Measure Information Form and Instructions

Project Title: ***Measuring Outcomes in Orthopedics Routinely (MOOR) – Risk-standardized inpatient respiratory depression rate following elective primary total hip arthroplasty (THA) 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) 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 Inpatient Respiratory Depression Rate Following Elective Primary Total Hip Arthroplasty (THA) or Total Knee Arthroplasty (TKA)

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 eCQM estimates the risk-standardized inpatient respiratory depression (IRD) rate following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA) at the clinician group level for adults 18 years and older. Respiratory depression will be defined using SpO2 data, and diagnostic/procedure codes documented during the index hospital admission. Given that this is a Merit-based Incentivized Payment System (MIPS) measure, the target population is patients 18 years and older across all payers.

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.)

***Table A*: Value set used to identify patients with a qualifying elective primary THA or TKA**

Value set name	OID number
Primary THA Procedure	2.16.840.1.113883.3.464.1003.198.12.1006
Primary TKA Procedure	2.16.840.1.113883.3.464.1003.198.12.1006

***Table B*: Value sets used to identify denominator exclusion criteria**

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
Mechanical Complications Related to Hip and Knee Procedures	2.16.840.1.113762.1.4.1206.1
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
Left Against Medical Advice	2.16.840.1.113883.3.117.1.7.1.308

***Table C**: Value sets used to identify numerator criteria*

Value set name	Value set code
Acute postprocedural respiratory failure	J95.821
Acute and chronic postprocedural respiratory failure	J95.822
Acute respiratory failure, unspecified whether with hypoxia or hypercapnia	J96.00
Acute respiratory failure with hypoxia	J96.02
Acute and chronic respiratory failure, unspecified whether with hypoxia or hypercapnia	J96.21
Acute and chronic respiratory failure with hypoxia	J96.90
Respiratory failure, unspecified with hypoxia	J96.91
Respiratory failure, unspecified with hypercapnia	J96.92
Need for ventilator	2.16.840.1.113762.1.4.1045.82
Endotracheal intubation	2.16.840.1.113762.1.4.1045.69

- 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 subset of patients from the denominator who experienced respiratory depression during their inpatient stay following their elective primary THA/TKA. The outcome of respiratory depression is dichotomous (i.e., yes/no). If a patient experiences respiratory depression one or more times during the index hospitalization, the outcome for that patient is measured as a "yes," and the patient is included in the numerator.

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

A patient is included in the numerator if at least one of the following occurs during the patient's inpatient period:

1. Documented diagnosis of acute respiratory failure and/or acute respiratory distress.
    - Acute postprocedural respiratory failure
        - J95.821
    - Acute and chronic postprocedural respiratory failure
        - J95.822
    - Acute respiratory failure, unspecified whether with hypoxia or hypercapnia
        - J96.00
    - Acute respiratory failure with hypoxia

        - J96.02
    - Acute and chronic respiratory failure, unspecified whether with hypoxia or hypercapnia
        - J96.20
    - Acute and chronic respiratory failure with hypoxia
        - J96.21
    - Respiratory failure, unspecified, unspecified whether with hypoxia or hypercapnia
        - J96.90
    - Respiratory failure, unspecified with hypoxia
        - J96.91
    - Respiratory failure, unspecified with hypercapnia
        - J96.92
2. Documented mechanical ventilation procedure code.
    - Need for Ventilator
        - 2.16.840.1.113762.1.4.1045.82
3. Documented intubation procedure code.
    - Endotracheal Intubation
        - 2.16.840.1.113762.1.4.1045.69
4. Patient has 3 or more SpO2 values ≤ 88 & >30 during their index admission.
5. Patient has 2 SpO2 values ≤ 88 & > 30 that occur within 24 hours of each other during the index admission.

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

The denominator population for this eCQM includes adults 18 years of age or older undergoing inpatient elective 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. All payers, aged 18 or older on the date of procedure

2. Having a qualifying elective primary THA/TKA inpatient procedure.

- Primary THA/TKA Procedure
    - 2.16.840.1.113883.3.464.1003.198.12.1006
- Procedure was done inpatient
    - 2.16.840.1.113762.1.4.1104.8
- Payer
    - 2.16.840.1.114222.4.11.3591

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

1. The patient was discharged against medical advice (AMA).
2. The patient received an excluded procedure

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

Patients will be excluded from the denominator if:

1. The patient was discharged against medical advice (AMA).
    - *Rationale: Indicator of potential patient non-compliance during the inpatient hospital stay*
        - *Value Set: Left Against Medical Advice (E) - 2.16.840.1.113883.3.117.1.7.1.308*
2. The patient received an excluded procedure
    - *Rationale: This measure seeks to develop a homogenous cohort*
        - *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*
        - *Mechanical Complications Related to Hip and Knee Procedures 2.16.840.1.113762.1.4.1206.1*
        - *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*

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 inpatient 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.

Step 3: Define the Numerator

Identify all patients from the denominator who had documented SpO2, diagnostic or procedure codes related to respiratory depression. The outcome is a dichotomous (yes for IRD; no for no IRD).

Step 4: Calculate the Complication Rate

Divide the number of patients in the numerator (step three) 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 IRD rate 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 IRD during the index admission using age, sex, selected clinical 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 IRD 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 risk-standardized IRD rate is calculated as the ratio of the number of "predicted" to the number of "expected" episodes of IRD, multiplied by the national observed IRD rate. For each clinician group, the numerator of the ratio is the number of patients who experienced IRD during the index admission that is predicted based on the clinician group's performance with its observed case mix, and the denominator is the number of patients who experienced IRD that is expected based on the national 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 IRD rates or better quality, and a higher ratio indicates higher-than-expected IRD rates or worse quality.

In summary, the hierarchical logistic regression model is on the patient level and contains the patient characteristics 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 IRD (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 IRD. 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 risk-standardized IRD rates can be very different across clinician groups; if the clinician group effects are weak after controlling for the patient risk factors, then the risk-standardized IRD rates 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.