Measure Justification Form: Hospital Harm: Postoperative Respiratory Failure

August 2022

Version 2

Table of Contents

Submitted To

Centers for Medicare & Medicaid Services (CMS)
Center for Clinical Standards and Quality (CCSQ)

Attention

Donta Henson
Centers for Medicare & Medicaid Services
7500 Security Boulevard
Baltimore, MD 21244-1850

Submitted By

American Institutes for Research
www.air.org

Project

Patient Safety Measure Development and Maintenance
Contract Number: 75FCMC18D0027

Task & Deliverable

Chapter 3 Information Gathering
Deliverable 3-3 Measure Information Form (MIF)

Authors

Garth Utter, University of California-Davis
Patrick Romano, University of California-Davis
Meghan Weyrich, University of California-Davis
Mia Nievera, AIR
Michelle Lefebvre, AIR
Katie Magoulick, AIR
Christina Superina, Kennell and Associates
Courtney Colahan, Kennell and Associates

1. Overview

1.1 Project Title

Patient Safety Measure Development and Maintenance Project

1.2 Date

Information included is current on August 5, 2022.

1.3 Project Overview

The Centers for Medicare & Medicaid Services (CMS) has contracted American Institutes for Research (AIR) to develop, maintain, reevaluate, and implement patient safety measures for CMS' hospital-level quality reporting programs. The contract name is Patient Safety Measure Development and Maintenance. The contract number is 75FCMC18D0027 (Task Order: 75FCMC19F0001).

2. Measure Name

Hospital Harm – Postoperative Respiratory Failure

3. Type of Measure

Outcome

4. Importance

4.1 Evidence to Support the Measure Focus

PRF is the most common serious post-operative pulmonary complication with an incidence of up to 7.5% (the incidence of any postoperative pulmonary complication ranges from 10-40%)[1-11] and an in-hospital mortality rate of 25 to 40%.[1,12] PRF is additionally associated with prolonged mechanical ventilation, prolonged intensive care unit (ICU) and hospital length of stay, readmissions, and the need for rehabilitation or skilled nursing facility placement upon discharge.[13] Interventions found to reduce the risk of PRF in some patient populations include enhanced recovery after surgery (ERAS) pathways, prophylactic mucolytics, postoperative continuous positive airway pressure ventilation, lung protective intraoperative ventilation, prophylactic respiratory physiotherapy, epidural analgesia, and goal directed hemodynamic therapy.[25] Yet, progress in reducing the incidence of PRF has been stymied by lack of consensus regarding the definition of PRF, which patients are most at-risk, which risk factors are potentially modifiable, and which patients are more likely to benefit from targeted interventions of a health care system's limited resources.

As described above, PRF is associated with increased length of hospital and ICU stay, and increased risk of readmission, all of which are factors that contribute substantially to the costs of inpatient care.[14-21] One study estimated the increased costs associated with PRF and found that they range from $5,983 to $7,109 per procedure for complications not requiring ventilation to $118,841 to $120,579 for complications requiring tracheostomy.[19] Another study found that each case of PRF is associated with approximately $53,000 in excess charges and nine excess days of hospitalization after adjusting for preoperative risk factors.[20]

Disparities in the incidence of PRF across hospitals suggest that there is an important opportunity to reduce the occurrence of these events. An electronic clinical quality measure (eCQM)-based Hospital Harm – Postoperative Respiratory Failure measure would enable hospitals to more reliably assess harm reduction efforts and modify their quality improvement efforts in near real-time. The measure would also help to identify hospitals that have persistently high rates of PRF. The proposed measure concept will ensure that PRF events are tracked and that hospitals are incentivized to reduce the incidence of PRF. The eCQM would also be able to identify cases from an all-payer population, as it would not be dependent upon claims-based ICD-10-CM coded data.

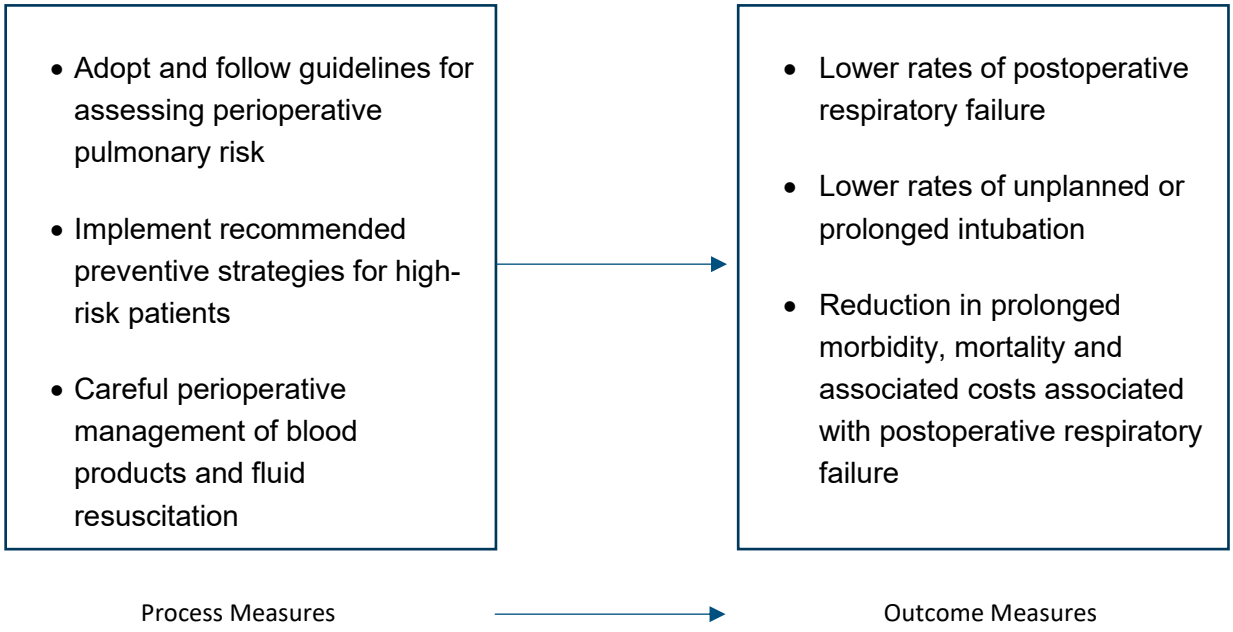
This eCQM is an adaptation of CMS' current claims-based Patient Safety Indicator (PSI 11), "Postoperative Respiratory Failure Rate." PSI 11 focused on the surgical patient population that does not have acute respiratory failure 'present on admission'. For improved face validity and better alignment with related quality measures, this eCQM also incorporates features of the manually abstracted measures "Unplanned Intubation" and "On Ventilator >48 Hours" of the American College of Surgeons' National Surgical Quality Improvement Program (and similar measures from the Society of Thoracic Surgeons' Adult Cardiac Surgery Registry).

4.1.1 This is a measure of:

☒ Outcome: *Hospital Harm – Postoperative Respiratory Failure*

4.1.2 Logic Model

Postoperative respiratory failure—usually defined as unplanned intubation or prolonged ventilation—is considered to be the most serious of the postoperative respiratory complications because it represents the "end stage" of several types of pulmonary complications (e.g., pneumonia, aspiration, pulmonary edema, ARDS) and it often results in prolonged morbidity, mortality, and associated costs. Healthcare facilities can decrease postoperative respiratory failure rates by adopting and following guidelines for assessing perioperative pulmonary risk and implementing recommended preventive strategies for high-risk patients. Careful management of blood products and fluid resuscitation in the perioperative setting may reduce the risk of postoperative respiratory failure due to adult respiratory distress syndrome (ARDS).



4.1.3 Value and Meaningfulness

Not applicable (this is not a patient-reported measure).

4.1.4 Empirical Data

(For outcome measures)

Association with process of care

Numerous studies have identified associations between specific intraoperative risk factors and postoperative respiratory failure.[1-5] Analyzing data on 50,367 patient admissions for common adult surgical procedures using an anesthesia information system between 2004 and 2009, Blum et al. identified intraoperative risk factors associated with respiratory failure among patients with similar preoperative risk: ventilator drive pressure (OR=1.17), fraction inspired oxygen (OR=1.02), erythrocyte transfusion (OR=5.36), and crystalloid administration in liters (OR=1.37).[1] The number of different anesthetics administered during the admission was associated with higher risk of ARDS (OR=1.37).[1]

Hughes et al. identified intraoperative risk factors for the postoperative development of ARDS among 89 patients admitted to the ICU with postoperative respiratory failure. In this study, patients who received more than 20mL/kg/h fluid resuscitation in the operating room had a higher chance of developing ARDS than those who received less than 10mL/kg/h (OR=3.8, p=0.04). Those who received between 10 and 20mL/kg/h had a non-significant odds ratio of 2.4 (p=0.14).[2]

In multivariable analysis of the National Surgical Quality Improvement Program (NSQIP) database of adult inpatients who underwent neurosurgery under general anesthesia

(2005-2010), Shalev and co-authors found that operative time exceeding 3 hours was associated with increased risk of reintubation (OR 2.9; 95%CI 1.8–4.8).[3]

In a retrospective time-matched cohort study, Attaallah et al. found that operative-specific risk factors including ASA status, elective case type, and surgical duration were significantly associated with postoperative respiratory failure.[4] A recent matched case-control study conducted across five academic medical centers (n=638) found greater intraoperative ventilator volume and pressure and 24-hour fluid balance to be potentially modifiable factors associated with postoperative respiratory failure (personal communication; manuscript under review). Two studies describe quality improvement interventions that resulted in decreased rates of acute respiratory failure.[6,7] In a one-year, prospective cohort intervention study involving 13,743 patients in a large academic medical center, Braddock et al. found that, adjusting for patient characteristics, implementation of a multifaceted, microsystem intervention utilizing in situ simulation training (TRANSFORM) was associated with a significantly decreased rate of ARF.[6] Multivariable logistic regression showed reduced odds of ARF following the intervention (OR 0.58, 95% CI 0.35 to 0.96). In a pre-post intervention study of 250 patients at an academic safety net hospital, Cassidy et al. found a trend towards fewer unplanned intubations following the I COUGH intervention, which emphasized incentive spirometry, coughing and deep breathing, oral care, patient and family education, head-of-bed elevation, and promoting mobilization.[7] The incidence of unplanned intubations declined from 2.0% to 1.2% in the intervention group (p = 0.09), but remained relatively stable at comparable NSQIP hospitals (1.4% to 1.6%). Risk-adjusted NSQIP data showed that unplanned intubations fell from an observed-to-expected (OE) ratio of 2.10 (95% CI 1.42 to 2.98) before I COUGH to an OE ratio of 1.31 (95% CI, 0.87 to 1.97) after the intervention; however, the authors did not report the statistical significance of this difference.

A systematic review of incentive spirometry after upper abdominal surgery found no evidence that this intervention is effective in preventing pulmonary complications, including acute respiratory inadequacy.[8] However, another systematic review by Lawrence et al evaluated all interventions to prevent postoperative pulmonary complications after non-cardiothoracic surgery. These authors identified good evidence suggesting that lung expansion therapy (for example, incentive spirometry, deep breathing exercises, and continuous positive airway pressure) reduces postoperative pulmonary risk after abdominal surgery and fair evidence suggesting that nasogastric tube decompression after abdominal surgery reduces risk. Fair evidence also suggests that short-acting neuromuscular blocking agents result in lower rates of residual neuromuscular blockade and may reduce risk for pulmonary complications.[9]

Association with hospital and health system characteristics

Several studies have examined the association between postoperative respiratory failure and hospital or health system characteristics. In a multivariable analysis of Nationwide Inpatient Sample (NIS) data from the Healthcare Cost and Utilization Project (HCUP), Rahman et al. found that postoperative respiratory failure was less likely in patients admitted to nonteaching hospitals than those admitted to teaching hospitals (OR 0.89, 95% CI 0.846 to 0.926).[10] The odds of developing postoperative respiratory failure increased by 6% for each

level increase in hospital size from small to large (OR 1.06, 95% CI 1.03 to 1.09). Using VA and NIS data from 2003 through 2004 (n=116 VA hospitals, n=992 community non-Federal hospitals), Rivard et al. reported lower risk-adjusted rates of postoperative respiratory failure in VA hospitals (3.86 per 1,000, 95% CI 2.83 to 4.88) than in the NIS (4.87 per 1,000, 95% CI 3.92 to 5.81).[11] Another study involving 4,581 staff surveys from 30 VA hospitals (2005-2006) by Rosen et al. found that there was no association between hospital safety climate (overall or for various climate dimensions) and individual hospital-level PSIs, including postoperative respiratory failure.[12]

Association with other outcomes

Several studies found that postoperative respiratory failure is associated with longer length of stay.[10,13-15] In a multivariable analysis of NIS data from 2002-2010, Rahman et al. found that length of stay was significantly longer for patients with postoperative respiratory failure (median 8.0 days) compared to those without respiratory failure (median 4.0 days, $p<0.0001$).[10] Using NSQIP data, Gajdos et al. found that failure to wean from ventilator and reintubation were associated with longer postsurgical length of stay in all age groups compared with participants not having these complications (median length of stay ≥19 days with complications; $p<0.001$).[14] In a smaller study (n=178), Marda et al. found that mean duration of intensive care unit (ICU) and hospital stay after surgery was significantly longer in patients who had postoperative pulmonary complications (PPCs), including respiratory failure, as compared to patients without PPCs (9.5 ± 14.8 days vs. 2.7 ± 1.8 days, [$p < 0.001$]; 22.6 ± 16.8 days vs. 7.6 ± 2.8 days [$p < 0.001$], respectively).[15]

Several studies also found that that postoperative respiratory failure is associated with higher 30-day readmission rates.[13,16,17] In three studies included in a recent literature review by Sabate et al., the estimated increased costs in U.S. dollars associated with postoperative respiratory failure ranged from $5,983 to $7,109 per procedure (for complications not requiring ventilation) to $118,841 to $120,579 (for complications requiring tracheostomy), in part due to more readmissions.[13] In a cross-sectional analysis of VA patient treatment files, including 1,807,488 index hospitalizations and 262,026 readmissions, Rosen et al. found that 30-day readmission rates after surgical hospitalizations with a PSI 11 event (17.8%) were significantly higher than after surgical hospitalizations without a PSI 11 event (9.9%) ($p<0.0001$),[17] with an adjusted odds ratio of 1.39 (95% CI 1.25 to 1.54). In a cohort study of NSQIP data from the American College of Surgeons (ACS) and Medicare inpatient claims (n =90,932), the rate of unplanned intubation within 30 days of an index procedure was significantly higher among patients with a 30-day readmission (4.1%) than among those without a 30-day readmission (1.8%, $p<0.001$).[16] Likewise, prolonged ventilation was more frequent among readmitted patients (4.4%) than among patients who were not readmitted (2.7%, $p<0.001$). Bath et al. used Medicare data (MedPAR) from 2009 to 2012 and found that the odds of 30-day readmission among patients undergoing abdominal aortic aneurysm repair were increased among patients with postoperative respiratory failure (OR=1.44, $p<0.0001$).[18]

Four different population-based studies have demonstrated that postoperative respiratory failure is independently associated with mortality. Based on NIS data of morbidly obese

patients who underwent bariatric surgery, Masoomi et al. found that patients who developed acute respiratory failure had significantly greater in-hospital mortality than those who did not develop this complication (5.69% versus 0.04%, p<0.01).[19] Based on an analysis of data from 165,600 senior patients undergoing non-emergent major general surgeries from the ACS NSQIP registry, Gajdos et al. found that reintubation had one of the highest failure-to-rescue rates among all postoperative complications (25.6%).[14] In multivariable analysis of 5,318 adults undergoing cardiothoracic surgery at a single institution, the risk of perioperative mortality was significantly increased among patients with a respiratory failure complication (OR 3.2, 95% CI 2.2 to 4.9).[20] Gray et al. retrospectively examined 57,000 inpatient discharges at six hospitals between July 2012 and June 2014 and found that hospitalizations with a PSI 11 event were associated with an additional 3.78 hospital days, compared to hospitalizations without a PSI 11 event (p<0.001), as well as a significantly increased risk of in-hospital mortality (OR=248.93; p<0.001).[21] One small study (n = 450) of patients from the ACS NSQIP database undergoing thoracoabdominal aortic aneurysm (TAAA) repair did not find such an association between reintubation and mortality.[22]

4.1.5 Systematic Review of the Evidence

(For intermediate outcome, process, or structure measures, including those that are instrument based)

Not applicable.

4.1.6 Other Sources of Evidence - as applicable

4.1.6.1 Briefly Synthesize the Evidence

Not applicable

4.1.6.2 Process Used to Identify the Evidence

Not applicable

4.1.6.3 Citations of the Evidence

Not applicable

4.2 Performance Gap and Opportunity for Improvement

4.2.1 Rationale

This eCQM identifies PRF events diagnosed and treated in the hospital. Rates of PRF can be considered an indicator of the quality of care provided by a hospital. In-hospital PRF is associated with poor clinical outcomes, including prolonged mechanical ventilation and length of hospital stay, readmission, need for rehabilitation or skilled nursing facility placement upon discharge, and mortality.[13-21]

PRF is the most common serious postoperative pulmonary complication.[1,4,5,9] An eCQM-based Hospital Harm PRF measure would enable hospitals to assess harm reduction efforts and

modify their quality improvement efforts in near real-time more reliably. The measure would also help to identify hospitals that have persistently high PRF rates. The proposed measure concept will ensure that PRF events are tracked and that hospitals are incentivized to reduce the incidence of PRF. The eCQM would also be able to identify cases from an all-payer population, as it would not be dependent upon claims-based ICD-10-CM coded data.

Adoption of this eCQM has the potential to improve the quality of care for surgical patients and, therefore, increase patient safety, which is a priority area identified by the National Quality Strategy.[18] Although this measure would be an adapted version of an existing measure for PRF (PSI 11), re-specification as an eCQM would fill a gap in measurement for the all-payer population. Additionally, with a systematic EHR-based patient safety measure in place, hospitals can more reliably assess harm reduction efforts and modify their efforts in near real-time. In this way, greater achievements in reducing postoperative respiratory failure and enhancing hospital performance on patient safety outcomes can be expected.

4.2.2 Performance Scores

TBD, this measure has not gone through the testing process.

4.2.3 Summary of Data Indicating Opportunity

In the United States, PRF—defined as unplanned endotracheal reintubation, prolonged dependence on mechanical ventilation, or inadequate oxygenation and/or ventilation—is the most common serious postoperative pulmonary complication, with an incidence 7.5% (the incidence of any postoperative pulmonary complication ranges from 10-40%).[1,4,5,9] Moreover, there are hospitals with persistently low and persistently high rates of PRF, suggesting that disparities in care exist between hospitals. One study found that PRF was less likely in patients admitted to nonteaching hospitals than those admitted to teaching hospitals (OR, 0.89 [95% CI, 0.846-0.926]).[14] This study additionally found that the odds of developing PRF increased by 6% for each level increase in hospital size from small to large.[14] This finding, and similar findings from analyses of CMS PSI 11 reported to the NQF, suggests that there remains room for improvement in hospitals with higher incidence of PRF.

4.2.4 Disparities

Reviews of the literature did not identify significant associations between PRF and demographic factors. As part of the 2020 Comprehensive Reevaluation for PSI 90 (of which PSI 11 is a component) to maintain National Quality Forum (NQF) endorsement, we conducted an analysis of postoperative respiratory failure rate disparities (see below).

Population-Based Disparity Factor	N (beneficiaries)	Observed Rate per 1,000	Adjusted Rate per 1,000
Race			
Unknown	19662	4.781	5.820
White	920041	5.507	5.198
Black	78549	8.453	6.046

Population-Based Disparity Factor	N (beneficiaries)	Observed Rate per 1,000	Adjusted Rate per 1,000
Other	11585	5.697	4.831
Asian	9340	5.782	4.749
Hispanic	14199	7.465	5.687
North American Native	6124	7.348	5.748
Gender			
Female	605665	5.006	5.197
Male	453835	6.751	5.386
Age			
<50	39287	7.865	5.757
50-54	27247	7.487	5.417
55-59	42943	7.778	5.431
60-64	55682	7.669	5.192
65-69	307397	4.447	5.242
70-74	262105	5.135	5.305
75-79	180021	5.916	5.212
80-84	95877	6.394	5.217
85-89	39029	8.840	5.424
90 plus	9912	8.676	4.986

4.2.5 Provide Summary of Data if No or Limited Data

Not applicable

5. Scientific Acceptability

5.1 Data Sample Description

Electronic clinical health record data

5.1.1 What Type of Data Were Used for Testing?

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.2 Identify the Specific Dataset

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.3 What Are the dates of the Data Used in Testing?

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.4 What Levels of Analysis Were Tested?

Hospital/facility/agency

5.1.5 How Many and Which Measured Entities Were Included in the Testing and Analysis?

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.6 How Many and Which Measured Patients Were Included in the Testing and Analysis?

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.7 Sample Differences – if applicable

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.1.8 What are the Social Risk Factors that were Available and Analyzed?

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.2 Reliability Testing (For Reference Only)

5.2.1 Level of Reliability Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.2.2 Method of Reliability Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.2.3 Statistical Results from Reliability Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.2.4 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.3 Validity Testing (For Reference Only)

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.3.1 Level of Validity Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.3.2 Method of Validity Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.3.3 Statistical Results from Validity Testing

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.3.4 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.4 Exclusion Analysis (For Reference Only)

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.4.1 Method of Testing Exclusions

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.4.2 Statistical Results from Testing Exclusions

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.4.3 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5 Risk Adjustment or Stratification (For Reference Only)

(For outcome or resource use measures)

Not Applicable.

5.5.1 Methods of Controlling for Differences

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.2 Rationale Why Risk Adjustment is Not Needed

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.3 Conceptual, Clinical, and Statistical Methods

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.4 Conceptual Model of Impact of Social Risks

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.5 Statistical Results

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.6 Analyses and Interpretation in Selection of Social Risk Factors

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.7 Methods Used to Develop the Statistical Model or Stratification Approach

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.8 Statistical Risk Model Discrimination Statistics

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.9 Statistical Risk Model Calibration Statistics

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.10 Statistical Risk Model Calibration – Risk decile plots or calibration curves

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.11 Results of Risk Stratification Analysis

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.12 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.5.13 Optional Additional Testing for Risk Adjustment

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.6 Identification of Meaningful Differences in Performance (For Reference Only)

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.6.1 Method

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.6.2 Statistical Results

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.6.3 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.7 Comparability of Multiple Data Sources/Methods (For Reference Only)

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.7.1 Method

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.7.2 Statistical Results

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.7.3 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.8 Missing Data Analysis and Minimizing Bias (For Reference Only)

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.8.1 Method

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.8.2 Missing Data Analysis

TBD. At this time, this measure is still being specified and has not gone through the testing process.

5.8.3 Interpretation

TBD. At this time, this measure is still being specified and has not gone through the testing process.

6. Feasibility

6.1 Data Elements Generated as Byproduct of Care Processes

Data elements are from the electronic health record. At this time, this measure is still being specified and has not gone through the testing and feasibility process.

6.2 Electronic Sources

Data elements are generated for the measure scores through the electronic health record during the provision of care. At this time, this measure is still being specified and has not gone through the testing and feasibility process.

6.2.1 Data Elements Electronic Availability

TBD. Once the measure is specified, a list of data elements will be provided.

6.2.2 Path to Electronic Capture

TBD

6.3.3 eCQM Feasibility

TBD. At this time, this measure is still being specified and has not gone through the testing and feasibility process.

6.3 Data Collection Strategy

TBD

6.3.1 Data Collection Strategy Difficulties (optional)

TBD

6.3.2 Fees, Licensing, Other Requirements

TBD

7. Useability and Use

7.1 Use

At this time, this measure is still being specified and has not gone through the testing and feasibility process.

7.1.1 Current and Planned Use

Public reporting – CMS Inpatient Quality Reporting (IQR) and Promoting Interoperability (PI) Programs, CMS Care Compare

- Purpose - TBD
- Geographic area - Nationwide
- Number and percentage of accountable entities and patients included - TBD
- Level of measurement – Facility
- Setting – Hospital

Quality improvement internal to a specific organization

- Purpose - TBD
- Geographic area - Nationwide
- Number and percentage of accountable entities and patients included - TBD
- Level of measurement – Facility
- Setting – Hospital

7.1.1.1 Reasons for Not Publicly Reporting or Use in Other Accountability Application

Not applicable

7.1.1.2 Plan for Implementation

TBD. At this time, this measure is still being specified and has not gone through the testing and feasibility process.

7.2.1 Feedback on the measure by those being measured or others

TBD

7.2.1.1 Technical Assistance Provided During Development or Implementation

TBD

7.2.1.2 Technical Assistance with Results

TBD

7.2.1.3 Feedback on Measure Performance and Implementation

TBD

7.2.1.4 Feedback from Providers being Measure

TBD

7.2.1.5 Feedback from Other Users

TBD

7.2.1.6 Consideration of Feedback

TBD

7.2 Usability

At this time, this measure is still being specified and has not gone through the testing and feasibility process.

7.2.1 Improvement

TBD

7.2.2 Unexpected Findings

TBD

7.2.2.1 Unexpected Benefits

TBD

8. Related and Competing Measures

8.1 Relation to Other NQF-Endorsed Measures

There is no existing NQF-endorsed PRF outcome measure for the entire surgical population. There is an existing NQF-endorsed PRF outcome measure that is specific to patients undergoing isolated Coronary Artery Bypass Graft (CABG) cardiac surgery – "Risk-Adjusted Postoperative Prolonged Intubation (Ventilation)" (NQF #0129). This measure was developed by the Society of Thoracic Surgeons and was first endorsed in 2007. NQF #0129 uses registry data to identify CABG patients who require intubation for over 24 hours following exit from the operating room. Since this measure is limited to patients undergoing isolated CABG surgery, the proposed measure provides the opportunity to assess the rate of PRF in a much larger patient population.

AHRQ's Patient Safety Indicator 11 (NQF 0533), "Postoperative Respiratory Failure Rate," was initially endorsed by NQF in 2009, and endorsement was renewed in 2015. However, AHRQ opted not to pursue maintenance of endorsement for NQF 0533 in 2020, as CMS incorporated PSI 11 into PSI 90, "Patient Safety and Adverse Events Composite," and NQF re-endorsed PSI 90 in 2021.

The proposed measure, which is a specification of AHRQ PSI 11 as an eCQM (and an adaptation of the existing NSQIP measure) would be the only currently NQF-endorsed eCQM outcome measure of postoperative respiratory failure.

8.2 Harmonization

The proposed eCQM focuses on a slightly different population than the existing AHRQ PSI 11. The dimensions of harmonization can include numerator, denominator, exclusions, calculation, and data source and collection instructions.
The paragraphs below include specific information pertaining to the claims-based measure PSI 11.

- **Numerator –** The numerator for PSI 11 includes postoperative respiratory failure as a secondary diagnosis, prolonged mechanical ventilation, or reintubation cases. The numerator for the proposed eCQM includes elective inpatient hospitalizations for patients with postoperative respiratory failure (PRF), defined as (1) intubation that occurs any time within 30 days after the conclusion of the first operation, or (2) cumulative time of mechanical ventilation (i.e., invasive positive pressure ventilation) exceeding 48 hours within 30 days after the conclusion of the first OR procedure.
- **Denominator** – The denominator for PSI 11 includes elective surgical discharges for patients ages 18 and older with any listed ICD-10-PCS procedure codes for an operating room procedure. Elective surgical discharges are defined by specific MS-DRG codes with admission type recorded as elective.
- **Exclusions** – PSI 11 excludes: (1) Cases with any listed ICD-10-CM diagnosis code present on admission for tracheostomy, (2) Cases in which the only operating room procedure is tracheostomy, (3) Cases in which a procedure for tracheostomy occurs before the first operating room procedure, (4) Cases with any listed ICD-10-CM diagnosis codes for malignant hyperthermia, (5) Cases with any listed ICD-10-CM diagnosis codes for neuromuscular disorder, (6) Cases with any listed ICD-10-PCS procedure codes for laryngeal or pharyngeal nose, mouth, pharynx, or facial surgery, (7) Cases with any listed ICD-10-PCS procedure codes for esophageal resection, (8) Cases with any listed ICD-10-PCS procedure codes for lung cancer surgery, (9) Cases with any listed ICD-10-PCS procedure codes for degenerative neurological disorder, (10) Cases with any listed ICD-10-PCS procedure codes for lung transplant, (11) Cases with MDC 4 (diseases/disorders of the respiratory system), (13) Cases with MDC 14 (pregnancy, childbirth, puerperium), (14) Cases with an ungroupable DRG (DRG=999), and (15) Cases with missing gender, age, quarter, year, or principal diagnosis.

  The proposed eCQM excludes cases: (1) In which the patient has already received mechanical ventilation for more than one hour prior to the start of the first OR

procedure, (2) With arterial blood gas with arterial partial pressure of oxygen (P_aO_2)<50 mmHg during the 72 hours prior to the start of the first OR procedure, (3) With arterial partial pressure of carbon dioxide (P_aCO_2)>50 mmHg combined with an arterial pH<7.30 during the 72 hours prior to the start of the first OR procedure, (4) With a principal ICD-10-CM diagnosis code (or secondary diagnosis present on admission) for acute respiratory failure, (5) With any listed ICD-10-CM diagnosis code present on admission for tracheostomy, (6) Where the only procedure is tracheostomy, (7) Where a procedure for tracheostomy occurs before the first operating room procedure, (8) With any listed ICD-10-CM diagnosis code for neuromuscular disorder or degenerative neurological disorder, and (9) With any listed ICD-10-PCS procedure code for laryngeal or pharyngeal, nose, mouth, pharynx or facial surgery involving significant risk of airway compromise.

- **Calculation** – PSI 11 is calculated directly using claims data from hospital records. The proposed measure is an eCQM and the calculation is still under development.
- **Data Source and Collection** – PSI 11 uses claims to identify PRF events, which differs from the proposed measure which will be an eCQM. The PSI 11 measure is only able to be calculated using Medicare claims data, while this Hospital Harm – Postoperative Respiratory Failure measure provides the opportunity to assess the rate of PRF in a much larger, all-payer patient population.
- **Population Differences** – The target population for PSI 11 includes adult (over 18 years of age) elective surgical patients, while the target population for the proposed measure includes elective adult inpatient hospitalizations for which the patient is 18 years of age or older at the start of the encounter, and at least one surgical procedure was performed within the first 3 days of the encounter.

8.3 Competing Measures

There are no competing measures for this new eCQM.

9. Appendix

Other Additional Information

Ad.1. Working Group/Expert Panel Involved in Measure Development
List the working group/panel members' names and organizations
Describe the members' role in measure development

Measure Developer/Steward Updates and Ongoing Maintenance

Ad.2. Year the Measure Was First Released
Ad.3. Month and Year of Most Recent Revision
Ad.4. What is your frequency for review/update of this measure?
Ad.5. When is your next scheduled review/update for this measure?
Ad.6. Copyright Statement

Ad.7. Disclaimers
Ad.8. Additional Information/Comments

References:

1. Arozullah AM, Daley J, Henderson WG, Khuri SF. Multifactorial risk index for predicting postoperative respiratory failure in men after major noncardiac surgery. The National Veterans Administration Surgical Quality Improvement Program. *Annals of surgery.* 2000;232(2):242-253.
2. Blum JM, Stentz MJ, Dechert R, et al. Preoperative and intraoperative predictors of postoperative acute respiratory distress syndrome in a general surgical population. *Anesthesiology.* 2013;118(1):19-29.
3. Brueckmann B, Villa-Uribe JL, Bateman BT, et al. Development and validation of a score for prediction of postoperative respiratory complications. *Anesthesiology.* 2013;118(6):1276-1285.
4. Canet J, Sabaté S, Mazo V, et al. Development and validation of a score to predict postoperative respiratory failure in a multicentre European cohort: A prospective, observational study. *Eur J Anaesthesiol.* 2015;32(7):458-470.
5. Gupta H, Gupta PK, Fang X, et al. Development and validation of a risk calculator predicting postoperative respiratory failure. *Chest.* 2011;140(5):1207-1215.
6. Hua M, Brady JE, Li G. A scoring system to predict unplanned intubation in patients having undergone major surgical procedures. *Anesthesia and analgesia.* 2012;115(1):88-94.
7. Johnson AP, Altmark RE, Weinstein MS, Pitt HA, Yeo CJ, Cowan SW. Predicting the Risk of Postoperative Respiratory Failure in Elective Abdominal and Vascular Operations Using the National Surgical Quality Improvement Program (NSQIP) Participant Use Data File. *Annals of surgery.* 2017;266(6).
8. Johnson RG, Arozullah AM, Neumayer L, Henderson WG, Hosokawa P, Khuri SF. Multivariable predictors of postoperative respiratory failure after general and vascular surgery: results from the patient safety in surgery study. *J Am Coll Surg.* 2007;204(6):1188-1198.
9. Kor DJ, Lingineni RK, Gajic O, et al. Predicting risk of postoperative lung injury in high-risk surgical patients: a multicenter cohort study. *Anesthesiology.* 2014;120(5):1168-1181.
10. Kor DJ, Warner DO, Alsara A, et al. Derivation and diagnostic accuracy of the surgical lung injury prediction model. *Anesthesiology.* 2011;115(1):117-128.
11. Ramachandran SK, Nafiu OO, Ghaferi A, Tremper KK, Shanks A, Kheterpal S. Independent predictors and outcomes of unanticipated early postoperative tracheal intubation after nonemergent, noncardiac surgery. *Anesthesiology.* 2011;115(1):44-53.
12. Canet J, Gallart L. Postoperative respiratory failure: Pathogenesis, prediction, and prevention. *Current Opinion in Critical Care.* 2014;20(1):56-62.
13. Thompson SL, Lisco SJ. Postoperative Respiratory Failure. *Int Anesthesiol Clin.* 2018;56(1):147-164.

14. Rahman M, Neal D, Fargen KM, Hoh BL. Establishing standard performance measures for adult brain tumor patients: a Nationwide Inpatient Sample database study. *Neuro Oncol.* 2013;15(11):1580-1588.
15. Gajdos C, Kile D, Hawn MT, Finlayson E, Henderson WG, Robinson TN. Advancing age and 30-day adverse outcomes after nonemergent general surgeries. *Journal of the American Geriatrics Society.* 2013;61(9):1608-1614.
16. Marda M, Pandia MP, Rath GP, Bithal PK, Dash HH. Post-operative pulmonary complications in patients undergoing transoral odontoidectomy and posterior fixation for craniovertebral junction anomalies. *Journal of anaesthesiology, clinical pharmacology.* 2013;29(2):200-204.
17. Lawson EH, Hall BL, Louie R, et al. Association between occurrence of a postoperative complication and readmission: implications for quality improvement and cost savings. *Annals of surgery.* 2013;258(1):10-18.
18. Rosen AK, Loveland S, Shin M, et al. Examining the impact of the AHRQ Patient Safety Indicators (PSIs) on the Veterans Health Administration: the case of readmissions. *Med Care.* 2013;51(1):37-44.
19. Sabate S, Mazo V, Canet J. Predicting postoperative pulmonary complications: implications for outcomes and costs. *Case reports in anesthesiology.* 2014;27(2):201-209.
20. Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. *Jama.* 2003;290(14):1868-1874.
21. Encinosa WE, Hellinger FJ. The impact of medical errors on ninety-day costs and outcomes: an examination of surgical patients. *Health Serv Res.* 2008;43(6):2067-2085.