmissions were identified and removed from the outcome, please refer to the attached report, Re-specifying the Hospital 30-Day Acute Myocardial Infarction, Heart Failure, and Total Hip/Knee Arthroplasty Readmission Measures by adding a Planned Readmission Algorithm.

2a1.2 Numerator Time Window *(The time period in which the target process, condition, event, or outcome is eligible for inclusion):*
We define this as readmission for any cause within 30 days from the date of discharge of the index THA and/or TKA hospitalization.

2a1.3 Numerator Details *(All information required to identify and calculate the cases from the target population with the target process, condition, event, or outcome such as definitions, codes with descriptors, and/or specific data collection items/responses):*
The outcome for this measure is unplanned all-cause readmission within 30 days of discharge date of an eligible index THA/TKA admission. Unplanned readmissions are acute clinical events experienced by a patient that require urgent rehospitalization. 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 quality improvement efforts. In contrast, planned readmissions are generally not a signal of quality of care.

The measure uses an algorithm for identifying "planned readmissions" that will not count as outcomes in the readmission measures. Analyzing Medicare FFS data from calendar years 2008 to 2010, 0.4% of index hospitalizations after THA/TKA were followed by a planned readmission within 30 days of discharge. The rationale for this algorithm and a discussion of its application to this measure are set forth in the attached report, Re-specifying the Hospital 30-Day Acute Myocardial Infarction, Heart Failure, and Total Hip/Knee Arthroplasty Readmission Measures by adding a Planned Readmission Algorithm. The detailed specifications are provided here.

Planned Readmission Algorithm

There are three principles that underlie the algorithm:

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.

Hence, for all readmissions, the measure first evaluates whether the principal discharge diagnosis or procedure category associated with each readmission is for care that is always planned (List 1 below). If yes, the readmission is classified as planned and is not counted in the outcome for the measure. If not, the measure checks for a potentially planned procedure (List 2 below). If the procedure is not in List 2, then the readmission is classified as unplanned and is counted in the outcome for the measure. If the procedure is in List 2, the measure checks whether the primary discharge diagnosis is acute or a complication of care (List 3 below). If the primary discharge diagnosis is in List 3, then the readmission is classified as unplanned and is counted in the outcome for the measure. If the primary discharge diagnosis is not in List 3, then the readmission is classified as planned and is not counted in the outcome for the measure.

Lists 1-3 below use the Clinical Classification Software (CCS), developed by the Agency for Healthcare Research and Quality (AHRQ). The software creates clinically-coherent, mutually-exclusive condition categories (diagnosis groups) and procedure categories.

List 1. AHRQ Procedure and Diagnosis CCS Categories that are always planned regardless of diagnosis:

Procedure CCS/Description

64/Bone marrow transplant
105/Kidney transplant
134/Cesarean section
135/Forceps; vacuum; and breech delivery
176/Other organ transplantation

Diagnosis CCS/Description

45/Maintenance chemotherapy
194/Forceps delivery
196/Normal pregnancy and/or delivery
254/Rehabilitation

CCS categories 194 and 196 are intended to be included only in all-payer settings, and are not intended for inclusion in CMS' claims-based readmission measures for Medicare fee-for-service beneficiaries aged 65 years and older.

List 2. Typically scheduled procedures (60 AHRQ procedure CCS categories from among 231 AHRQ procedure CCS categories; 11 individual ICD-9 procedure codes)

Procedure CCS/Description

3/Laminectomy; excision intervertebral disc
5/Insertion of catheter or spinal stimulator and injection into spinal
9/Other OR therapeutic nervous system procedures
10/Thyroidectomy; partial or complete
12/Other therapeutic endocrine procedures
33/Other OR therapeutic procedures on nose; mouth and pharynx
36/Lobectomy or pneumonectomy
38/Other diagnostic procedures on lung and bronchus
40/Other diagnostic procedures of respiratory tract and mediastinum
43/Heart valve procedures
44/Coronary artery bypass graft (CABG)
45/Percutaneous transluminal coronary angioplasty (PTCA)
47/Diagnostic cardiac catheterization; coronary arteriography
48/Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator
49/Other OR heart procedures
51/Endarterectomy; vessel of head and neck
52/Aortic resection; replacement or anastomosis
53/Varicose vein stripping; lower limb
56/Other vascular bypass and shunt; not heart
59/Other OR procedures on vessels of head and neck
62/Other diagnostic cardiovascular procedures
66/Procedures on spleen
67/Other therapeutic procedures; hemic and lymphatic system
74/Gastrectomy; partial and total
78/Colorectal resection
79/Local excision of large intestine lesion (not endoscopic)

84/Cholecystectomy and common duct exploration
85/Inguinal and femoral hernia repair
86/Other hernia repair
99/Other OR gastrointestinal therapeutic procedures
104/Nephrectomy; partial or complete
106/Genitourinary incontinence procedures
107/Extracorporeal lithotripsy; urinary
109/Procedures on the urethra
112/Other OR therapeutic procedures of urinary tract
113/Transurethral resection of prostate (TURP)
114/Open prostatectomy
119/Oophorectomy; unilateral and bilateral
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
152/Arthroplasty knee
153/Hip replacement; total and partial
154/Arthroplasty other than hip or knee
158/Spinal fusion
159/Other diagnostic procedures on musculoskeletal system
166/Lumpectomy; quadrantectomy of breast
167/Mastectomy
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)

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)

List 3. Acute diagnoses or complications of care that indicate the readmission is not planned (99 acute diagnosis groups from among 285 AHRQ condition CCS categories; 4 groupings of individual ICD-9 diagnosis codes that represent cardiac diagnoses that would not be associated with a planned readmission).

Diagnosis CCS/Description

1/Tuberculosis
2/Septicemia (except in labor)
3/Bacterial infection; unspecified site
4/Mycoses
5/HIV infection
7/Viral infection

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

204/Other non-traumatic joint injury
207/Pathological Fractures
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
232/Sprains and strains
233/Intracranial injury
234/Crushing injury or internal injury
235/Open wounds of head; neck; and trunk
236/Open wounds of extremities

237/Complication of device; implant or graft
238/Complications of surgical procedures or medical care
239/Superficial injury; contusion
240/Burns
241/Poisoning by psychotropic agents
242/Poisoning by other medications and drugs
243/Poisoning by nonmedicinal substances
244/Other injuries and conditions due to external causes
245/Syncope
246/Fever of unknown origin
247/Lymphadenitis
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 amnesic and other cognitive disorders
656/Impulse control disorders, NEC
658/Personality disorders
660/Alcohol-related disorders
661/Substance-related disorders
662/Suicide and intentional self-inflicted injury
663/Screening and history of mental health and substance abuse codes
670/Miscellaneous disorders

ICD-9 codes/Description

Acute ICD-9 codes within AHRQ Diagnosis CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy

03282/Diphtheritic myocarditis
03640/Meningococcal carditis nos
03641/Meningococcal pericarditis
03642/Meningococcal endocarditis
03643/Meningococcal myocarditis
07420/Coxsackie carditis nos
07421/Coxsackie pericarditis
07422/Coxsackie endocarditis
07423/Coxsackie myocarditis
11281/Candidal endocarditis
11503/Histoplasma capsulatum pericarditis
11504/Histoplasma 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 AHRQ Diagnosis CCS 105: Conduction disorders

4260/Atrioventricular block complete
42610/Atrioventricular block nos
42611/Atrioventricular block-1st degree
42612/Atrioventricular block-mobitz ii
42613/Atrioventricular block-2nd degree nec
4262/Left bundle branch hemiblock
4263/Left bundle branch block nec
4264/Right bundle branch block
42650/Bundle branch block nos
42651/Right bundle branch block/left posterior fascicular block
42652/Right bundle branch block/left ant fascicular block
42653/Bilateral bundle branch block nec
42654/Trifascicular block
4266/Other heart block
4267/Anomalous atrioventricular excitation
42681/Lown-ganong-levine syndrome
42682/Long qt syndrome
4269/Conduction disorder nos

Acute ICD-9 codes within AHRQ Diagnosis 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 AHRQ Diagnosis 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

2a1.4 Denominator Statement (Brief, narrative description of the target population being measured):

The target population for this measure includes admissions for patients at least 65 years of age undergoing elective primary THA and/or TKA procedures

2a1.5 Target Population Category (Check all the populations for which the measure is specified and tested if any): **Adult/Elderly Care, Populations at Risk**

2a1.6 Denominator Time Window (The time period in which cases are eligible for inclusion):

This measure was originally developed using claims data from calendar year 2007 and 2008. Updated data presented in this

application are from 2008-2010. CMS is using a three-year time period in the national dry run of the measure.

2a1.7 Denominator Details (All information required to identify and calculate the target population/denominator such as definitions, codes with descriptors, and/or specific data collection items/responses):

Note: This outcome measure does not have a traditional numerator and denominator like a core process measure (e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year). We therefore use this field to define the measure cohort.

The denominator includes patients aged 65 and older admitted to non-federal acute care hospitals for an elective, primary THA and/or TKA. Patients are eligible for inclusion in the denominator if they had a THA and/or a TKA AND had continuous enrollment in Medicare FFS one year prior to the date of index admission.

This cohort is defined using the following ICD-9-CM procedure codes identified in Medicare Part A Inpatient claims data:

- 81.51 Total Hip Arthroplasty
- 81.54 Total Knee Arthroplasty

2a1.8 Denominator Exclusions (Brief narrative description of exclusions from the target population):

In order to identify a cohort of elective THA and/or TKA procedures, the measure excludes admissions for patients:

1. With a femur, hip or pelvic fracture coded in the principal discharge diagnosis field for the index admission i.e. presence of one of the following diagnosis codes: 733.10, 733.14, 733.15, 733.19, 733.8, 733.81, 733.82, 733.95, 733.96, 733.97, 808.0, 808.1, 808.2, 808.3, 808.41, 808.42, 808.43, 808.49, 808.50, 808.51, 808.52, 808.53, 808.8, 820, 820.0, 820.00, 820.01, 820.02, 820.03, 820.09, 820.1, 820.10, 820.11, 820.12, 820.13, 820.19, 820.2, 820.20, 820.21, 820.22, 820.3, 820.30, 820.31, 820.32, 820.8, 820.9, 821, 821.0, 821.00, 821.01, 821.1, 821.10, 821.11, 821.2, 821.20, 821.21, 821.22, 821.23, 821.29, 821.3, 821.30, 821.31, 821.32, 821.33, 821.39

Rationale: THA procedures are not elective in these patients, and these patients are at higher risk for mortality, complication and readmission.

2. Undergoing revision procedures (with a concurrent THA/TKA)

Presence of one of the following procedure codes: 81.53, 81.55, 81.59, 00.70, 00.71, 00.72, 00.73, 00.80, 00.81, 00.82, 00.83, 00.84

Rationale: Revision procedures may be performed at a disproportionately small number of hospitals and such procedures carry a higher risk category for mortality, complication, and readmission.

3. Undergoing partial hip arthroplasty procedures (with a concurrent THA/TKA)

Presence of the following procedure code: 81.52

Rationale: Partial arthroplasties are primarily done for hip fractures and are typically performed on patients who are older, frailer, and have more comorbid conditions.

4. Undergoing resurfacing procedures (with a concurrent THA/TKA)

Presence of one of the following procedure codes: 00.85, 00.86, 00.87

Rationale: Resurfacing procedures are a different type of procedure involving only the joint's articular surface. Resurfacing procedures are typically performed on younger, healthier patients.

5. With a mechanical complication coded in the principal discharge diagnosis field of the index admission

Presence of one of the following procedure codes: 996.4, 996.40, 996.41, 996.42, 996.43, 996.44, 996.45, 996.46, 996.47, 996.49, 996.77, 996.78

Rationale: A complication coded as the principal discharge diagnosis suggests the procedure was more likely the result of a previous procedure and indicates the complication was present on admission. These patients may require more technically complex arthroplasty procedures, and may be at increased risk for complications, particularly mechanical complications.

6. With a procedure code for removal of implanted devices/prostheses
Presence of one of the following procedure codes: 78.65, 78.66, 78.67, 80.05, 80.06, 80.09
Rationale: Elective procedures performed in these patients may be more complicated.
 7. With a malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the principal discharge diagnosis field for the index admission
Presence of one of the following procedure codes: 170.6, 170.7, 170.9, 195.3, 195.5, 198.5, 199.0
Rationale: Patients with these malignant neoplasms are at increased risk for readmission, and the procedure may not be elective.
- After excluding the above admissions to select elective primary THA/TKA procedures, the measure also excludes admissions for patients:
8. Without at least 12 months pre-index admission enrollment in Medicare FFS
Rationale: Appropriate risk adjustment requires uniform data availability of pre-operative comorbidity.
 9. Without at least 30-days post-discharge enrolment in Medicare FFS
Rationale: The 30-day readmission outcome cannot be assessed for the standardized time period.
 10. Who are transferred in to the index hospital
Rationale: If the patient is transferred from another acute care facility to the hospital where the index procedure occurs, it is likely that the procedure is not elective or that the admission is associated with an acute condition.
 11. Who were admitted for the index procedure and subsequently transferred to another acute care facility
Rationale: Attribution of readmission to the index hospital would not be possible in these cases, since the index hospital performed the procedure but another hospital discharged the patient to the non-acute care setting.
 12. Who leave against medical advice (AMA)
Rationale: Hospitals and physicians do not have the opportunity to provide the highest quality care for these patients.
 13. With more than two THA/TKA procedures codes during the index hospitalization
Rationale: Although clinically possible, it is highly unlikely that patients would receive more than two elective THA/TKA procedures in one hospitalization and this may reflect a coding error.
 14. Who die during the index admission
Rationale: Patients who die during the initial hospitalization are not eligible for readmission.

Additional otherwise qualifying THA and/or TKA admissions that occurred within 30 days of discharge date of an earlier index admission are not considered as index admissions (they are considered as potential planned readmissions and excluded from the outcome).

2a1.9 Denominator Exclusion Details (All information required to identify and calculate exclusions from the denominator such as definitions, codes with descriptors, and/or specific data collection items/responses):

In-hospital deaths are identified using the discharge disposition vital status indicator.
Transfers to other acute care facilities and in to the index hospital are defined when a patient with an inpatient hospital admission (with at least one qualifying THA/TKA admission) is discharged from an acute care hospital and admitted to another acute care hospital on the same day or next day.
Transfers in to the index hospital are defined when patients are discharged from one acute hospital and admitted to another acute care hospital where the patient has at least one qualifying THA/TKA admission on the same day or next day
Discharges Against Medical Advice (AMA) are identified using the discharge disposition indicator.
Lack of claims data for 30 days post-discharge is identified by patient enrollment status in the CMS' Enrollment Database (EDB).

2a1.10 Stratification Details/Variables (All information required to stratify the measure results including the stratification variables,

codes with descriptors, definitions, and/or specific data collection items/responses):

N/A - This measure is not stratified.

2a1.11 Risk Adjustment Type (Select type. Provide specifications for risk stratification in 2a1.10 and for statistical model in 2a1.13): **Statistical risk model** 2a1.12 If "Other," please describe:

2a1.13 Statistical Risk Model and Variables (Name the statistical method - e.g., logistic regression and list all the risk factor variables. Note - risk model development should be addressed in 2b4.):

Our approach to risk adjustment is tailored to and appropriate for a publicly reported outcome measure, as articulated in the American Heart Association (AHA) Scientific Statement, "Standards for Statistical Models Used for Public Reporting of Health Outcomes"¹.

The proposed measure employs a hierarchical logistic regression model (a form of hierarchical generalized linear model [HGLM]) to create a hospital level 30-day RSRR. In brief, the approach simultaneously models two levels (patient and hospital) to account for the variance in patient outcomes within and between hospitals². The patient level models the log-odds of a hospital readmission within 30 days of discharge adjusting for age, sex, selected clinical covariates, and a hospital-specific intercept. The second level models the hospital-specific intercepts as arising from a normal distribution. The hospital-specific intercept represents the underlying risk of a readmission at that hospital, after accounting for patient risk. The hospital-specific intercepts are given a distribution in order to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk, the hospital-specific intercepts should be identical across all hospitals.

Risk-adjustment Variables: Variables are patient-level risk-adjustors that are expected to be predictive of readmission, based on empirical analysis, prior literature, and clinical judgment, including age and indicators of comorbidity and disease severity. For each patient, covariates are obtained from Medicare claims extending 12 months prior to and including the index admission. The model adjusts for case differences based on the clinical status of the patient at the time of admission. We use condition categories (CCs), which are clinically meaningful groupings of more than 15,000 ICD-9-CM diagnosis codes. A map which contains a list of the ICD-9-CM codes and their groupings into CCs for the publicly reported readmission measures is available on www.qualitynet.org. We do not risk-adjust for CCs that are possible adverse events of care and that are only recorded in the index admission. In addition, only comorbidities that convey information about the patient at that time or in the 12-months prior, and not complications that arise during the course of the hospitalization, are included in the risk-adjustment. The risk adjustment model included 33 variables which are listed below along with their frequencies and odds ratios:

Demographics

1. Age-65 (years above 65, continuous)
2. Sex

TKA/THA Procedure

3. Type of procedure (THA versus TKA)
4. Number of procedures (2 vs.1)

Clinical Risk Factors

5. History of Infection (CC 1, 3-6)
6. Metastatic cancer and acute leukemia (CC 7)
7. Cancer (CC 8-12)
8. Diabetes and DM complications (CC 15-20, 119, 120)
9. Protein-calorie malnutrition (CC 21)
10. Disorders of Fluid/Electrolyte/Acid-Base (CC 22, 23)
11. Rheumatoid Arthritis and Inflammatory Connective Tissue Disease (CC 38)
12. Severe Hematological Disorders (CC 44)
13. Dementia and senility (CC 49, 50)
14. Major psychiatric disorders (CC 54-56)

15. Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)
16. Polyneuropathy (CC 71)
17. Congestive Heart Failure (CC 80)
18. Chronic Atherosclerosis (CC 83-84)
19. Hypertension (CC 89, 91)
20. Arrhythmias (CC 92, 93)
21. Stroke (CC 95, 96)
22. Vascular or circulatory disease (CC 104-106)
23. COPD (CC 108)
24. Pneumonia (CC 111-113)
25. End-stage renal disease or dialysis (CC 129, 130)
26. Renal Failure (CC 131)
27. Decubitus ulcer or chronic skin ulcer (CC 148, 149)
28. Cellulitis, Local Skin Infection (CC 152)
29. Other Injuries (CC162)
30. Major Symptoms, Abnormalities (CC 166)
31. Skeletal Deformities (ICD-9 code 755.63)
32. Post Traumatic Osteoarthritis (ICD-9 codes 716.15, 716.16)
33. Morbid Obesity (ICD-9 code 278.01)

References:

1. Krumholz HM, Brindis RG, Brush JE, et al. 2006. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement From the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. *Circulation* 113: 456-462.
2. Normand S-LT, Shahian DM. 2007. Statistical and Clinical Aspects of Hospital Outcomes Profiling. *Stat Sci* 22 (2): 206-226.

Variable/Frequency/Percent/Odds Ratio (95% confidence interval)

Demographics

1. Age-65 (years above 65, continuous)/mean(SD)=10.1(6.0)/OR(95% CI)=1.04(1.03-1.04)
2. Sex/Count=323,317/Percent=36.0/OR(95% CI)=1.12(1.10-1.14)

TKA/THA Procedure

3. THA procedure/Count=25,5305/Percent=28.5/OR(95% CI)=1.13(1.10-1.15)
4. Number of procedures (2 vs.1)/Count=26,738/Percent=3.0/OR(95% CI) =1.32(1.26-1.39)

Clinical Risk Factors

5. History of Infection (CC 1, 3-6)/Count=160,496/Percent=17.9/OR(95% CI)=1.11(1.08-1.13)
6. Metastatic cancer and acute leukemia (CC 7)/Count=4,858/Percent=0.5/OR(95% CI)=1.18(1.06-1.31)
7. Cancer (CC 8-12)/Count=167,344/Percent=18.6/OR(95% CI)=0.98 (0.96-1.01)
8. Diabetes and DM complications (CC 15-20,119,120)/Count=250,364/Percent=27.9/OR(95% CI)=1.13(1.11-1.15)
9. Protein-calorie malnutrition (CC 21)/Count=5,637/Percent=0.6/OR(95% CI) =1.31(1.20-1.42)
10. Disorders of Fluid/Electrolyte/Acid-Base (CC 22, 23)/Count=108,295/Percent= 12.07/OR(95% CI) =1.15(1.12-1.18)
11. Rheumatoid Arthritis and Inflammatory Connective Tissue Disease (CC 38)/Count=76,787/Percent=8.6/OR(95% CI) =1.13(1.10-1.17)
12. Severe Hematological Disorders (CC 44)/Count=6,443/Percent=0.7/OR(95% CI)= 1.42(1.31-1.54)
13. Dementia and senility (CC 49, 50)/Count=38,042/Percent=4.2/OR(95% CI)= 1.22(1.17-1.26)
14. Major psychiatric disorders (CC 54-56)/Count=34,697/Percent=3.9/OR(95% CI)= 1.32(1.27-1.37)
15. Hemiplegia, paraplegia, paralysis, functional disability (CC 67-69, 100-102, 177-178)/Count=14,059/Percent=1.6/OR(95% CI)=

- 1.09(1.03-1.16)
16. Polyneuropathy (CC 71)/Count=52,227/Percent=5.8/OR(95% CI)= 1.14(1.10-1.18)
 17. Congestive Heart Failure (CC 80)/Count=83,772/Percent=9.3/OR(95% CI) =1.27(1.23-1.30)
 18. Chronic Atherosclerosis (CC 83-84)/Count=268,808/Percent=30.0/OR(95% CI)= 1.24(1.21-1.26)
 19. Hypertension (CC 89, 91)/Count=743,513/Percent=82.9/OR(95% CI)= 1.20(1.16-1.23)
 20. Arrhythmias (CC 92, 93)/Count=203,651/Percent=22.7/OR(95% CI)= 1.16(1.14-1.18)
 21. Stroke (CC 95, 96)/Count=20,762/Percent=2.3/OR(95% CI)= 1.08(1.02-1.13)
 22. Vascular or circulatory disease (CC 104-106)/Count=203,325/Percent=22.7/OR(95% CI)= 1.14(1.12-1.15)
 23. COPD (CC 108)/Count=128,429/Percent=14.3/OR(95% CI)= 1.32(1.29-1.35)
 24. Pneumonia (CC 111-113)/Count=40,343/Percent=4.5/OR(95% CI)= 1.14(1.10-1.19)
 25. End-stage renal disease or dialysis (CC 129, 130)/Count=1,185/Percent=0.1/OR(95% CI)= 1.69(1.45-1.97)
 26. Renal Failure (CC 131)/Count=60,837/Percent=6.8/OR(95% CI)= 1.27(1.24-1.31)
 27. Decubitus ulcer or chronic skin ulcer (CC 148, 149)/Count=23,646/Percent=2.6/OR(95% CI)= 1.16(1.11-1.22)
 28. Cellulitis, Local Skin Infection (CC 152)/Count=69,408/Percent=7.7/OR(95% CI)=1.12(1.09-1.16)
 29. Other Injuries (CC162)/Count=241,361/Percent=26.9/OR(95% CI)=1.12 (1.09-1.16)
 30. Major Symptoms, Abnormalities (CC 166)/Count=467,427/Percent=52.1/OR(95% CI)=1.11(1.09-1.13)
 31. Skeletal Deformities (ICD-9 code 755.63)/Count=1,335/Percent=0.1/OR(95% CI)=1.01(0.87-1.38)
 32. Post Traumatic Osteoarthritis (ICD-9 codes 716.15, 716.16)/Count=3,994/Percent=0.4/ OR(95% CI)=0.95(0.83-1.09)
 33. Morbid Obesity (ICD-9 code 278.01)/Count=34,370/Percent=3.8/OR(95% CI)=1.30(1.25-1.36)

2a1.14-16 Detailed Risk Model Available at Web page URL (or attachment). Include coefficients, equations, codes with descriptors, definitions, and/or specific data collection items/responses. Attach documents only if they are not available on a webpage and keep attached file to 5 MB or less. NQF strongly prefers you make documents available at a Web page URL. Please supply login/password if needed:

Attachment

[Delv-72e1_Updated_Hip-Knee_Readmission_Tech-Maintenance_Report_9-14-12.pdf](#)

2a1.17-18. Type of Score: [Rate/proportion](#)

2a1.19 Interpretation of Score (*Classifies interpretation of score according to whether better quality is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score*): [Better quality = Lower score](#)

2a1.20 Calculation Algorithm/Measure Logic(*Describe the calculation of the measure score as an ordered sequence of steps including identifying the target population; exclusions; cases meeting the target process, condition, event, or outcome; aggregating data; risk adjustment; etc.*):

The RSRR is calculated as the ratio of the number of "predicted" to the number of "expected" readmissions, multiplied by the national unadjusted readmission rate. For each hospital, the numerator of the ratio is the number of readmissions within 30 days predicted on the basis of the hospital's performance with its observed case-mix, and the denominator is the number of readmissions expected on the basis of the nation's performance with that hospital's case-mix. This approach is analogous to a ratio of "observed" to "expected" used in other types of statistical analyses. It conceptually allows for a comparison of a particular hospital's performance given its case-mix to an average hospital's performance with the same case-mix. Thus a lower ratio indicates lower-than-expected readmission or better quality and a higher ratio indicates higher-than-expected readmission or worse quality.

After regressing the risk factors and the hospital-specific intercept on the risk of readmission, the predicted number of readmissions within 30 days (the numerator) is calculated by summing the estimated regression coefficients multiplied by the patient characteristics, adding the estimated hospital-specific intercept, transforming this value to the probability scale, and then summing over all patients attributed to the hospital to get the predicted value. The expected number of readmissions within 30 days (the denominator) is obtained by summing the estimated regression coefficients multiplied by the patient characteristics observed in the hospital, adding the estimated average hospital intercept, transforming to the probability scale and then summing over all patients in the hospital to get the expected value.

Please see attachment for more details on the calculation algorithm.

2a1.21-23 Calculation Algorithm/Measure Logic Diagram URL or attachment:

2a1.24 **Sampling (Survey) Methodology.** If measure is based on a sample (or survey), provide instructions for obtaining the sample, conducting the survey and guidance on minimum sample size (response rate):

N/A - This measure is not based on a sample or survey.

2a1.25 **Data Source** (Check all the sources for which the measure is specified and tested). If other, please describe:

Administrative claims

2a1.26 **Data Source/Data Collection Instrument** (Identify the specific data source/data collection instrument, e.g. name of database, clinical registry, collection instrument, etc.): Administrative Claims

The measure uses Medicare Part A inpatient and outpatient and Part B outpatient claims.

The Medicare data sources used to create the measure were:

1. Medicare Part A Inpatient and Outpatient and Part B outpatient claims from the Standard Analytic File, including inpatient and outpatient claims for the 12 months prior to an index admission.

2. Medicare Enrollment Database (EDB): This database contains Medicare beneficiary demographic, benefit/coverage, and vital status information. This dataset was used to obtain information on several inclusion/exclusion indicators such as Medicare status on admission.

2a1.27-29 **Data Source/data Collection Instrument Reference Web Page URL or Attachment:** Attachment
2012_Updates_to_the_THA-TKA_readmission_measure_-1551.pdf

2a1.30-32 **Data Dictionary/Code Table Web Page URL or Attachment:**

Attachment

Planned_Readmissions_Updates-AMI_HF_Hip-Knee.pdf

2a1.33 **Level of Analysis** (Check the levels of analysis for which the measure is specified and tested): Facility

2a1.34-35 **Care Setting** (Check all the settings for which the measure is specified and tested): Hospital/Acute Care Facility

2a2. **Reliability Testing.** (Reliability testing was conducted with appropriate method, scope, and adequate demonstration of reliability.)

2a2.1 **Data/Sample** (Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):

Medicare Part A inpatient claims data for calendar year 2008-2010 were used to test reliability of the re-specified measure. The 2008 cohort included 292,257 admissions, the 2009 cohort included 299,532 admissions, and the 2010 cohort included 305,532 admissions.

2a2.2 **Analytic Method** (Describe method of reliability testing & rationale):

Data Element Reliability

In constructing the measure in Medicare FFS patients, we aim to utilize only those data elements from the claims that have both face validity and reliability. We avoid the use of fields that are thought to be coded inconsistently across hospitals or providers.

Specifically, we use fields that are consequential for payment and which are audited. We identify such variables through empiric

analyses and our understanding of CMS auditing and billing policies and seek to avoid variables which do not meet this standard. For example, "discharge disposition" is a variable in Medicare claims data that is not thought to be a reliable variable for identifying a transfer between two acute care facilities. Thus, we derive a variable using admission and discharge dates as a surrogate for "discharge disposition" to identify hospital admissions involving transfers. This allows us to identify these admissions using variables in the claims data which have greater reliability than the "discharge disposition" variable.

In addition, CMS has in place several hospital auditing programs used to assess overall claims code accuracy, to ensure appropriate billing, and for overpayment recoupment. CMS routinely conducts data analysis to identify potential problem areas and detect fraud, and audits important data fields used in our measures, including diagnosis and procedure codes and other elements that are consequential to payment.

Finally, we assess the reliability of the data elements by comparing model variable frequencies and odds ratios in three years of data (2008-2010).

Measure Result Reliability

The reliability of a measurement is the degree to which repeated measurements of the same entity agree with each other. For measures of hospital performance, the measured entity is naturally the hospital, and reliability is the extent to which repeated measurements of the same hospital give similar results. Accordingly, our approach to assessing reliability is to consider the extent to which assessments of a hospital using different but randomly selected subsets of patients produce similar measures of hospital performance. That is, we take a "test-retest" approach in which hospital performance is measured once using a random subset of patients, then measured again using a second random subset exclusive of the first, and the agreement of the two resulting performance measures compared across hospitals.¹

For test-retest reliability of the measure in Medicare FFS patients aged 65 and older, we combined index admissions from successive measurement periods into one dataset, randomly sampled half of patients within each hospital, calculated the measure for each hospital, and repeated the calculation using the second half. Thus, each hospital is measured twice, but each measurement is made using an entirely distinct set of patients. To the extent that the calculated measures of these two subsets agree, we have evidence that the measure is assessing an attribute of the hospital, not of the patients. As a metric of agreement we calculated the intra-class correlation coefficient², and assessed the values according to conventional standards³. Specifically, we used a combined the 2008-2010 sample, randomly split it into two approximately equal subsets of patients, and calculated the RSRR for each hospital for each sample. The agreement of the two RSRRs was quantified for hospitals in each sample using the intra-class correlation as defined by ICC (2,1) by Shrout and Fleiss.²

Using two independent samples provides an honest estimate of the measure's reliability, compared with using two random but potentially overlapping samples which would exaggerate the agreement. Moreover, because our final measure is derived using hierarchical logistic regression, and a known property of hierarchical logistic regression models is that smaller volume hospitals contribute less 'signal', a split sample using a single measurement period would introduce extra noise, potentially underestimating the actual test-retest reliability that would be achieved if the measure were reported using three years of data.

References:

1. Rousson V, Gasser T, Seifert B. "Assessing intrarater, interrater and test-retest reliability of continuous measurements," *Statistics in Medicine*, 2002, 21:3431-3446.
2. Shrout P, Fleiss J. Intraclass correlations: uses in assessing rater reliability. *Psychological Bulletin*, 1979, 86, 420-3428.
3. Landis J, Koch G, The measurement of observer agreement for categorical data, *Biometrics*, 1977;33:159-174.

2a2.3 Testing Results (*Reliability statistics, assessment of adequacy in the context of norms for the test conducted*):

Data Element Reliability

Overall, risk factor frequencies changed very little across the three-year period, and there were no notable differences in the odds ratios across years of data.

Measure Result Reliability

There were 897,255 admissions in the combined three-year sample, with 449,480 admissions in one of the randomly selected sample and 447,775 admissions in the other randomly selected sample. The intra-class correlation coefficient between the two RSRRs for each hospital was 0.365, which according to the conventional interpretation is "Fair."¹ The intra-class correlation coefficient is based on a split sample of 3 years of data, resulting in a volume of patients in each sample equivalent to only 1.5 years of data, whereas the measure is likely to be reported with a full three years of data. Based on our experiences with similar

measures using split sample, with 4 years (and volume equivalent to 2 years), the intra-class correlation coefficient would be higher and in the moderate range.

References:

1. Landis J, Koch G, The measurement of observer agreement for categorical data, *Biometrics*, 1977;33:159-174.

2b. VALIDITY. Validity, Testing, including all Threats to Validity: H M L I

2b1.1 Describe how the measure specifications (measure focus, target population, and exclusions) are consistent with the evidence cited in support of the measure focus (criterion 1c) and identify any differences from the evidence:

N/A

2b2. Validity Testing. (Validity testing was conducted with appropriate method, scope, and adequate demonstration of validity.)

2b2.1 Data/Sample (Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):

Face validity: model performance.

2b2.2 Analytic Method (Describe method of validity testing and rationale; if face validity, describe systematic assessment):

Measure validity is demonstrated through prior validity testing done on our other claims-based measures, through use of established measure development guidelines, and by systematic assessment of measure face validity by a TEP of national experts and stakeholder organizations.

Validity of Claims-Based Measures

Our team has demonstrated for a number of prior measures the validity of claims-based measures for profiling hospitals by comparing either the measure results or individual data elements against medical records. CMS validated the six NQF-endorsed measures currently in public reporting (AMI, heart failure, and pneumonia mortality and readmission) with models that used chart-abstracted data for risk adjustment. Specifically, claims model validation was conducted by building comparable models using abstracted medical chart data for risk adjustment for heart failure patients (National Heart Failure data), AMI patients (Cooperative Cardiovascular Project data) and pneumonia patients (National Pneumonia Project dataset). When both models were applied to the same patient population, the hospital risk-standardized rates estimated using the claims-based risk adjustment models had a high level of agreement with the results based on the medical record model, thus supporting the use of the claims-based models for public reporting. Our group has reported these findings in the peer-reviewed literature.¹⁻⁶

Validity Indicated by Established Measure Development Guidelines

We developed this measure in consultation with national guidelines for publicly reported outcomes measures, with outside experts, and with the public. The measure is consistent with the technical approach to outcomes measurement set forth in NQF guidance for outcomes measures⁷ (National Quality Forum, 2010), CMS Measure Management System (MMS) guidance, and the guidance articulated in the American Heart Association scientific statement, "Standards for Statistical Models Used for Public Reporting of Health Outcomes".⁸

Validity as Assessed by External Groups

Throughout measure development, we obtained expert and stakeholder input via three mechanisms: regular discussions with an advisory working group, a national TEP, and a 30-day public comment period in order to increase transparency and to gain broader input into the measure.

The working group was comprised of individuals with clinical and methodological expertise relevant to orthopedic quality measurement. We held regular conference calls throughout the development process, and the Yale team solicited detailed feedback and guidance on key clinical and methodological decisions pertaining to measure development. The working group provided a forum for focused expert review and discussion of technical issues during measure development prior to consideration by the broader TEP. The working group meetings addressed key issues surrounding measure development, including detailed discussions regarding the appropriate cohort for inclusion in the measure. The working group provided a forum for focused expert review and discussion of technical issues during measure development prior to consideration by the broader TEP, which was

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convened to address the THA/TKA outcomes measures under development.

In addition to the working group, and in alignment with the CMS Measure Management System, we convened a TEP to provide input and feedback during measure development from a group of recognized experts in relevant fields. To convene the TEP, we released a public call for nominations and selected individuals to represent a range of perspectives including clinicians, consumers, and purchasers, as well as individuals with experience in quality improvement, performance measurement, and health care disparities. We held three structured TEP conference calls consisting of presentation of key issues, our proposed approach, and relevant data, followed by open discussion among TEP members.

Finally, we solicited public comment on the proposed measure through CMS' Measure Management System Public Comment site (https://www.cms.gov/MMS/17_CallforPublicComment.asp#TopOfPage). Public comments were summarized and publicly posted for 30 days. The resulting content was taken into consideration during the final stages of measure development.

References:

1. Krumholz HM, Wang Y, Mattera JA, Wang Y-F, Han LF, Ingber MJ, Roman S, Normand SL. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with an acute myocardial infarction. *Circulation*. 2006 Apr 4;113(13):1683-92.
2. Krumholz HM, Lin Z, Drye EE, Desai MM, Han LF, Rapp MT, Mattera JA, Normand SL. An administrative claims measure suitable for profiling hospital performance based on 30-day all-cause readmission rates among patients with acute myocardial infarction. *Circulation: Cardiovascular Quality and Outcomes*. 2011 Mar 1;4(2):243-52.
3. Krumholz HM, Wang Y, Mattera JA, Wang Y-F, Han LF, Ingber MJ, Roman S, Normand SL. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with heart failure. *Circulation*. 2006 Apr 4;113(13):1693-701.
4. Keenan PS, Normand SL, Lin Z, Drye EE, Bhat KR, Ross JS, Schuur JD, Stauffer BD, Bernheim SM, Epstein AJ, Wang Y-F, Herrin J, Chen J, Federer JJ, Mattera JA, Wang Y, Krumholz HM. An administrative claims measure suitable for profiling hospital performance on the basis of 30-day all-cause readmission rates among patients with heart failure. *Circulation: Cardiovascular Quality and Outcomes*. 2008 Sep;1(1):29-37.
5. Bratzler DW, Normand SL, Wang Y, O'Donnell WJ, Metersky M, Han LF, Rapp MT, Krumholz HM. An administrative claims model for profiling hospital 30-day mortality rates for pneumonia patients. *Public Library of Science One*. 2011 Apr 12;6(4):e17401.
6. Lindenauer PK, Normand SL, Drye EE, Lin Z, Goodrich K, Desai MM, Bratzler DW, O'Donnell WJ, Metersky ML, Krumholz HM. Development, validation, and results of a measure of 30-day readmission following hospitalization for pneumonia. *Journal of Hospital Medicine*. 2011 Mar;6(3):142-50.
7. National Quality Forum. National voluntary consensus standards for patient outcomes, first report for phases 1 and 2: A consensus report http://www.nysna.org/images/pdfs/practice/nqf_ana_outcomes_draft10.pdf. Accessed August 19, 2010.
8. Krumholz HM, Brindis RG, Brush JE, et al. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement From the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. *Circulation*. 2006;113(3):456-462.

2b2.3 Testing Results (*Statistical results, assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment*):

Validity of Claims-Based Measures

When the medical record-based models used for validation of the related AMI, heart failure and pneumonia readmission measures were applied to the corresponding patient populations, the hospital risk-standardized rates estimated using the claims-based risk

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adjustment models had a high level of agreement with the results based on the medical record model, thus supporting the use of the claims-based models for public reporting.

Validity as Assessed by External Groups

In regards to measure face validity, experts evaluated the original NQF-endorsed measure and members of our diverse technical expert panel that included orthopedic surgeons, experts in measurement, quality improvement, and health care disparities, consumers, and purchasers generally supported the measure.

POTENTIAL THREATS TO VALIDITY. (*All potential threats to validity were appropriately tested with adequate results.*)

2b3. Measure Exclusions. (*Exclusions were supported by the clinical evidence in 1c or appropriately tested with results demonstrating the need to specify them.*)

2b3.1 Data/Sample for analysis of exclusions (*Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included*):

2008-2010 Medicare FFS data for patients aged 65 years and older undergoing elective THA and/or TKA.

2b3.2 Analytic Method (*Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference*):

All exclusions (detailed in section 2a1.8. "Denominator Exclusions") were determined by careful clinical review and have been used based on clinically relevant decisions. These exclusions are consistent with similar NQF-endorsed readmission measures.

2b3.3 Results (*Provide statistical results for analysis of exclusions, e.g., frequency, variability, sensitivity analyses*):

We examined overall frequencies and proportions of the admissions excluded for each exclusion criterion in all THA/TKA admissions in 2008-2010 Medicare fee-for-service data. The initial cohort included 1,404,143 admissions. After excluding patients that were not undergoing elective THA/TKA (i.e. patients with concurrent procedures or diagnoses that were indicative of non-elective primary arthroplasty), the cohort included 1,027,565 admissions. The final cohort, after additional patient exclusions, included 897,321 admissions. Categories are not mutually exclusive.

From among 1,027,565 admissions:

- 1) In-hospital deaths (n=1,208, 0.12%)
- 2) Patients with incomplete administrative data in 12 months prior to index hospitalization (n=115,632, 11.25%)
- 3) Transfer-out patients (n=10,851, 1.06%)
- 4) Transfer-in patients (n=186, 0.02%)
- 5) Without at least 30 days post-discharge or claim end date information (n=38,227, 3.72%)
- 6) Patients who leave hospital against medical advice (AMA) (n=209, 0.02%)
- 7) Patients with more than two THA/TKA procedure codes (n=1, 0.00%)
- 8) Additional admission for THA/TKA within 30 days of prior index admission (n=1,440, 0.14%)

2b4. Risk Adjustment Strategy. (*For outcome measures, adjustment for differences in case mix (severity) across measured entities was appropriately tested with adequate results.*)

2b4.1 Data/Sample (*Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included*):

Measure Development and Validation in Medicare FFS:

For development, we randomly divided the 2008 Medicare cohort (original NQF-endorsed measure specifications) into the development cohort of 148,132 admissions and validation cohort of 148,092 admissions. Additionally, we used a second validation cohort of 300,338 admissions in 2007 data.

Assessment of Temporal Trends in Risk Factors and Model Performance (2008-2010)

To assess temporal trends, we used Medicare cohorts from 2008 through 2010 (re-specified measure). The 2008 cohort included 292,257 admissions; the 2009 cohort included 299,532 admissions; and the 2010 cohort included 305,532 admissions.

2b4.2 Analytic Method (*Describe methods and rationale for development and testing of risk model or risk stratification including selection of factors/variables*):

Measure Development and Validation in Medicare FFS:

This measure is fully risk-adjusted using a hierarchical logistic regression model to calculate hospital RSRRs (see "risk adjustment methodology" for additional details).

Approach to assessing model performance:

For the development and validation cohorts, we computed five summary statistics for assessing model performance (Harrell, 2001): (1) over-fitting indices (over-fitting refers to the phenomenon in which a model accurately describes the relationship between predictive variables and outcome in the development dataset but fails to provide valid predictions in new patients)

(2) predictive ability

(3) area under the receiver operating characteristic (ROC) curve

(4) distribution of residuals

(5) model chi-square (A test of statistical significance usually employed for categorical data to determine whether there is a good fit between the observed data and expected values; i.e., whether the differences between observed and expected values are attributable to true differences in characteristics or instead the result of chance variation).

Assessment of Temporal Trends in Risk Factors and Model Performance (2008-2010):

Across years, we examined consistency in parameter estimates for risk-adjustment variables and model performance (C statistic).

--

Reference: Harrell FE, Shih YCT. Using full probability models to compute probabilities of actual interest to decision makers. *Int J Technol Assess Health Care*. 2001;17:17–26.

2b4.3 Testing Results (*Statistical risk model: Provide quantitative assessment of relative contribution of model risk factors; risk model performance metrics including cross-validation discrimination and calibration statistics, calibration curve and risk decile plot, and assessment of adequacy in the context of norms for risk models. Risk stratification: Provide quantitative assessment of relationship of risk factors to the outcome and differences in outcomes among the strata*):

Measure Development and Validation in Medicare FFS:

Performance Metrics in Development Cohort: Development cohort consisted of 148,132 patient stays at 3,223 hospitals (half of 2008 cohort), with a risk-adjusted median readmission rate of 6.0% (represents rate in the original NQF-endorsed measure). The development model had strong discrimination and fit. The risk-standardized readmission rate ranged from 3.2% to 46.8%, a range of 43.6 percentage points. Results are summarized below:

Over-fitting indices: (0,1)

Residuals lack of fit: <-2 = 0.0%; [-2, 0) = 93.8%; [0, 2) = 0.1%; [2+ = 6.0%

Model Chi-square [# of covariates]: 2492 [33]

Predictive ability (lowest decile %, highest decile %): (2.4, 13.4)

Area under the ROC curve = 0.65 (GLM)

The discrimination and the explained variation of the model are consistent with those of models currently used to publicly report condition specific rates of both mortality and readmission.

Model Validation using 2008 Validation Cohort: 2008 Validation cohort consisted of 148,092 admissions (other half of the 2008 cohort) randomly selected from 3,213 hospitals, with a risk-standardized median readmission rate of 6.0% (represents rate from the original NQF-endorsed measure). The model performance was not substantively different in this validation sample, as compared to the development sample. Results are summarized below:

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Over-fitting indices: (-0.06, 0.98)
Residuals lack of fit: <-2 = 0.0%; [-2, 0) = 93.8%; [0, 2) = 0.1%; [2+ = 6.0%
Model Chi-square[# of covariates]: 2406 [33]
Predictive ability (lowest decile %, highest decile %):(2.6, 13.2)
Area under the ROC curve = 0.64

Model Validation using 2007 Validation Cohort: 2007 validation cohort consisted of 300,338 admissions from 3,295 hospitals. The model performance was not substantively different in this validation sample, as compared to the development sample. Results are summarized below:

Over-fitting indices: (-0.11, 0.94)
Residuals lack of fit: <-2 = 0.0%; [-2, 0) = 93.6%; [0, 2) = 0.1%; [2+ = 6.2%
Model Chi-square[# of covariates]: 4596 [33]
Predictive ability (lowest decile %, highest decile %):(2.8, 13.4)
Area under the ROC curve = 0.64

Assessment of Temporal Trends in Risk Factors and Model Performance (2008-2010):
Parameter estimates for risk-adjustment variables were consistent across years. In addition, model performance was also consistent across years of data; the C statistic was approximately 0.64 across all three years.

2b4.4 If outcome or resource use measure is not risk adjusted, provide rationale and analyses to justify lack of adjustment: N/A - The measure is risk-adjusted.

2b5. Identification of Meaningful Differences in Performance. *(The performance measure scores were appropriately analyzed and discriminated meaningful differences in quality.)*

2b5.1 Data/Sample *(Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*
2008-2010 Medicare Part A inpatient claims data (n=847,822 admissions)

2b5.2 Analytic Method *(Describe methods and rationale to identify statistically significant and practically/meaningfully differences in performance):*

Risk-adjusted hospital-level readmission rates following THA and/or TKA were assessed across hospitals. For a 2012 dry run in which CMS is providing hospitals with their performance results on this measure in anticipation of future public reporting, hospital performance is categorized identically to the three publicly reported readmission measures for AMI, heart failure and pneumonia. Specifically, CMS currently estimates an interval estimate for each hospital's risk-standardized rate to characterize the amount of uncertainty associated with the rate, compares the interval estimate to the national crude rate for the outcome, and categorizes hospitals as "better than," "worse than," or "no different than" the US national rate. See Calculation Algorithm attachment for description of analytic method.

2b5.3 Results *(Provide measure performance results/scores, e.g., distribution by quartile, mean, median, SD, etc.; identification of statistically significant and meaningfully differences in performance):*

Recent analyses of Medicare FFS data show substantial variation in THA/TKA RSRRs among hospitals. Using data from calendar years 2008 to 2010 and the re-specified measure, the median hospital-level RSRR was 5.5% and ranged from 3.0% to 9.9%.

2b6. Comparability of Multiple Data Sources/Methods. *(If specified for more than one data source, the various approaches result in comparable scores.)*

2b6.1 Data/Sample *(Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*
N/A

2b6.2 Analytic Method *(Describe methods and rationale for testing comparability of scores produced by the different data sources specified in the measure):*

See Guidance for Definitions of Rating Scale: H=High; M=Moderate; L=Low; I=Insufficient; NA=Not Applicable
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N/A

2b6.3 Testing Results (Provide statistical results, e.g., correlation statistics, comparison of rankings; assessment of adequacy in the context of norms for the test conducted):

N/A

2c. Disparities in Care: H M L I NA (If applicable, the measure specifications allow identification of disparities.)

2c.1 If measure is stratified for disparities, provide stratified results (Scores by stratified categories/cohorts): This measure is not stratified.

2c.2 If disparities have been reported/identified (e.g., in 1b), but measure is not specified to detect disparities, please explain:

There were no hospital-level disparities detected during measure development. Please see "Summary of Data on Disparities by Population Group" for additional information.

2.1-2.3 Supplemental Testing Methodology Information:

Steering Committee: Overall, was the criterion, *Scientific Acceptability of Measure Properties*, met? (Reliability and Validity must be rated moderate or high) Yes No

Provide rationale based on specific subcriteria:

If the Committee votes No, STOP

3. USABILITY

Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making. (evaluation criteria)

C.1 Intended Actual/Planned Use (Check all the planned uses for which the measure is intended): Public Reporting, Quality Improvement with Benchmarking (external benchmarking to multiple organizations)

3.1 Current Use (Check all that apply; for any that are checked, provide the specific program information in the following questions): Not in use

3a. Usefulness for Public Reporting: H M L I
(The measure is meaningful, understandable and useful for public reporting.)

3a.1. Use in Public Reporting - disclosure of performance results to the public at large (If used in a public reporting program, provide name of program(s), locations, Web page URL(s)). If not publicly reported in a national or community program, state the reason AND plans to achieve public reporting, potential reporting programs or commitments, and timeline, e.g., within 3 years of endorsement: [For Maintenance – If not publicly reported, describe progress made toward achieving disclosure of performance results to the public at large and expected date for public reporting; provide rationale why continued endorsement should be considered.]

This recently-developed measure is designed for use in public reporting but is not yet in use. The measure is undergoing a dry-run in the fall of 2012. CMS has added the measure to its Inpatient Quality Reporting program with public reporting schedule to begin in 2013.

3a.2. Provide a rationale for why the measure performance results are meaningful, understandable, and useful for public reporting. If usefulness was demonstrated (e.g., focus group, cognitive testing), describe the data, method, and results: During the measure development process, the measure was evaluated by a group of clinical experts and a technical expert panel (TEP) to construct a measure for use in public reporting. We have received input and feedback on key issues related to the meaningfulness,

usefulness, and design of the measure. Existing similar measures currently in public reporting have undergone consumer testing to ensure public interpretability and understanding of the measures.

3.2 Use for other Accountability Functions (payment, certification, accreditation). If used in a public accountability program, provide name of program(s), locations, Web page URL(s): This measure is not currently used in a public accountability program.

3b. Usefulness for Quality Improvement: H M L I
 (The measure is meaningful, understandable and useful for quality improvement.)

3b.1. Use in QI. If used in quality improvement program, provide name of program(s), locations, Web page URL(s):
 [For Maintenance – If not used for QI, indicate the reasons and describe progress toward using performance results for improvement].

Measure is not currently used in a QI program but a primary goal of the measure is to provide hospitals with information necessary to implement focused quality improvement.

3b.2. Provide rationale for why the measure performance results are meaningful, understandable, and useful for quality improvement. If usefulness was demonstrated (e.g., QI initiative), describe the data, method and results:

This measure has been evaluated by a group of clinical experts and a TEP throughout the measure development process. We have received input and feedback on key methodological, clinical, and other measure decisions, as well as its utility in guiding focused quality improvement within hospitals.

Overall, to what extent was the criterion, Usability, met? H M L I
 Provide rationale based on specific subcriteria:

4. FEASIBILITY

Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement. (evaluation criteria)

4a. Data Generated as a Byproduct of Care Processes: H M L I

4a.1-2 How are the data elements needed to compute measure scores generated? (Check all that apply).

Data used in the measure are:

Coded by someone other than person obtaining original information (e.g., DRG, ICD-9 codes on claims)

4b. Electronic Sources: H M L I

4b.1 Are the data elements needed for the measure as specified available electronically (Elements that are needed to compute measure scores are in defined, computer-readable fields): ALL data elements in electronic claims

4b.2 If ALL data elements are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using other than electronic sources:

4c. Susceptibility to Inaccuracies, Errors, or Unintended Consequences: H M L I

4c.1 Identify susceptibility to inaccuracies, errors, or unintended consequences of the measurement identified during testing and/or operational use and strategies to prevent, minimize, or detect. If audited, provide results:

Using administrative claims variables for risk adjustment:

This measure uses variables from claims data submitted by hospitals to CMS for payment as “clinical” risk adjusters. Prior research has demonstrated that administrative claims data can be used to develop risk-adjusted outcomes measures for readmission following hospitalization for acute myocardial infarction (AMI),¹ heart failure,² and pneumonia,³ and that the models produce estimates of RSRRs that are very similar to rates estimated by models based on medical record data.

For example, validation results for the AMI measure showed a similar predicted readmission rate for myocardial infarction with a range of 13% to 31% for the administrative model and 13% to 29% for the medical records model. The correlation coefficient of the

standardized rate was 0.98. Similarly, the heart failure administrative model predicted readmission rate ranged from 16% to 34%, while the medical records model produced predicated readmission rates of 15%-38%. The correlation coefficient for the two heart failure models was 0.97.

This high level of agreement in the results based on two different approaches supports the continued use of claims-based models for public reporting. The models have also demonstrated consistent performance across years of claims data. The approach to gathering risk factors for patients also mitigates the potential limitations of claims data. Because not every diagnosis is coded at every visit, we identified comorbid conditions for risk adjustment in inpatient, outpatient, and physician claims data coded in the year prior to the hospital stay, as well as those coded in the secondary diagnosis fields during the index hospital stay. This strategy allows for comprehensive review of patients' medical histories. If a diagnosis appeared only once, in some visits and not others, it was included, minimizing the effect of incomplete coding.

We were careful, however, to include information about each patient's status at index hospital stay and not to adjust for possible complications of the hospital stay. Although some codes, by definition, represent conditions that are present before the hospital stay (e.g. cancer), other codes and conditions cannot be distinguished from complications occurring during the index hospital stay (e.g., infection or shock). If these are secondary diagnoses from the index hospital stay, then they are not adjusted for in the analysis.

Potentially creating access barriers

These are elective procedures, and therefore publicly reporting this measure could reduce access to care for certain populations, particularly for patients who may be healthy enough to undergo the procedure but who carry a higher risk for readmission. We do not anticipate this; however, we recommend monitoring for unexpected consequences once the measure is implemented.

References:

1. Krumholz HM, Lin Z, Drye EE, Desai MM, Han LF, Rapp MT, Mattera JA, Normand SL. An administrative claims measure suitable for profiling hospital performance based on 30-day all-cause readmission rates among patients with acute myocardial infarction. *Circulation: Cardiovascular Quality and Outcomes*. 2011 Mar 1;4(2):243-52.
2. Keenan PS, Normand SL, Lin Z, Drye EE, Bhat KR, Ross JS, Schuur JD, Stauffer BD, Bernheim SM, Epstein AJ, Wang Y-F, Herrin J, Chen J, Federer JJ, Mattera JA, Wang Y, Krumholz HM. An administrative claims measure suitable for profiling hospital performance on the basis of 30-day all-cause readmission rates among patients with heart failure. *Circulation: Cardiovascular Quality and Outcomes*. 2008 Sep;1(1):29-37.
3. Lindenauer PK, Normand SL, Drye EE, Lin Z, Goodrich K, Desai MM, Bratzler DW, O'Donnell WJ, Metersky ML, Krumholz HM. Development, validation, and results of a measure of 30-day readmission following hospitalization for pneumonia. *Journal of Hospital Medicine*. 2011 Mar;6(3):142-50.

4d. Data Collection Strategy/Implementation: H M L I

A.2 Please check if either of the following apply (*regarding proprietary measures*):

4d.1 Describe what you have learned/modified as a result of testing and/or operational use of the measure regarding data collection, availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, other feasibility/implementation issues (*e.g., fees for use of proprietary measures*):

This measure is undergoing a dry run to familiarize hospitals with the measure and to test the data production process prior to the public reporting of hospital performance. CMS is providing hospitals with Hospital-Specific Reports containing information about the measures, their measure results, and patient-level data.

Overall, to what extent was the criterion, *Feasibility*, met? H M L I

Provide rationale based on specific subcriteria:

OVERALL SUITABILITY FOR ENDORSEMENT

Does the measure meet all the NQF criteria for endorsement? Yes No

Rationale:

See Guidance for Definitions of Rating Scale: H=High; M=Moderate; L=Low; I=Insufficient; NA=Not Applicable

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If the Committee votes No, STOP.

If the Committee votes Yes, the final recommendation is contingent on comparison to related and competing measures.

5. COMPARISON TO RELATED AND COMPETING MEASURES

If a measure meets the above criteria and there are endorsed or new related measures (either the same measure focus or the same target population) or competing measures (both the same measure focus and the same target population), the measures are compared to address harmonization and/or selection of the best measure before a final recommendation is made.

5.1 If there are related measures (*either same measure focus or target population*) or competing measures (*both the same measure focus and same target population*), list the NQF # and title of all related and/or competing measures:

0330 : Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following heart failure hospitalization

0505 : Hospital 30-day all-cause risk-standardized readmission rate (RSRR) following acute myocardial infarction (AMI) hospitalization.

0506 : Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following pneumonia hospitalization

5a. Harmonization

5a.1 If this measure has EITHER the same measure focus OR the same target population as [NQF-endorsed measure\(s\)](#): Are the measure specifications completely harmonized? Yes

5a.2 If the measure specifications are not completely harmonized, identify the differences, rationale, and impact on interpretability and data collection burden:

5b. Competing Measure(s)

5b.1 If this measure has both the same measure focus and the same target population as NQF-endorsed measure(s): Describe why this measure is superior to competing measures (*e.g., a more valid or efficient way to measure quality*); OR provide a rationale for the additive value of endorsing an additional measure. (*Provide analyses when possible*):

N/AN/A

CONTACT INFORMATION

Co.1 Measure Steward (Intellectual Property Owner): [Centers for Medicare & Medicaid Services \(CMS\), 7500 Security Blvd, Mail Stop S3-02-01, Baltimore, Maryland, 21244-9045](#)

Co.2 Point of Contact: [Lein, Han, Ph.D., Government Task Leader, Lein.han@cms.hhs.gov, 410-786-0205-](#)

Co.3 Measure Developer if different from Measure Steward: [Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation \(YNHHSC/CORE\), 1 Church Street Suite 200, New Haven, Connecticut, 06510](#)

Co.4 Point of Contact: [Lisa, Suter, MD, lisa.suter@yale.edu, 203-764-9553-](#)

Co.5 Submitter: [Lisa, Suter, MD, lisa.suter@yale.edu, 203-764-9553-, Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation \(YNHHSC/CORE\)](#)

Co.6 Additional organizations that sponsored/participated in measure development:

[MPR: Mathematica Policy Research; RTI: Research Triangle Institute](#)

Co.7 Public Contact: [Lisa, Suter, MD, lisa.suter@yale.edu, 203-764-9553-, Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation \(YNHHSC/CORE\)](#)

ADDITIONAL INFORMATION

Workgroup/Expert Panel involved in measure development

Ad.1 Provide a list of sponsoring organizations and workgroup/panel members' names and organizations. Describe the members' role in measure development.

Working Group

Role: To provide technical expertise on key methodological decisions during measure development.

Members:

Daniel J. Berry, MD
Professor of Orthopedics, Mayo Clinic College of Medicine
Chair, Department of Orthopaedic Surgery, Mayo Clinic

Kevin J. Bozic, MD, MBA
Associate Professor and vice chair, Department of Orthopaedic Surgery at the University of California, San Francisco
Chair, Health Systems Committee, American Academy of Orthopaedic Surgeons (AAOS)

Robert Bucholz, MD
Professor, Orthopaedic Surgery, University of Texas Southwestern Medical Center
Past President, AAOS

Lisa Gale Suter, MD
Assistant Professor, Yale University School of Medicine, Rheumatology (West Haven Veterans Administration Hospital)

Charles M. Turkelson, PhD
Director of Research and Scientific Affairs, AAOS

Lawrence Weis, MD
Assistant Professor, Yale Orthopaedics and Rehabilitation, Yale University School of Medicine, Orthopaedics (West Haven Veterans Association Hospital)

Technical Expert Panel

Role: To provide feedback on recommendations for measure development.

Members:

Mark L. Francis, MD
Professor of Medicine and Biomedical Sciences, Chief, Division of Rheumatology, Department of Internal Medicine, Texas Tech University Health Sciences Center

Cynthia Jacelon, PhD, RN, CRRN
Associate Professor, School of Nursing, University of Massachusetts
Association of Rehabilitation Nurses

Norman Johanson, MD
Chairman, Orthopedic Surgery, Drexel University College of Medicine

C. Kent Kwoh, MD
Professor of Medicine, University of Pittsburgh
Associate Chief and Director of Clinical Research,

NQF #1551 Hospital-level 30-day, all-cause risk-standardized readmission rate (RSRR) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA), Last Updated Date: Oct 25, 2012

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Barbara Schaffer
THA Patient

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Professor, University of California at Los Angeles

Steven H. Stern, MD
Vice President, Cardiology & Orthopedics/ Neuroscience, United Healthcare

Richard E. White, Jr., MD
American Association of Hip and Knee Surgeons

Ad.2 If adapted, provide title of original measure, NQF # if endorsed, and measure steward. Briefly describe the reasons for adapting the original measure and any work with the original measure steward: [N/A](#)

Measure Developer/Steward Updates and Ongoing Maintenance

Ad.3 Year the measure was first released:

Ad.4 Month and Year of most recent revision:

Ad.5 What is your frequency for review/update of this measure? [N/A](#)

Ad.6 When is the next scheduled review/update for this measure?

Ad.7 Copyright statement: [N/A](#)

Ad.8 Disclaimers: [N/A](#)

Ad.9 Additional Information/Comments: [Updates document, technical Report, calculation algorithm, and planned readmissions report attached](#)

Date of Submission (MM/DD/YY): [12/14/2010](#)