Measure Information Form and Instructions

Project Title: Measuring Outcomes in Orthopedics Routinely (MOOR) – Risk Standardized Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) electronic clinical quality measure (eCQM)

Date: 11/25/2020

Information included is current on 12/21/20.

Project Overview:

The Centers for Medicare & Medicaid Services (CMS) has provided funding to the Brigham and Women's Hospital (BWH) to develop a set of electronic clinical quality measures (eCQMs) related to total joint arthroplasty (TJA). The cooperative agreement name is Measuring Outcomes in Orthopedics Routinely (MOOR) and the number is: 1V1CMS331637-01-00.

1. Measure Name/Title (NQF Submission Form De.2.)

Risk-standardized complication rate (RSCR) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA) electronic clinical quality measure (eCQM).

2. Descriptive Information

2.1 Measure Type (NQF Submission Form De.1.)

Identify a measure type from the list. Patient-reported outcomes (PROs) include health-related quality of life, functional status, symptom burden, experience with care, and health-related behavior.

☐ process
☐ process: appropriate use
☒ outcome
☐ outcome: PRO
☐ cost / resource use
☐ efficiency
☐ structure
☐ intermediate outcome
☐ composite

2.2 Brief Description of Measure (NQF Submission Form De.3.)

This measure estimates the RSCR following elective primary THA and/or TKA at the clinician group level for adults 18 years and older. The outcome (complication) is defined as any one of the specified complications [1] occurring from the date of index admission to 90 days post date of the index admission (or procedure encounter if the procedure is done on an outpatient basis). Because this is a MIPS measure, the target population is patients 18 and over across all payers.

References:

1. Grosso LM et. al. Hospital-level Risk-Standardized Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) And/Or Total Knee Arthroplasty (TKA): Measure Methodology Report. Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE), June 2012, page 71.
2. (2019). "Hospital-level risk-standardized complication rate (RSCR) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA)." National Quality Forum. Retrieved July 9, 2019, from: http://www.qualityforum.org/Qps/MeasureDetails.aspx?standardID=1550&print=0&entityTypeID=1

2.3 If Paired or Grouped (NQF Submission Form De.4.)

This measure is not paired or grouped with any other measures.

3. Measure Specifications

These items follow the NQF requirements for measure submission and provide information required for measure evaluation.

3.1 Measure-Specific Webpage (NQF Submission Form S.1.)

Not applicable; this measure is under development.

3.2 If this is an electronic clinical quality measure (eCQM) (NQF Submission Form S.2a.):

The measure is under development using the eMeasure Authoring Tool (MAT). The Human Readable file and data dictionary is attached

3.3 Data Dictionary, Code Table, or Value Sets (NQF Submission Form S.2b.)

To identify patients with a qualifying elective primary total hip and/or total knee arthroplasty, we utilized the following Value Set from the Joint Commission.

- Total Hip, Total Knee Replacement: OID # 2.16.840.1.113762.1.4.1029.96

For the denominator exclusions and complications, we developed and published the following value sets in the VSAC:

Value Set Name	OID Number
Nonprimary Total Hip, Total Knee Replacement	2.16.840.1.113762.1.4.1206.5
Fracture Exclusions for Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.2
Malignant Neoplasm Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.7
Sepsis Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.4
Pneumonia Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.6
Surgical Site Bleeding and Other Surgical Site Complications	2.16.840.1.113762.1.4.1206.10
Pulmonary Embolism Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.3
Mechanical Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.1
Periprosthetic Joint Infection/Wound Infection and Other Wound Complications	2.16.840.1.113762.1.4.1206.8
Procedures Resulted from Periprosthetic Joint Infection/Wound Infections	2.16.840.1.113762.1.4.1206.9
Procedures Resulted from Surgical Site Bleeding and Other Surgical Site Complications	2.16.840.1.113762.1.4.1206.11

- See attached excel file for full data dictionary

3.4 For an instrument-based measure (NQF Submission Form S.2c and S2.d):

Not applicable; this measure is based on routinely collected electronic health record (EHR) data.

3.5 Updates since last submission (NQF Submission Form S.3.1 and S.3.2)

Not applicable; this measure is under development.

3.6 Numerator Statement (NQF Submission Form S.4.)

The outcome for this measure is any complication occurring during the index admission to 90 days' following discharge. If the elective primary THA or TKA are done outpatient, the outcome is any complication that occurred during a period of 90 days following procedure. Complications are counted in the measure if they occur during the index hospital admission or within the 90-day period following discharge or procedure (if outpatient). The complication outcome is a dichotomous (yes/no) outcome. If a patient experiences one or more of these complications in the applicable period, the complication outcome for that patient is counted in the measure as a "yes".

3.7 Numerator Details (NQF Submission Form S.5.)

The complication is a dichotomous outcome (yes for any complication(s); no for no complications). Therefore, if a patient experiences one or more complications, the outcome variable will be coded as a "yes". Complications are counted in the measure if they occur during the index hospital admission or procedure encounter if done as outpatient (and are not present on admission) or within the 90-day post-date of admission or procedure (outpatient).

The complications captured in the numerator are identified during the index admission OR up to 90 days post-date of index admission (inpatient or outpatient), depending on the complication. The follow-up period for complications from date of index admission is as follows:

The follow-up period for **AMI**, **pneumonia**, and **sepsis/septicemia/shock** is seven days from the date of index admission because these conditions are more likely to be attributable to the procedure if they occur within the first week after the procedure. Additionally, analyses indicated a sharp decrease in the rate of these complications after seven days (Grosso et al., 2012).

Death, surgical site bleeding, and **pulmonary embolism** are followed for 30 days following admission because clinical experts agree these complications are still likely attributable to the hospital performing the procedure during this period and rates for these complications remained elevated until roughly 30 days' post admission (Grosso et al., 2012).

The measure follow-up period is 90 days after admission for **mechanical complications** and **periprosthetic joint infection/wound infection**. Experts agree that mechanical complications and periprosthetic joint infection/wound infections due to the index THA/TKA occur up to 90 days following THA/TKA (Grosso et al., 2012).

The measure counts all complications occurring during an index admission regardless of when they occur. For example, if a patient experiences an AMI on day 10 of the index admission, the measure will count the AMI as a complication, although the specified follow-up period for AMI

is seven days. Clinical experts agree with this approach, as such complications likely represent the quality of care provided during the index admission (Grosso et al., 2012).

Complication	Time Frame (days)
Acute Myocardial Infarction	7
Pneumonia	7
Sepsis	7
Pulmonary embolism	30
Surgical site bleeding	30
Death	30
Wound infection/Periprosthetic joint infection	90
Mechanical Complication	90

Table 1: TJA Complications and follow-up time frames (inpatient and outpatient) (Grosso et al., 2012).

The measure does not count complications that are coded as present on admission (POA) during the index admission; this prevents identifying a condition as a complication of care if it was present on admission for the THA/TKA procedure.

For full list of SNOMED CT/ICD-10 codes defining complications, see the Data Dictionary attached in the Appendix.

See following value sets in the VSAC:

Value Set Name	OID Number	Steward
Total Hip, Total Knee Replacement	2.16.840.1.113762.1.4.1029.96	The Joint Commission
Nonprimary Total Hip, Total Knee Replacement	2.16.840.1.113762.1.4.1206.5	Brigham & Women's Hospital
Fracture Exclusions for Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.2	Brigham & Women's Hospital
Malignant Neoplasm Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.7	Brigham & Women's Hospital
Sepsis Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.4	Brigham & Women's Hospital
Pneumonia Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.6	Brigham & Women's Hospital
Surgical Site Bleeding and Other Surgical Site Complications	2.16.840.1.113762.1.4.1206.10	Brigham & Women's Hospital
Pulmonary Embolism Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.3	Brigham & Women's Hospital
Mechanical Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.1	Brigham & Women's Hospital

Value Set Name	OID Number	Steward
Periprosthetic Joint Infection/Wound Infection and Other Wound Complications	2.16.840.1.113762.1.4.1206.8	Brigham & Women's Hospital
Procedures Resulted from Periprosthetic Joint Infection/Wound Infections	2.16.840.1.113762.1.4.1206.9	Brigham & Women's Hospital
Procedures Resulted from Surgical Site Bleeding and Other Surgical Site Complications	2.16.840.1.113762.1.4.1206.11	Brigham & Women's Hospital

References:

1. Grosso L., et al. (2012). "Hospital-level Risk-Standardized Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) And/Or Total Knee Arthroplasty (TKA) Measure Methodology Report." https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQn etTier3&cid=1228774719413.

3.8 Denominator Statement (NQF Submission Form S.6.)

The target population for this eCQM includes adults 18 years of age or older undergoing elective inpatient or outpatient primary THA and/or TKA procedures (all adult patients, all payers).

3.9 Denominator Details (NQF Submission Form S.7.)

To be included in the measure cohort used in public reporting, patients must meet the following inclusion criteria:

1. Aged 18 or older on the date of procedure

2. Having a qualifying elective primary THA/TKA procedure (inpatient or outpatient); elective primary THA/TKA procedures are defined as those procedures without any of the following:

- Femur, hip, or pelvic fractures coded in the billing diagnosis field from any hospital encounters within 3 months prior to the date of procedure.
- Partial hip arthroplasty (PHA) procedures (with a concurrent THA/TKA); partial knee arthroplasty procedures are not distinguished by ICD9 codes and are currently captured by the THA/TKA measure
- Revision procedures with a concurrent THA/TKA
- Resurfacing procedures with a concurrent THA/TKA
- Mechanical complication coded in the billing diagnosis field from any hospital encounters within 3 months prior to the date of procedure
- Malignant neoplasm of the pelvis, sacrum, coccyx, lower limbs, or bone/bone marrow or a disseminated malignant neoplasm coded in the billing diagnosis field from any hospital

encounters within 3 months prior to the date of procedure.
- Removal of implanted devises/prostheses
- Transfer status from another acute care facility for the THA/TKA

Patients are eligible for inclusion in the denominator if they had an elective primary THA and/or a TKA when they were 18 or over. Please refer to the Data Dictionary (attached in Appendix) for the SNOMED CT/ICD 10 codes used to define the cohort for each measure. The ICD 10 codes will allow clinician group practices to run the eCQM using a standard report against EHR data (October 2015 and later) to explore trends over time.

3.10 Denominator Exclusions (NQF Includes "Exception" in the "Exclusion" Field) (NQF Submission Form S.8.)

This measure will exclude patients:

1. Who were discharged against medical advice (AMA); or,
2. Who had more than two THA/TKA procedure codes during the index hospitalization.

If a patient has more than one eligible admission in a calendar year after applying these exclusion criteria (in addition to denominator exclusion conditions and concurrent non-primary THA/TKA procedures), we use the first eligible admission and exclude the other eligible admissions in that year.

3.11 Denominator Exclusion Details (NQF Includes "Exception" in the "Exclusion" Field) (NQF Submission Form S.9.)

This measure excludes index admissions/procedures for patients:

1. Who were discharged against medical advice (AMA);
    - Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
2. Who had more than two THA/TKA procedure 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, which may reflect a coding error.

3.12 Stratification Details/Variables (NQF Submission Form S.10.)

The measure will not be stratified.

3.13 Risk Adjustment Type (NQF Submission Form S.11.)

Select the risk adjustment type. Provide specifications for risk stratification in 3.14 (NQF Submission Form S.12.) and for the statistical model in 3.16-3.17 (NQF Submission Form S.14.–15.).

☐ no risk adjustment or risk stratification
☐ stratification by risk category/subgroup
☒ statistical risk model
☐ other (S.13.a.)

We adapted Dawson's conceptual model for relationships between social determinants of health and systolic blood pressure to describe the relationship between antecedents, predisposing, enabling factors, need for healthcare factors and patient outcomes. For this eCQM the outcome we are measuring is the occurrence of inpatient respiratory depression following THA/TKA. In terms of antecedents, regional variation will be important when looking at these rates nationally. Rosenberg and colleagues found that the amount of variability in health outcomes in the U.S. is large even after accounting for differences in population, co-morbidities, and health system factors. African American/Black race is an important outcome antecedent in the total joint replacement population [1]. Pfefferle et al. noted poorer outcomes for African American patients (particularly African American women) after TKA. They found that African American women under the age of 60 had the greatest incidence of manipulation after TKA due to stiffness and decreased range of motion [2]. Stone et al. also found that African American patients had longer lengths of stay, more complications (e.g., sepsis, manipulation under anesthesia) and were less likely to be discharged home than Caucasian patients after total joint surgery [3].

Patient demographics including age, sex and household income may be important predisposing factors of post-surgical outcomes. Basilico and colleagues found that older age was an important risk factor for complications following total joint replacement surgery [4]. As noted above, younger African American women have the greatest incidence of manipulation post TKA. Dy et al. found that younger age and lower income (e.g., Medicaid) increased the risk of undergoing early revision THA [5]. Kremers et al. did not find associations between marital status and educational attainment and postoperative complications [6].

English proficiency may be an important enabling factor for patients undergoing THA/TKA. De Oliveira et al. found that THA/TKA patients had a high prevalence of inadequate health literacy (60%) that may be associated with poor comprehension of discharge instructions and could potentially impact post-surgical outcomes [7].

Comorbidity and smoking status are important factors that increase the need for healthcare and may contribute to poorer outcomes in patients undergoing total joint replacement. Kremers et al. explored social and behavioral factors in THA/TKA and found that a positive smoking status

was associated with higher rates of post-surgical infections [6]. In addition, literature has shown that obesity is associated with higher rates of peri-operative complications, joint and wound infections, mechanical complications, deep vein thrombosis, blood loss, operative time, and need for revision surgery following primary total joint arthroplasty [8]. Currently, more than one third of Americans are classified as obese (BMI ≥ 30kg/m2) and morbidly obese patients have significantly higher risk of complications noted above and they undergo total knee arthroplasty at an average age of 13 years younger than non-obese patients due to rapid progression of osteoarthritis [9].

References:

1. Rosenberg BL., et al. (2016). "Quantifying Geographic Variation in Health Care Outcomes in the United States before and after Risk-Adjustment". PLoS ONE 11(12):e0166762.
2. Pfefferle KJ, et al. (2014). "Risk factors for manipulation after total knee arthroplasty: a pooled electronc health record database study". Journal of Arthroplasty 29(10): 2036-8.
3. Stone AH, et al. (2019). "Differences in perioperative outcomes and complications between African American and white patients after total joint arthroplasty". Journal of Arthroplasty 34(4):656-662.
4. Basilico FC, et al. (2008). "Risk factors for cardiovascular complications following total joint replacement surgery". American College of Rheumatology 58(7): 1915-1920.
5. Dy CJ, et al. (2013). "Risk factors for early revision after total hip arthroplasty". American College of Rheumatology 66(6):907-915.
6. Kremers HM., et al. (2015). "Social and behavioral factors in total knee and hip arthroplasty". The Journal of Arthroplasty. 30:1852-1854.
7. De Oliveira GS., et al. (2015). "The impact of health literacy in the care of surgical patients: a qualitative systematic review". BMC Surgery 15 (86).
8. Haynes J, et al. (2017). "Obesity in total hip arthroplasty: Does it make a difference?" Bone Joint J. 99-B (1 Supple A): 31-6
9. Changulani M, et al. (2008). "The relationship between obesity and the age at which hip and knee replacement is undertaken". J Bone Joint Sug. 90: (B:360-363)

3.14 Type of Score (NQF Submission Form S.12.):

- ☐count
- ☒rate/proportion
- ☐ratio
- ☐categorical (e.g., yes or no)
- ☐continuous variable (CV) (e.g., an average)
- ☐other (specify)

3.15 Interpretation of Score (NQF Submission Form S.13.)

A lower score indicates better quality of care.

3.16 Calculation Algorithm/Measure Logic (NQF Submission Form S.14.)

Step 1: Define the Initial Population

Identify all patients aged 18 years or older, covered by any healthcare payer, who received an elective primary THA and/or TKA within the measurement period.

Step 2: Define the Denominator

Apply the denominator exclusion criteria to all the patients from the initial population and determine the denominator population. For the full list of denominator exclusions, please refer to section 3.9, 3.10, and 3.11.

Step 3: Define the Numerator

Identify all patients from the denominator who had a complication during the index admission or within the 90-day post-date of admission period/procedure (inpatient or outpatient). The complication is a dichotomous outcome (yes for any complication(s); no for no complications).

Step 4: Calculate the Complication Rate

Divide the number of patients in the numerator (step 3) by the number of patients in the denominator (step 2) and multiply by 100. The measure is reported as a percentage: XX out of 100.

The measure estimates clinician group-level risk standardized complication rates (RSCRs) following elective primary THA/TKA using hierarchical logistic regression models. In brief, the approach simultaneously models data at the patient and clinician group levels to account for variance in patient outcomes within and between clinician groups [1,2,3,4]. At the patient level, it models the log-odds of a complication occurring within 90 days of the index admission (or procedure if done as outpatient) using age, sex, selected clinical covariates (*see **Figure 1** above, "Conceptual model for relationship between Social/behavioral determinants of health" for list of covariates*) and a clinician group-specific random intercept. At the clinician group level, it models the clinician group-specific intercepts as arising from a normal distribution. The clinician group intercept represents the underlying risk of a complication at the clinician group level, after accounting for patient risk. The clinician group-specific intercepts are given a distribution to account for the clustering (non-independence) of patients within the same clinician group. If there were no differences among clinician groups, then after adjusting for patient risk, the clinician group intercepts should be identical across all clinician groups.

The RSCR is calculated as the ratio of the number of "predicted" to the number of "expected" episodes with a complication (inpatient or outpatient), multiplied by the national observed complication rate. For each clinician group, the numerator of the ratio is the number of

complications within 90 days predicted based on the clinician group's performance with its observed case mix, and the denominator is the number of complications expected based on the nation's performance with that clinician group'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 clinician group's performance given its case mix to an average clinician group's performance with the same case mix. Thus, a lower ratio indicates lower-than-expected complication rates or better quality, and a higher ratio indicates higher-than-expected complication rates or worse quality.

In summary, the hierarchical logistic regression model is on the patient level and contains the patient characteristics (*see* ***Figure 1)*** as covariates (with fixed regression coefficients for these covariates that are common over all clinician groups) as well as a random effect for clinician group into which the patient's clinician belongs. The fixed regression coefficients of the risk factors are estimated using maximum likelihood with numerical quadrature to form the marginal likelihood integrated over the random clinician group-specific intercepts [5]. The random clinician group-specific intercepts are then estimated using an empirical Bayes approach [6].

The "predicted" number of encounters with a complication (the numerator) is calculated by using the coefficients estimated by regressing the risk factors and the clinician group-specific random intercept on the risk of having an encounter with a complication. The estimated clinician group-specific intercept is added to the sum of the estimated regression coefficients multiplied by the patient characteristics. The results are transformed from the logit scale back to the probability scale (using the anti-logit transformation) and summed over all patients attributed to a clinician group to get a predicted value. The "expected" number of encounters with a complication (the denominator) is obtained in the same manner, but a common intercept using all clinician groups in our sample is added. The results are log transformed and summed over all patients in the clinician group to get an expected value. Thus, the risk factors for the patients and their common fixed regression coefficients are used in both the 'predicted' and the 'expected', but the expected is based solely on the patient characteristics, whereas the predicted includes the clinician group effect. Note, though, the clinician group random effect can be considered the residual clinician group effect after controlling for the patient risk factors. If there are strong clinician group effects after controlling for patient risk factors, then the RSCRs can be much different across clinician groups; if the clinician group effects are weak after controlling for the patient risk factors, then the RSCRs will be close to one. To assess clinician group performance for each reporting period, we re-estimate the model coefficients using the years of data in that period. This approach has been used in clinical papers by the statistician on our team [7,8].

References:

1. Normand S-LT., et al. (2007). "Statistical and Clinical Aspects of Hospital Outcomes Profiling." Stat Sci. 22(2): 206-226.
2. Dimick JB., et al. (2010). "Ranking hospitals on surgical mortality: the importance of reliability adjustment." Health Services Research. 45(6p1):1614-29.

3. Krell RW., et al. (2014). "Reliability of risk-adjusted outcomes for profiling hospital surgical quality." JAMA surgery. 149(5):467-74.
4. MacKenzie TA., et al. (2015). "A primer on using shrinkage to compare in-hospital mortality between centers." Ann Thorac Surg. 99(3):757-761.
5. Lange K. (1999). Numerical Analysis for Statisticians. New York: Springer – Verlag
6. Schall R. (1991). "Estimation in generalized linear models with random effects." Biometrika. 78(4): 719-727.
7. Wakeam E., et al. (2017). "Variation in the cost of 5 common operations in the United States." Surgery. 162(3):592-604.
8. Krimphove MJ., et al. (2019). "The current landscape of low-value care in men diagnosed with prostate cancer: what is the role of individual hospitals?" Urol Oncol. pii: S1078-1439(19)30134-6.

3.17 Sampling (NQF Submission Form S.15.)

Not applicable; this measure is not based on a sample.

3.18 Survey/Patient-Reported Data (NQF Submission Form S.16.)

Not applicable; this measure is not based on survey or patient-reported data.

3.19 Data Source (NQF Submission Form S.17.)

Indicate all sources for which the measure is specified and tested.

☐ administrative data
☐ claims data
☒ patient medical records (i.e., paper-based or electronic)
☒ electronic clinical data
☐ registries
☐ standardized patient assessments
☐ patient-reported data and surveys
☐ non-medical data
☐ other—describe in 3.20 (NQF Submission Form S.18.)

3.20 Data Source or Collection Instrument (NQF Submission Form S.18.)

Routinely collected information documented in EHRs.

3.21 Data Source or Collection Instrument (Reference) (NQF Submission Form S.19.)

Not applicable.

3.22 Level of Analysis (NQF Submission Form S.20.)

Indicate only the levels for which the measure is specified and tested.

☐ clinician: individual
☒ clinician: group/practice
☐ facility
☐ health plan
☐ integrated delivery system
☐ population: community, county, or city
☐ population: regional and state
☐ other

3.23 Care Setting (NQF Submission Form S.21.)

Indicate only the settings for which the measure is specified and tested.

☐ ambulatory surgery center
☒ clinician office/clinic
☐ outpatient rehabilitation
☐ urgent care – Ambulatory
☐ behavioral health: Inpatient
☐ behavioral health: Outpatient
☐ dialysis facility
☐ emergency medical services/ambulance
☐ emergency department
☐ home health
☐ hospice
☐ hospital
☐ hospital: critical care
☐ hospital: acute care facility
☐ imaging facility
☐ laboratory
☐ pharmacy
☐ nursing home / skilled nursing facility (SNF)
☐ inpatient rehabilitation facility (IRF)
☐ long-term acute care
☐ birthing center
☐ no applicable care setting
☐ other

3.24 Composite Performance Measure (NQF Submission Form S.22.)

Not applicable; this measure is not a composite performance measure.