



Measure Information

This document contains the information submitted by measure developers/stewards, but is organized according to NQF's measure evaluation criteria and process. The item numbers refer to those in the submission form but may be in a slightly different order here. In general, the item numbers also reference the related criteria (e.g., item 1b.1 relates to sub criterion 1b).

Brief Measure Information

NQF #: 2414

Corresponding Measures:

Measure Title: Pediatric Lower Respiratory Infection Readmission Measure

Measure Steward: Center of Excellence for Pediatric Quality Measurement

sp.02. Brief Description of Measure: This measure calculates case-mix-adjusted readmission rates, defined as the percentage of admissions followed by 1 or more readmissions within 30 days, following hospitalization for lower respiratory infection (LRI) in patients less than 18 years old. The measure covers patients discharged from general acute care hospitals, including children's hospitals.

1b.01. Developer Rationale:

Readmissions have become a major focus for improving the quality of health systems. Hospitals, payers, states, and the federal government are seeking to improve the quality of care by measuring and reducing readmissions.

In many cases, readmissions signal how well disease is managed, indicating a worsening of health status that may have been prevented, and can reflect the quality of key processes, including discharge planning and education, care transitions, and follow-up care. The number of children who experience readmissions is substantial, and readmission rates for some conditions are high. Disparities in pediatric readmission exist based on race/ethnicity, socioeconomic status, and special health care needs. Readmission rates vary among hospitals, and effective interventions to reduce readmissions have suggested potential for improvement.

Our candidate measure fills gaps in pediatric quality measurement. It addresses the current dearth of measures that assess inpatient care. It also meets the need for readmission measures developed for use in children. Our measure estimates readmission rates following hospitalization for LRIs, which are among the most common reasons for hospitalization in children and account for a large number of readmissions. It focuses on patients less than 18 years old, thus complementing adult readmission measures, including the CMS all-cause and condition-specific measures and the NCQA all-cause measure. It uses a case-mix adjustment model specifically developed for pediatric patients, allowing for comparisons among health systems whose patient populations differ in their demographic characteristics or chronic condition status.

An inherent limitation of readmission rates is that they do not indicate which factors most influence readmissions for a given population and are thus most important to address. Gaining these insights requires looking further to identify patterns in why patients were readmitted and which contributing factors could be modified to prevent future readmissions. Measuring readmission rates, however, is an essential first step to gauge the magnitude of the problem and to motivate investigations to understand the causes of readmission, including those that health systems can remedy.

sp.12. Numerator Statement:

The numerator consists of hospitalizations at general acute care hospitals for LRI in patients less than 18 years old that are followed by 1 or more readmissions to general acute care hospitals within 30 days. Readmissions are excluded from the numerator if the readmission was for a planned procedure or for chemotherapy.

The measure outcome is a readmission rate, defined as the percentage of index admissions with 1 or more readmissions within 30 days. The readmission rate, unadjusted for case-mix, is calculated as follows:

number of index admissions with 1 or more readmissions within 30 days/
total number of index admissions

sp.14. Denominator Statement: Hospitalizations at general acute care hospitals for LRI in patients less than 18 years old.

sp.16. Denominator Exclusions: EXCLUSIONS FROM THE NUMERATOR (READMISSIONS) AND DENOMINATOR (INDEX HOSPITALIZATIONS)

We exclude certain hospitalizations from the measure entirely (i.e., from the numerator and denominator) based on clinical criteria or for issues of data completeness or quality that could prevent assessment of eligibility for the measure cohort or compromise the accuracy of readmission rates. Hospitalizations are excluded from the measure if they meet any of the following criteria:

1. The hospitalization was at a specialty or non-acute care hospital.

Rationale: The focus of the measure is admissions to hospitals that provide general pediatric acute care. Records for admissions to specialty and non-acute-care hospitals are therefore omitted from the dataset. Because hospital type cannot be determined for records with missing data in the hospital type variable, these records are also removed from the dataset.

2. Records for the hospitalization contain incomplete data for variables needed to assess eligibility for the measure or calculate readmission rates, including hospital type, patient identifier, admission date, discharge date, disposition status, date of birth, primary ICD-9 or principal ICD-10 diagnosis codes, and gender.

Rationale: Complete and valid information for the variables listed above is needed to define the measure cohort and calculate case-mix-adjusted readmission rates. Identifying readmissions within 30 days requires information on dates of admission and end-of-service dates and the ability to link unique patient identifiers across inpatient claims records. Hospital identifiers are needed to determine the hospital at which index admissions occurred. The disposition status is needed to determine whether a patient was discharged or experienced some other outcome (e.g., was transferred to another acute care hospital, left against medical advice, died). Establishing a patient's eligibility for membership in the pediatric cohort and performing case-mix adjustment requires an accurate date of birth and end-of-service date. Because gender is 1 of the variables used for case-mix adjustment, episodes of care with missing or inconsistent gender cannot be evaluated in the measure.

3. Records for the hospitalization contain data of questionable quality for calculating readmission rates, including
 - a. Inconsistent date of birth across records for a patient.
 - b. Discharge date prior to admission date.
 - c. Admission or discharge date prior to date of birth.
 - d. Admission date after a disposition status of death during a prior hospitalization.

Rationale: Complete and valid information for the variables listed above is needed to define the measure cohort and calculate case-mix-adjusted readmission rates. Identifying readmissions within 30 days requires information on dates of admission and end-of-service. A valid disposition status is needed to determine whether a patient was discharged or experienced some other outcome (e.g., was transferred to another acute care hospital, left against medical advice, died). Establishing a patient's eligibility for membership in the pediatric cohort and performing case-mix adjustment requires an accurate date of birth and end-of-service date.

4. Codes other than ICD-9 or ICD-10 codes are used for the primary procedure.

Rationale: ICD-9 or ICD-10 procedure codes are necessary for applying clinical exclusions.

5. The patient was older than 18 years, 29 days at the time of admission.

Rationale: This age exclusion limits the population to pediatric patients and prevents inclusion of records that overlap with adult readmission measures. Age eligibility for inclusion in the measure is based on age at the time of discharge from the index admission. Because the focus of the measure is pediatric patients, a patient's hospitalization is ineligible for inclusion in the measure as an index admission if the patient was 18 years old or greater at the time of discharge. Because the subsequent observation period for readmissions is 30 days, a patient's hospitalization is ineligible for inclusion in the measure as a readmission if the patient was older than 18 years, 29 days at the start of the readmission.

6. The hospitalization was for obstetric care, including labor and delivery.

Rationale: Hospitalizations for obstetric conditions are excluded because care related to pregnancy does not generally fall within the purview of pediatric providers.

7. The primary ICD-9 or principal ICD-10 diagnosis code was for a mental health condition.

Rationale: Hospitalizations for mental health conditions are excluded because we found that hospitals with high readmission rates for mental health hospitalizations tend to have low readmission rates for hospitalizations for other conditions, and vice versa. We describe this analysis in detail in Section 2b.3 of the Measure Testing Submission Form.

8. The hospitalization was for birth of a healthy newborn.

Rationale: Hospitalizations for birth of healthy newborns are excluded because these hospitalizations, unlike all others, are not for evaluation and management of disease.

EXCLUSIONS FROM THE DENOMINATOR ONLY (INDEX HOSPITALIZATIONS ONLY)

We also apply further exclusions to the denominator only (i.e., these hospitalizations are excluded from index hospitalizations but could still meet criteria for readmissions). Hospitalizations are excluded from the denominator only if they meet any of the following criteria:

9. The patient was 18 years old or greater at the time of discharge.

Rationale: Age eligibility for inclusion in the measure is based on age at the time of discharge from the index admission. Because the measure covers pediatric patients, a patient's hospitalization is ineligible for inclusion in the measure as an index admission if the patient was 18 years old or greater at the time of discharge.

10. The discharge disposition was death.

Rationale: A patient must be discharged alive from an index admission in order to be readmitted. Therefore, any record with a discharge disposition of death cannot serve as an index admission.

11. The discharge disposition was leaving the hospital against medical advice.

Rationale: A discharge disposition of leaving against medical advice indicates that a patient left care before the hospital determined that the patient was ready to leave.

12. The hospital has less than 80% of records with complete patient identifier, admission date, and discharge date or less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis codes. (Records for these hospitals are still assessed as possible readmissions, but readmission rates are not calculated for these hospitals due to their lack of complete data.)

Rationale: Readmission rates are not calculated for hospitals missing large amounts of data for the above variables because these hospitals have limited data to accurately apply measure cohort exclusions and calculate case-mix-adjusted readmission rates. Assessing eligibility for the measure cohort and performing case-mix adjustment requires information on admission dates, end-of-service dates, and diagnosis codes. Identifying readmissions requires information on admission dates and end-of-service dates and the ability to link unique patient identifiers

across inpatient claims records.

13. The hospital is in a state not being analyzed.

Rationale: A claims database used for readmission analysis may contain records for hospitals located in states that are not included in the database (because covered patients may sometimes be admitted to out-of-state hospitals). Records for these out-of-state hospital admissions are not excluded from the measure dataset because these records may meet criteria for being counted as readmissions as part of an in-state hospital's readmission rate. However, readmission rates are not calculated for out-of-state hospitals due to the lack of complete data for these hospitals.

14. Thirty days of follow-up data are not available for assessing readmissions.

Rationale: Identifying readmissions within 30 days requires a full 30 days of follow-up data.

15. The hospitalization does not have a primary ICD-9 or principal ICD-10 LRI diagnosis or does not have a secondary ICD-9 or additional ICD-10 LRI diagnosis plus a primary ICD-9 or principal ICD-10 diagnosis of asthma, respiratory failure, or sepsis/bacteremia.

Rationale: This measure focuses on readmissions following hospitalization for LRI. Episodes of care that do not meet the case definition for an LRI hospitalization are therefore excluded from index admissions.

Measure Type: Outcome

sp.28. Data Source:

Claims

sp.07. Level of Analysis:

Facility

IF Endorsement Maintenance – Original Endorsement Date: 2014-12-23 01:02 PM

Most Recent Endorsement Date: 12/9/2016 4:04:25 PM

IF this measure is included in a composite, NQF Composite#/title:

IF this measure is paired/grouped, NQF#/title:

sp.03. IF PAIRED/GROUPED, what is the reason this measure must be reported with other measures to appropriately interpret results?:

1. Importance to Measure and Report

Extent to which the specific measure focus is evidence-based, important to making significant gains in healthcare quality, and improving health outcomes for a specific high-priority (high-impact) aspect of healthcare where there is variation in or overall less-than-optimal performance. Measures must be judged to meet all sub criteria to pass this criterion and be evaluated against the remaining criteria

1ma.01. Indicate whether there is new evidence about the measure since the most recent maintenance evaluation. If yes, please briefly summarize the new evidence, and ensure you have updated entries in the Evidence section as needed.

[Response Begins]

Yes

[Yes Please Explain]

Please see 1a.02 and 1b.04 for the new evidence.

[Response Ends]

Please separate added or updated information from the most recent measure evaluation within each question response in the Importance to Measure and Report: Evidence section. For example:

Current Submission:

Updated evidence information here.

Previous (Year) Submission:

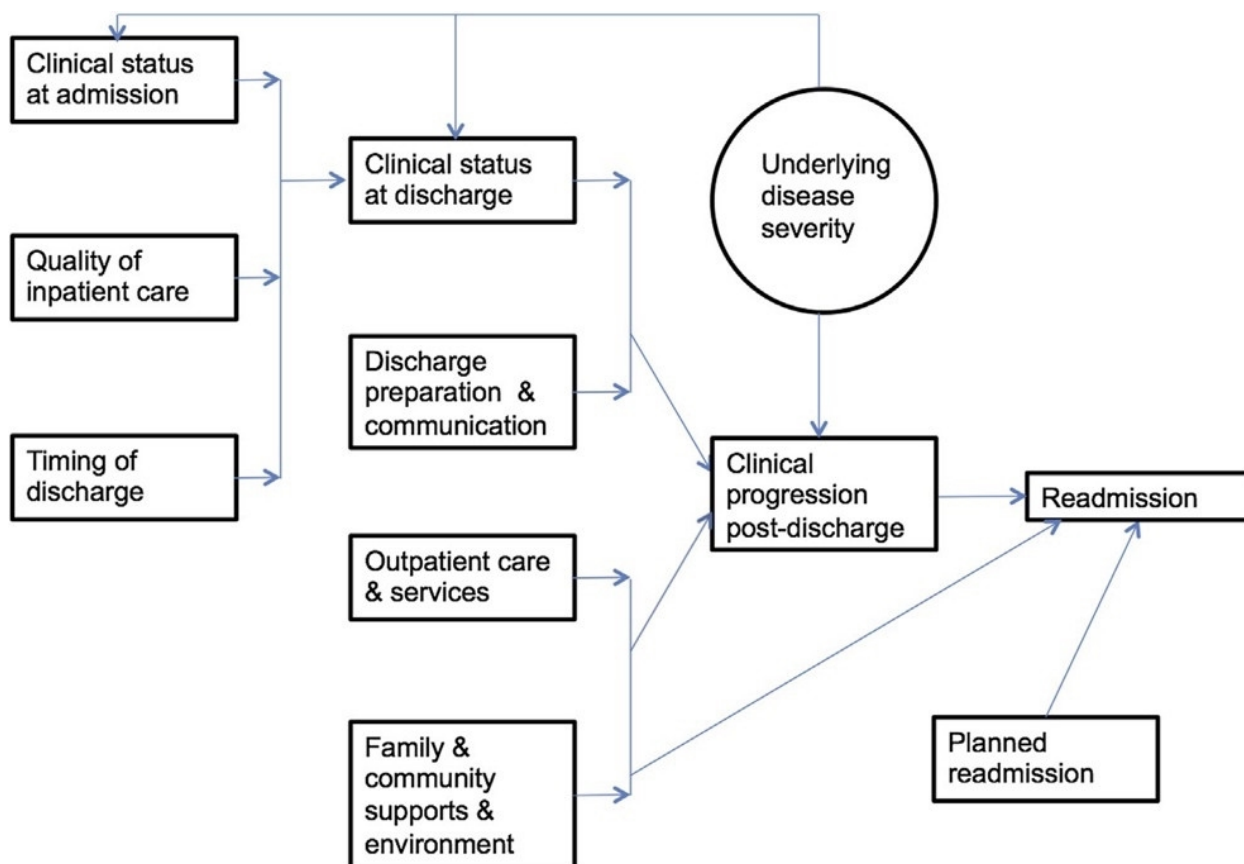
Evidence from the previous submission here.

1a.01. Provide a logic model.

Briefly describe the steps between the healthcare structures and processes (e.g., interventions, or services) and the patient's health outcome(s). The relationships in the diagram should be easily understood by general, non-technical audiences. Indicate the structure, process or outcome being measured.

[Response Begins]

Logic Model¹



In many cases, readmissions signal how well disease is managed, indicating a worsening of health status that may have been prevented, and can reflect the quality of key processes, including discharge planning and education, care transitions, and follow-up care.

REFERENCES

1. Nakamura MM, Toomey SL, Zaslavsky AM, et al. Measuring pediatric hospital readmission rates to drive quality improvement. *Acad Pediatr.* 2014;14(5 Suppl):S39-S46. doi:10.1016/j.acap.2014.06.012 @ @ @

[Response Ends]

1a.02. Provide evidence that the target population values the measured outcome, process, or structure and finds it meaningful.

Describe how and from whom input was obtained.

[Response Begins]

Previous (2015) Submission:

Hospitalization of a child is disruptive to families. It can affect parent/caregiver work and sibling school or daycare arrangements and expose families to various psychosocial stressors.^{1,2} In addition, readmission exposes patients to additional hospital days and thus increased potential for infections and medical errors that can occur during hospitalization.^{3,4}

Frequent hospitalization may have negative developmental effects, including anxiety and feelings of isolation, particularly for children who are chronically ill and return to school after prolonged hospitalizations.⁵ Frequently hospitalized adolescents are more likely to drop out of school than their healthy peers.^{6,7} School reintegration can

be complicated by side effects caused by treatment or the illness itself or by increased social, emotional, and behavioral problems.⁸

Current Submission:

New evidence affirms that hospitalizations, including readmissions, impact the psychological well-being of patient families.^{9,10} Furthermore, children frequently miss school, and their parents may miss work, for multiple weeks after hospital discharge.¹¹ School absenteeism may lower educational achievement, cause economic strain, and lead to poor health in adulthood.

REFERENCES

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[Response Ends]

1a.03. Provide empirical data demonstrating the relationship between the outcome (or PRO) and at least one healthcare structure, process, intervention, or service.

[Response Begins]

Evidence suggests that readmission rates provide a useful measure of health care quality. Use of effective, evidence-based approaches to diagnosis, treatment, and monitoring of disease leads to fewer complications and decreased exacerbations, which can, in turn, result in a decreased frequency of hospitalizations. Readmission rates therefore in part reflect the quality of clinical care and resulting disease outcomes.

Studies have shown that hospitals that provide care in accordance with clinical practice guidelines have lower readmission rates than those that do not.^{1–3} Several retrospective cohort analyses and case-control studies and a

prospective pre-post observational study have demonstrated that adherence to evidence-based processes of care results in improved clinical outcomes.^{1,2,4-7} For example, improved adherence to the Joint Commission's recommended 3 Children's Asthma Care (CAC 1-3) measures was associated with improved chronic asthma symptoms and fewer exacerbations, as well as longer periods out of the hospital with fewer readmissions.⁵ Similarly, lower quality of inpatient care is associated with a higher risk of unplanned readmission.⁴

Readmission rates also reflect the quality of key health care processes. Several studies, largely in adults, have demonstrated that interventions focused on improving the quality of the discharge process, the transition from the hospital to ambulatory or long-term care, and the provision of timely follow-up care have been associated with reduced hospital readmission rates, suggesting that the quality of these processes is associated with readmission risk.⁸⁻²⁷ For example, hospitals that provide patient-focused, individualized pre-discharge education as well as post-discharge support have fewer readmissions than those that do not provide such services.^{9-11,13-21,24,27}

Project RED and the Care Transition Measure are 2 examples of initiatives that have improved the quality of discharge and care transition processes for adult patients by incorporating such interventions as a transition coach who provides assistance with medication self-management, makes home visits and telephone calls to patients after discharge, and sets up timely follow-up appointments with primary or specialty care providers. Such interventions that emphasize the importance of teaching patients about their diagnoses and reviewing their treatment and discharge plan with them throughout their hospital stay are associated with a subsequent reduction in 30-day readmission rates.^{15,28}

Few studies have investigated the relationship between pediatric readmission rates and care coordination, discharge planning, and care transition, but given the equal importance of these processes for pediatric patients, improvements in these processes would likewise be expected to improve pediatric readmission rates. Indeed, parental perception that a child is not healthy enough for discharge is associated with a greater risk of subsequent, unplanned 30-day readmission.²⁹ Responding to parental concerns about a child's health prior to hospital discharge may help mitigate readmission risk. In another study of both pediatric and adult patients with sickle cell disease, patients who had post-discharge follow-up within 30 days of hospital discharge were readmitted less often than those who did not have post-discharge follow-up.²⁴

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[Response Ends]

1b.01. Briefly explain the rationale for this measure.

Explain how the measure will improve the quality of care, and list the benefits or improvements in quality envisioned by use of this measure.

[Response Begins]

Readmissions have become a major focus for improving the quality of health systems. Hospitals, payers, states, and the federal government are seeking to improve the quality of care by measuring and reducing readmissions.

In many cases, readmissions signal how well disease is managed, indicating a worsening of health status that may have been prevented, and can reflect the quality of key processes, including discharge planning and education, care transitions, and follow-up care. The number of children who experience readmissions is substantial, and readmission rates for some conditions are high. Disparities in pediatric readmission exist based on race/ethnicity, socioeconomic status, and special health care needs. Readmission rates vary among hospitals, and effective interventions to reduce readmissions have suggested potential for improvement.

Our candidate measure fills gaps in pediatric quality measurement. It addresses the current dearth of measures that assess inpatient care. It also meets the need for readmission measures developed for use in children. Our measure estimates readmission rates following hospitalization for LRIs, which are among the most common reasons for hospitalization in children and account for a large number of readmissions. It focuses on patients less than 18 years old, thus complementing adult readmission measures, including the CMS all-cause and condition-specific measures and the NCQA all-cause measure. It uses a case-mix adjustment model specifically developed for pediatric patients, allowing for comparisons among health systems whose patient populations differ in their demographic characteristics or chronic condition status.

An inherent limitation of readmission rates is that they do not indicate which factors most influence readmissions for a given population and are thus most important to address. Gaining these insights requires looking further to identify patterns in why patients were readmitted and which contributing factors could be modified to prevent future readmissions. Measuring readmission rates, however, is an essential first step to gauge the magnitude of the problem and to motivate investigations to understand the causes of readmission, including those that health systems can remedy.

[Response Ends]

1b.02. Provide performance scores on the measure as specified (current and over time) at the specified level of analysis.

Include mean, std dev, min, max, interquartile range, and scores by decile. Describe the data source including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities include. This information also will be used to address the sub-criterion on improvement (4b) under Usability and Use.

[Response Begins]

Table 1 contains performance scores from 2008 Medicaid Analytic eXtract (MAX) data. MAX cohort hospital and patient characteristics are provided in response to questions 2a.05 and 2a.06. The MAX dataset includes 176 hospital referral regions, 2,111 hospitals, and 395,754 patients with discharge dates from December 1, 2007 to December 31, 2008.

Table 1 - 2008 MAX LRI Readmission Rates (RR) among Hospital Referral Regions

*	Adjusted Readmission Rate
Mean	0.053
Std Dev	0.009
Min	0.038
Max	0.105
IQR	0.009
D1	0.045
D2	0.047
D3	0.049
D4	0.050
D5	0.052
D6	0.053
D7	0.055
D8	0.059
D9	0.065

This table displays performance scores from 2008 MAX data on readmission rates, including the mean, standard deviation, minimum, maximum, IQR, and deciles.

*Cell intentionally left empty.

[Response Ends]

1b.03. If no or limited performance data on the measure as specified is reported above, then provide a summary of data from the literature that indicates opportunity for improvement or overall less than optimal performance on the specific focus of measurement. Include citations.

[Response Begins]

READMISSIONS: A QUALITY GAP

Readmissions disrupt the lives of patients and families, expose patients to risks of harm during hospitalization, and are costly. The number of children who experience readmissions is substantial. Overall, readmissions within 30 days occur for 2% to 6% of pediatric hospitalizations.¹⁻⁴ Thirty-day readmissions occur for 3.7% to 4.5% of pediatric bronchiolitis hospitalizations and 4.5% of pediatric pneumonia hospitalizations.^{1,5} Because LRIs are such a common reason for hospitalization, the absolute number of readmissions following LRI hospitalizations is high.

In many cases, readmissions signal the quality of disease management, indicating a worsening of health status that may have been prevented. They also can reflect the quality of key processes, including discharge planning and education, care transitions, and follow-up care.

Disparities in pediatric readmission rates exist based on race/ethnicity, socioeconomic status, and special health care needs. For example, children with pre-existing neurologic conditions are more likely to develop influenza complications and are at a higher risk for readmission following hospitalization for influenza.⁶

POTENTIAL FOR LRI QUALITY IMPROVEMENT

Studies have shown hospital-level variation in pediatric readmission rates for LRI, suggesting there is potential for improvement in the quality of LRI care. One study found significant variation among children's hospitals in 3-day pediatric bronchiolitis readmission rates, which ranged from 0% to 2.7% ($p < .001$).⁷ Another study of children's hospitals found significant variation in risk-adjusted 30-day readmission rates for admission diagnoses of bronchiolitis and pneumonia.¹

Effective interventions to reduce LRI readmissions have been demonstrated.⁸⁻¹⁰ For bronchiolitis, for example, implementation of a clinical pathway with management and discharge criteria significantly reduced 14-day readmission rates.⁸ For pneumonia, improvements during hospitalization in use of recommended antibiotics, communication of discharge information to patients, and use of electronic medical records have reduced readmission rates.¹¹⁻¹²

Unplanned readmissions following hospitalization for LRI care are commonly for complications of the original disease. Interventions aimed at preventing these complications when possible, or better managing them when they occur, could potentially reduce readmissions. The most common complications for bronchiolitis are asthma and other chronic respiratory problems.¹³⁻¹⁴ Neurologic conditions are increasingly frequent complications of influenza.^{6,15-16} Local complications of pneumonia, such as empyema, lung abscess, and necrotizing pneumonia, are becoming more prevalent, particularly in younger children.¹⁶⁻¹⁷

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[Response Ends]

1b.04. Provide disparities data from the measure as specified (current and over time) by population group, e.g., by race/ethnicity, gender, age, insurance status, socioeconomic status, and/or disability.

Describe the data source including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included. Include mean, std dev, min, max, interquartile range, and scores by decile. For measures that show high levels of performance, i.e., “topped out”, disparities data may demonstrate an opportunity for improvement/gap in care for certain sub-populations. This information also will be used to address the sub-criterion on improvement (4b) under Usability and Use.

[Response Begins]

Prior (2015) Submission:

We evaluated disparities using 2008 MAX data for 26 states, which include Medicaid claims from 67,191 index hospitalizations at 1,743 children’s and non-children’s hospitals. We also used 2005-2009 AHRQ Revisit data for New York and Nebraska, which include claims for all payers from 87,877 index hospitalizations at 241 children’s and non-children’s hospitals, to evaluate disparities in readmission risk associated with race/ethnicity and insurance status. We chose which states’ data to use based on assessment of data quality and completeness. Both datasets can be used to evaluate readmissions back to the same hospital or to different hospitals.

DISPARITIES ASSOCIATED WITH RACE/ETHNICITY

We assessed disparities in readmission risk associated with race/ethnicity using both 2005-2009 AHRQ Revisit data for New York (all-payer) and the MAX dataset (Medicaid only). AHRQ Revisit data for Nebraska do not include a race/ethnicity variable and so could not be used in the analysis.

Race/ethnicity is recorded in AHRQ Revisit data using the categories Asian or Pacific Islander, Black, Hispanic, Native American, Other, or White. For our analysis, we combined the Asian or Pacific Islander, Native American,

and Other categories into a single “Other” category because each category contained a very small number of observations. We found that compared with White patients, Black patients (odds ratio [OR] 1.25, 95% CI 1.13–1.38; $p < .001$) and Hispanic patients (OR 1.33, 95% CI 1.20–1.48; $p < .001$) had higher odds of readmission, independent of case-mix (age, gender, and chronic conditions) and index admission hospital.

Race/ethnicity is recorded in MAX data using the categories Asian/Pacific Islander, Black, Latino, Mixed race, Native American, or White. When we assessed the relationship between readmission risk and each race/ethnicity category using White patients as the reference group, controlling for case-mix (age, gender, and chronic conditions) and index admission hospital, we found significant differences in the odds of readmission for patients of Mixed race (OR 1.53, 95% CI 1.10–2.13; $p = .01$) and Native American patients (OR 1.27, 95% CI 1.07–1.51; $p = .01$) but not Black or Latino patients.

The finding of a higher likelihood of readmission for Black and Hispanic patients as compared to White patients in our all-payer dataset but not our Medicaid-only dataset suggests that socioeconomic status, as reflected by insurance status, might explain at least some of the apparent difference in readmission risk. To test this hypothesis, we repeated the race/ethnicity analysis in the AHRQ Revisit New York dataset and also controlled for insurance status. We found that the differences in readmission risk between Black and White patients (OR 1.18, 95% CI 1.06–1.32; $p < .001$) and between Hispanic and White patients (OR 1.25, 95% CI 1.12–1.40; $p < .001$) were attenuated but not eliminated, indicating, at least for this particular patient sample, some association of race/ethnicity with higher readmission risk, independent of insurance status.

DISPARITIES ASSOCIATED WITH INSURANCE STATUS

We assessed disparities in readmission risk associated with insurance status using 2005–2009 AHRQ Revisit New York and Nebraska data. We found that compared with Medicaid-insured patients, the odds of readmission were significantly lower for those who had private insurance (OR 0.79, 95% CI 0.73–0.85; $p < .001$), other types of insurance (such as Medicare or other government-sponsored insurance) (OR 0.71, 95% CI 0.53–0.94; $p < .001$), or self-pay status (OR 0.75, 95% CI 0.64–0.88; $p < .001$), independent of case-mix (age, gender, and chronic conditions) and index admission hospital.

We also evaluated whether a given hospital’s readmission performance tends to correlate among patients with different insurance statuses. We fitted the measure model to 2005–2009 AHRQ Revisit New York and Nebraska data, adding a random slope indicator variable for each insurance status. We found that the regression coefficients were highly correlated for Medicaid and private insurance (correlation = 0.91) and for Medicaid and other insurance types (correlation = 0.85); for self-pay and private insurance (correlation = 0.82) and for self-pay and other insurance types (correlation = 0.88); and for private insurance and other types of insurance (correlation = 0.99). However, the regression coefficients were only moderately correlated for Medicaid and self-pay (correlation = 0.51), suggesting that readmission performance for patients with these two insurance statuses tends to be disparate within hospitals.

DISPARITIES ASSOCIATED WITH RURALITY/URBANICITY

Using our MAX dataset, we assessed disparities in readmission risk associated with residence in rural versus urban areas. We used patients’ 5-digit zip codes to assign rural-urban commuting area (RUCA) codes, which are a Census tract-based classification system that uses Bureau of Census Urbanized Area and Urban Cluster definitions together with work commuting information to characterize Census tracts regarding their rural and urban status.¹ We then used the RUCA codes to assign the area of each patient’s residence to 1 of 5 levels of a rurality/urbanicity classification scheme created by the Dartmouth Atlas Working Group: urban core, suburban, large town, small town, or isolated rural.²

Controlling for case-mix (age, gender, and chronic conditions) and index admission hospital, we found that readmission risk did not vary significantly among the 5 levels of rurality/urbanicity ($p = .32$ for chi-square test).

Current Submission:

New evidence affirms disparities in the rate of readmissions between children insured by Medicaid and children with private insurance. In particular, despite an overall decline in readmission rates for publicly- and privately-insured children from 2010 to 2017, readmission rates remained higher among Medicaid beneficiaries than for their counterparts. Mean hospital 30-day risk-adjusted readmission rates increased for Medicaid beneficiaries,

from 6.5% (SD 2.1%) in 2010 to 6.9% (SD 1.8%) in 2017 ($P = .017$), but remained stable for privately insured patients, from 5.9% (SD 2.0%) in 2010 to 6.0% (SD 1.1%) in 2017 ($P = .14$).³

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[Response Ends]

1b.05. If no or limited data on disparities from the measure as specified is reported above, then provide a summary of data from the literature that addresses disparities in care on the specific focus of measurement. Include citations. Not necessary if performance data provided in above.

[Response Begins]

N/A

[Response Ends]

2. 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. Measures must be judged to meet the sub criteria for both reliability and validity to pass this criterion and be evaluated against the remaining criteria.

spma.01. Indicate whether there are changes to the specifications since the last updates/submission. If yes, update the specifications in the Measure Specifications section of the Measure Submission Form, and explain your reasoning for the changes below.

[Response Begins]

No

[Response Ends]

spma.02. Briefly describe any important changes to the measure specifications since the last measure update and provide a rationale.

For annual updates, please explain how the change in specifications affects the measure results. If a material change in specification is identified, data from re-testing of the measure with the new specifications is required for early maintenance review.

For example, specifications may have been updated based on suggestions from a previous NQF CDP review.

[Response Begins]

N/A

[Response Ends]

sp.01. Provide the measure title.

Measure titles should be concise yet convey who and what is being measured (see [What Good Looks Like](#)).

[Response Begins]

Pediatric Lower Respiratory Infection Readmission Measure

[Response Ends]

sp.02. Provide a brief description of the measure.

Including type of score, measure focus, target population, timeframe, (e.g., Percentage of adult patients aged 18-75 years receiving one or more HbA1c tests per year).

[Response Begins]

This measure calculates case-mix-adjusted readmission rates, defined as the percentage of admissions followed by 1 or more readmissions within 30 days, following hospitalization for lower respiratory infection (LRI) in patients less than 18 years old. The measure covers patients discharged from general acute care hospitals, including children's hospitals.

[Response Ends]

sp.04. Check all the clinical condition/topic areas that apply to your measure, below.

Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.

Please do not select:

- *Surgery: General*

[Response Begins]

Critical Care

Infectious Diseases (ID)

Respiratory

[Response Ends]

sp.05. Check all the non-condition specific measure domain areas that apply to your measure, below.

[Response Begins]

Care Coordination

Care Coordination: Readmissions

Care Coordination: Transitions of Care

[Response Ends]

sp.06. Select one or more target population categories.

Select only those target populations which can be stratified in the reporting of the measure's result.

Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.

Please do not select:

- *Populations at Risk: Populations at Risk*

[Response Begins]

Children (Age < 18)

[Response Ends]

sp.07. Select the levels of analysis that apply to your measure.

Check ONLY the levels of analysis for which the measure is SPECIFIED and TESTED.

Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.

Please do not select:

- *Clinician: Clinician*
- *Population: Population*

[Response Begins]

Facility

[Response Ends]

sp.08. Indicate the care settings that apply to your measure.

Check ONLY the settings for which the measure is SPECIFIED and TESTED.

[Response Begins]

Inpatient/Hospital

[Response Ends]

sp.09. Provide a URL link to a web page specific for this measure that contains current detailed specifications including code lists, risk model details, and supplemental materials.

Do not enter a URL linking to a home page or to general information. If no URL is available, indicate "none available".

[Response Begins]

None available.

[Response Ends]

sp.12. Attach the data dictionary, code table, or value sets (and risk model codes and coefficients when applicable). Excel formats (.xlsx or .csv) are preferred.

Attach an excel or csv file; if this poses an issue, [contact staff](#). Provide descriptors for any codes. Use one file with multiple worksheets, if needed.

[Response Begins]

Available in attached Excel or csv file

[Response Ends]

Attachment: 2414_2414_2018 ICD-10 Pediatric Lower Respiratory Infection Readmission Measure Data Dictionary-508.xlsx

For the question below: state the outcome being measured. Calculation of the risk-adjusted outcome should be described in sp.22.

sp.13. State the numerator.

Brief, narrative description of the measure focus or what is being measured about the target population, i.e., cases from the target population with the target process, condition, event, or outcome).

DO NOT include the rationale for the measure.

[Response Begins]

The numerator consists of hospitalizations at general acute care hospitals for LRI in patients less than 18 years old that are followed by 1 or more readmissions to general acute care hospitals within 30 days. Readmissions are excluded from the numerator if the readmission was for a planned procedure or for chemotherapy.

The measure outcome is a readmission rate, defined as the percentage of index admissions with 1 or more readmissions within 30 days. The readmission rate, unadjusted for case-mix, is calculated as follows:

number of index admissions with 1 or more readmissions within 30 days/
total number of index admissions

[Response Ends]

For the question below: describe how the observed outcome is identified/counted. Calculation of the risk-adjusted outcome should be described in sp.22.

sp.14. Provide details needed to calculate the numerator.

All information required to identify and calculate the cases from the target population with the target process, condition, event, or outcome such as definitions, time period for data collection, specific data collection items/responses, code/value sets.

Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.

[Response Begins]

A readmission is operationalized as the first unplanned admission to any acute care hospital within 30 days of discharge from a prior hospitalization at an acute care hospital. This prior admission, which serves as the reference point for enumerating 30-day readmissions, is the index admission. Additional admissions within 30 days from discharge from an index admission are not counted as index admissions. An admission more than 30 days from discharge from an index admission is counted as a new index admission.

We chose 30 days as the follow-up period during which to evaluate readmissions for multiple reasons. Readmissions within 30 days seem likely to reflect the quality of care provided both in the hospital and following discharge, which is consistent with the measure's intended purpose of assessing quality not just for a hospital but also for its wider health system. A follow-up period of 30 days is consistent with many readmission measures already in use, including the CMS readmission measures for adults. In addition, when we used a time-to-event curve to evaluate the proportion of readmissions within 1 year that occur within timeframes from 1 day up to 365 days, we observed a smooth curve with no obvious break to suggest an alternative follow-up period.

Readmissions are excluded if they are for a planned procedure or for chemotherapy. Readmissions for planned procedures and for chemotherapy are part of a patient's intended course of care and thus unlikely to be related to health system quality. This measure therefore focuses on unplanned readmissions because they are more likely to be related to a defect in quality of care during the index admission or during the interval between the index admission and readmission. In adult and pediatric medicine, most planned readmissions are for planned procedures or chemotherapy; therefore, these exclusions are intended to capture the majority of planned admissions.

We identify planned procedures using an algorithm based on primary procedure codes. Expert pediatric clinicians in 15 different procedure-oriented specialties reviewed procedures typically performed by their specialty. The reviewers indicated which procedures (1) are usually planned (defined as planned in more than 80% of cases) and (2) could require hospitalization. Admissions for which the primary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code or the principal International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) procedure code for a planned procedure coded was 1 of these procedures are excluded from readmissions. ICD-9-CM codes will henceforth be referred to as ICD-9 codes. ICD-10-CM diagnosis codes and ICD-10 Procedure Coding System (PCS) codes will be referred to as ICD-10

diagnosis and ICD-10 procedure codes, respectively.

EXCLUSIONS FROM THE NUMERATOR (READMISSIONS):

- Hospitalizations with a primary ICD-9 code or a principal ICD-10 code for a planned procedure (i.e., planned = 1).
- Hospitalizations with a primary ICD-9 or a principal ICD-10 diagnosis or procedure code for chemotherapy (i.e., chemo = 1).

These exclusions are applied without deleting the records from the dataset as these hospitalizations may still meet criteria for index admissions, detailed in Section S.10.

Variable definitions and ICD-9 or ICD-10 codes for identifying readmissions for planned procedures and for chemotherapy are provided in the Data Dictionary.

If a planned readmission occurs within 30 days of an index admission, it does not count as a readmission against the index admission, and no subsequent admissions occurring within 30 days of discharge from the index admission count as readmissions against the index admission. After 30 days from discharge from the index admission, a new index admission can be counted.

[Response Ends]

For the question below: state the target population for the outcome. Calculation of the risk-adjusted outcome should be described in sp.22.

sp.15. State the denominator.

Brief, narrative description of the target population being measured.

[Response Begins]

Hospitalizations at general acute care hospitals for LRI in patients less than 18 years old.

[Response Ends]

For the question below: describe how the target population is identified. Calculation of the risk-adjusted outcome should be described in sp.22.

sp.16. Provide details needed to calculate the denominator.

All information required to identify and calculate the target population/denominator such as definitions, time period for data collection, specific data collection items/responses, code/value sets.

Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.

[Response Begins]

Index hospitalizations are identified by applying a case definition for LRI and the exclusion criteria detailed in Sections S.10 and S.11. The LRI case definition requires either a primary ICD-9 or principal ICD-10 diagnosis code for bronchiolitis, influenza, or community-acquired pneumonia (CAP) or a secondary ICD-9 or additional ICD-10

diagnosis code for one of these LRIs plus a primary ICD-9 or additional ICD-10 diagnosis code for asthma, respiratory failure, or sepsis/bacteremia. The variable definition and ICD-9 or ICD-10 codes for the case definition are provided in the ICD-9 or ICD-10 Data Dictionary.

[Response Ends]

sp.17. Describe the denominator exclusions.

Brief narrative description of exclusions from the target population.

[Response Begins]

EXCLUSIONS FROM THE NUMERATOR (READMISSIONS) AND DENOMINATOR (INDEX HOSPITALIZATIONS)

We exclude certain hospitalizations from the measure entirely (i.e., from the numerator and denominator) based on clinical criteria or for issues of data completeness or quality that could prevent assessment of eligibility for the measure cohort or compromise the accuracy of readmission rates. Hospitalizations are excluded from the measure if they meet any of the following criteria:

1. The hospitalization was at a specialty or non-acute care hospital.

Rationale: The focus of the measure is admissions to hospitals that provide general pediatric acute care. Records for admissions to specialty and non-acute-care hospitals are therefore omitted from the dataset. Because hospital type cannot be determined for records with missing data in the hospital type variable, these records are also removed from the dataset.

2. Records for the hospitalization contain incomplete data for variables needed to assess eligibility for the measure or calculate readmission rates, including hospital type, patient identifier, admission date, discharge date, disposition status, date of birth, primary ICD-9 or principal ICD-10 diagnosis codes, and gender.

Rationale: Complete and valid information for the variables listed above is needed to define the measure cohort and calculate case-mix-adjusted readmission rates. Identifying readmissions within 30 days requires information on dates of admission and end-of-service dates and the ability to link unique patient identifiers across inpatient claims records. Hospital identifiers are needed to determine the hospital at which index admissions occurred. The disposition status is needed to determine whether a patient was discharged or experienced some other outcome (e.g., was transferred to another acute care hospital, left against medical advice, died). Establishing a patient's eligibility for membership in the pediatric cohort and performing case-mix adjustment requires an accurate date of birth and end-of-service date. Because gender is 1 of the variables used for case-mix adjustment, episodes of care with missing or inconsistent gender cannot be evaluated in the measure.

3. Records for the hospitalization contain data of questionable quality for calculating readmission rates, including

- a. Inconsistent date of birth across records for a patient.
- b. Discharge date prior to admission date.
- c. Admission or discharge date prior to date of birth.
- d. Admission date after a disposition status of death during a prior hospitalization.

Rationale: Complete and valid information for the variables listed above is needed to define the measure cohort and calculate case-mix-adjusted readmission rates. Identifying readmissions within 30 days requires information on dates of admission and end-of-service. A valid disposition status is needed to determine whether a patient was discharged or experienced some other outcome (e.g., was transferred to another acute care hospital, left against medical advice, died). Establishing a patient's eligibility for membership in the pediatric cohort and performing case-mix adjustment requires an accurate date of birth and end-of-service date.

4. Codes other than ICD-9 or ICD-10 codes are used for the primary procedure.

Rationale: ICD-9 or ICD-10 procedure codes are necessary for applying clinical exclusions.

5. The patient was older than 18 years, 29 days at the time of admission.

Rationale: This age exclusion limits the population to pediatric patients and prevents inclusion of records that overlap with adult readmission measures. Age eligibility for inclusion in the measure is based on age at the time of discharge from the index admission. Because the focus of the measure is pediatric patients, a patient's hospitalization is ineligible for inclusion in the measure as an index admission if the patient was 18 years old or greater at the time of discharge. Because the subsequent observation period for readmissions is 30 days, a patient's hospitalization is ineligible for inclusion in the measure as a readmission if the patient was older than 18 years, 29 days at the start of the readmission.

6. The hospitalization was for obstetric care, including labor and delivery.

Rationale: Hospitalizations for obstetric conditions are excluded because care related to pregnancy does not generally fall within the purview of pediatric providers.

7. The primary ICD-9 or principal ICD-10 diagnosis code was for a mental health condition.

Rationale: Hospitalizations for mental health conditions are excluded because we found that hospitals with high readmission rates for mental health hospitalizations tend to have low readmission rates for hospitalizations for other conditions, and vice versa. We describe this analysis in detail in Section 2b.3 of the Measure Testing Submission Form.

8. The hospitalization was for birth of a healthy newborn.

Rationale: Hospitalizations for birth of healthy newborns are excluded because these hospitalizations, unlike all others, are not for evaluation and management of disease.

EXCLUSIONS FROM THE DENOMINATOR ONLY (INDEX HOSPITALIZATIONS ONLY)

We also apply further exclusions to the denominator only (i.e., these hospitalizations are excluded from index hospitalizations but could still meet criteria for readmissions). Hospitalizations are excluded from the denominator only if they meet any of the following criteria:

9. The patient was 18 years old or greater at the time of discharge.

Rationale: Age eligibility for inclusion in the measure is based on age at the time of discharge from the index admission. Because the measure covers pediatric patients, a patient's hospitalization is ineligible for inclusion in the measure as an index admission if the patient was 18 years old or greater at the time of discharge.

10. The discharge disposition was death.

Rationale: A patient must be discharged alive from an index admission in order to be readmitted. Therefore, any record with a discharge disposition of death cannot serve as an index admission.

11. The discharge disposition was leaving the hospital against medical advice.

Rationale: A discharge disposition of leaving against medical advice indicates that a patient left care before the hospital determined that the patient was ready to leave.

12. The hospital has less than 80% of records with complete patient identifier, admission date, and discharge date or less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis codes. (Records for these hospitals are still assessed as possible readmissions, but readmission rates are not calculated for these hospitals due to their lack of complete data.)

Rationale: Readmission rates are not calculated for hospitals missing large amounts of data for the above variables because these hospitals have limited data to accurately apply measure cohort exclusions and calculate case-mix-adjusted readmission rates. Assessing eligibility for the measure cohort and performing case-mix adjustment requires information on admission dates, end-of-service dates, and diagnosis codes. Identifying readmissions requires information on admission dates and end-of-service dates and the ability to link unique patient identifiers across inpatient claims records.

13. The hospital is in a state not being analyzed.

Rationale: A claims database used for readmission analysis may contain records for hospitals located in states that

are not included in the database (because covered patients may sometimes be admitted to out-of-state hospitals). Records for these out-of-state hospital admissions are not excluded from the measure dataset because these records may meet criteria for being counted as readmissions as part of an in-state hospital's readmission rate. However, readmission rates are not calculated for out-of-state hospitals due to the lack of complete data for these hospitals.

14. Thirty days of follow-up data are not available for assessing readmissions.

Rationale: Identifying readmissions within 30 days requires a full 30 days of follow-up data.

15. The hospitalization does not have a primary ICD-9 or principal ICD-10 LRI diagnosis or does not have a secondary ICD-9 or additional ICD-10 LRI diagnosis plus a primary ICD-9 or principal ICD-10 diagnosis of asthma, respiratory failure, or sepsis/bacteremia.

Rationale: This measure focuses on readmissions following hospitalization for LRI. Episodes of care that do not meet the case definition for an LRI hospitalization are therefore excluded from index admissions.

[Response Ends]

sp.18. Provide details needed to calculate the denominator exclusions.

All information required to identify and calculate exclusions from the denominator such as definitions, time period for data collection, specific data collection items/responses, code/value sets – Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.

[Response Begins]

DATA PREPARATION AND APPLICATION OF EXCLUSIONS TO THE MEASURE COHORT (NUMERATOR AND DENOMINATOR) AND TO THE DENOMINATOR ONLY

Steps 1 through 8, below, describe the data preparation steps to implement and the exclusions to apply to the measure cohort (numerator and denominator) and to the denominator only before fitting the pediatric all-condition readmission model to inpatient claims data.

STEP 1: IDENTIFY HOSPITALS ELIGIBLE FOR INCLUSION IN THE MEASURE

This measure focuses on calculating pediatric readmission rates for general acute care hospitalizations. Criteria for retaining only hospitals identified as general acute care facilities are specified below.

Exclusions at the Hospital Level:

- Drop records for specialty and non-acute-care hospitals: For the list of American Hospital Association (AHA) hospital codes and Centers for Medicare & Medicaid Services (CMS) taxonomy codes for general acute care hospitals eligible for inclusion in the measure, see the Data Dictionary submitted in Section S.2b. Drop records for a hospital if the records contain only an AHA code or only a CMS code and the code is NOT for a general acute care hospital. If a hospital's records include both an AHA and a CMS code, drop the records for the hospital if either code is NOT for a general acute care hospital.
- Drop records for which hospital type is missing.

STEP 2: IDENTIFY HOSPITALS FOR WHICH READMISSION RATES SHOULD NOT BE CALCULATED

Hospitals with very incomplete data may lack adequate information to calculate accurate readmission rates. Readmission rates should therefore not be evaluated for these hospitals (i.e., their admissions should not be included in the measure as index admissions). To provide an accurate assessment based on the full dataset, data completeness at the hospital level should be assessed before excluding individual records for data quality or clinical criteria. Criteria for identifying hospitals for which readmission rates should not be calculated are listed below.

Exclusions at the Hospital Level for Calculating Readmission Rates:

- Hospitals with less than 80% of records with complete unique patient identifier, admission date, and end-of-service date
- Hospitals with less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis codes
- Out-of-state hospitals

Create a dichotomous variable named “hosp_noindex,” coded 1 for hospitals meeting the above exclusion criteria (this variable will be used to exclude these hospitals’ admissions from being evaluated as index admissions) and 0 for all other hospitals. Although readmission rates should not be calculated for these hospitals, these hospitals’ records should remain in the dataset so that their admissions can be evaluated as potential readmissions for other hospitals.

STEP 3: EXCLUDE PATIENTS WHO HAVE MISSING OR INVALID DATA FOR ANALYZING READMISSIONS

Exclusions at the Patient Level:

- Drop all records for a patient if ANY record is missing patient identifier, hospital identifier, admission date, end-of-service date, or disposition status.
- Drop all records for a patient if date of birth is missing in ALL records.
- Drop all records for a patient if date of birth is not consistent across records.
- Drop all records for a patient if ANY record has an end-of-service date prior to the admission date.
- Drop all records for a patient if ANY record has an admission date or end-of-service date prior to the date of birth.
- Drop all records for a patient if ANY record uses codes other than ICD-9 or ICD-10 codes for the primary procedure.
- Drop all records for a patient if gender is missing in ALL records.
- Drop all records for a patient if gender is not consistent across records.

STEP 4: SPECIFY VARIABLES DEFINED AT THE RECORD LEVEL

The variables listed in the Data Dictionary (provided in Section S.2b) are used to construct the measure cohort and/or to calculate readmission rates. These variables must be named and coded as specified in the Data Dictionary and should be created prior to identifying episodes of care and applying further exclusions to the data.

STEP 5: DEFINE EPISODES OF CARE

Data for a single period of inpatient care may be contained in more than 1 claims record. It therefore may be necessary to collapse instances of multiple claims for the same hospitalization into a single episode of care prior to applying some exclusion criteria and evaluating readmissions. This allows all data relevant to a given hospitalization to be appropriately evaluated for measure cohort exclusion. The process for defining episodes of care is detailed below.

1. IDENTIFY TRUE DUPLICATES AND DROP ALL BUT 1.

- True duplicates are records that have identical values for all key variables needed to assess cohort eligibility and calculate case-mix-adjusted readmission rates, where these key variables include all variables listed in the Data Dictionary (provided in Section S.2b) except hasprimary. Combine true duplicates, using the MAXIMUM value of hasprimary.

2. IDENTIFY AND COMBINE MULTIPLE VALID RECORDS FROM THE SAME HOSPITAL FOR THE SAME HOSPITALIZATION.

- Sort records by the following variables, in the specified order: patientid, hospitalid, admit_dt, end_service_dt, and disp_status.

- Define records to be part of the same hospitalization at the same hospital if (a) patientid and hospitalid are equal to those in the previous record and (b) admission dates and end-of-service dates indicate consecutive time periods or nesting of 1 time period within another in that any of the following is true:
 - admission date is before the previous record's end-of-service date
 - admission date is equal to the previous record's end-of-service date AND the previous record's disposition status is other (i.e., disp_status = 0) or transfer to an acute care hospital (i.e., disp_status = 2)
 - admission date is 1 day after the previous record's end-of-service date AND the previous record's disposition status is other (i.e., disp_status = 0) or transfer to an acute care hospital (i.e., disp_status = 2)
 - admission and end-of-service dates are both the same as those of the previous record, and admission date is equal to end-of-service date (i.e., the records are for a same-day discharge)

If the above criteria for multiple valid records from the same hospital for the same hospitalization are met, combine all of the records. Retain the variables patientid, dob, hospitalid, male, and hosp_noindex, which will be the same across records by this step. Use the MINIMUM value for admit_dt. Use the MAXIMUM value for end_service_dt, hasprimary, cci1-cci10 and cci12-cci18, planned, chemo, mh, obstetric, and newborn. Use the value of disp_status and ins_end (this variable is only used in single-payer analyses) from the record with the maximum end-of-service date. If multiple records have the same maximum end-of-service date but inconsistent values for disp_status, use the MAXIMUM value of disp_status within those records. Using the maximum value for end_service_dt captures the discharge date that serves as the starting point for the 30-day follow-up period for evaluating readmissions. Using the maximum value for chronic condition indicator and clinical exclusion variables across records captures the presence of a chronic condition or clinical exclusion for the entire episode of care. For example, if 1 record contains a primary ICD-9 or principal ICD-10 mental health diagnosis, this diagnosis will be applied to the entire episode of care, and the entire episode of care will be excluded.

3. IDENTIFY AND COMBINE MULTIPLE VALID RECORDS FROM MULTIPLE HOSPITALS FOR HOSPITALIZATIONS THAT INCLUDED TRANSFERS.

- Sort records by the following variables, in the specified order: patientid, admit_dt, end_service_dt, and disp_status.
- Define records to be in the same episode of care if (a) patientid is equal to patientid in the previous record, (b) the previous record's disposition status is transfer to an acute care hospital (i.e., disp_status = 2), and (c) the admission date is equal to or is 1 day after the previous record's end-of-service date.

If the above criteria for connected hospitalizations are met, combine all of the records. Retain the variables patientid, dob, and male, which will be the same across records by this step. Use the MINIMUM value for admit_dt. Use the MAXIMUM value for end_service_dt, hasprimary, cci1-cci10 and cci12-cci18, planned, chemo, mh, obstetric, and newborn. Use the value of hospitalid, disp_status, ins_end, and hosp_noindex from the last record.

4. IDENTIFY AND EXCLUDE INVALID EPISODES OF CARE

There may be episodes of care that are temporally overlapping (i.e., in which it appears that a patient was in 2 different hospitals at the same time). These episodes should be dropped.

- Drop all episodes of care that share the same patient identifier, admission date, and end-of-service date but have different hospital identifiers.
- For each patient identifier, drop all temporally adjacent episodes of care if there are overlapping dates (i.e., admission date is before the end-of-service date for the preceding episode of care) but different hospital identifiers.

STEP 6: SPECIFY VARIABLES DEFINED AT THE EPISODE-OF-CARE LEVEL

Because multiple records may be combined to create an episode of care, some variables used for measure cohort exclusions and readmission analysis should be defined only after defining valid episodes of care. This sequencing

assures that the variable values accurately represent information for the entire hospitalization, rather than capturing only a subset of information for the hospitalization. These variables should be created as specified in the Data Dictionary provided in Section S.2b, prior to applying further exclusion criteria to the data.

STEP 7: DEFINE EPISODES OF CARE ELIGIBLE FOR INCLUSION IN MEASURE COHORT

The exclusions listed below are applied only after defining episodes of care (in Step 5) and defining variables at the episode-of-care level (in Step 6).

Exclusions at the Patient Level Based on Data Completeness Criteria:

- Drop all episodes of care for a patient if the primary ICD-9 or principal ICD-10 diagnosis code is missing (i.e., hasprimary = 0) for ANY episode of care for that patient.

Exclusions at the Episode-of-Care Level Based on Data Quality Criteria:

- Drop episodes of care with admission dates that occur after a discharge status of death during a prior episode of care.

Exclusions at the Episode-of-Care Level Based on Clinical Criteria:

- Drop episodes of care for patients greater than 18 years, 29 days old at the time of admission.
- Drop episodes of care for birth of healthy newborns (i.e., newborn = 1).
- Drop episodes of care with a primary ICD-9 or principal ICD-10 non-delivery obstetrics diagnosis or any labor and delivery diagnosis or procedure (i.e., obstetric = 1).
- Drop episodes of care with a primary ICD-9 or principal ICD-10 mental health diagnosis (i.e., mh = 1).

STEP 8: DEFINE INDEX ADMISSIONS AND READMISSIONS

A clean dataset containing only eligible admissions must be prepared before defining index admissions and readmissions. This dataset should consist of all admissions that are eligible for inclusion in the measure cohort based on the criteria detailed in data preparation steps 1 through 7, above.

Exclusions at the Episode-of-Care Level for Defining Index Admissions:

- Episodes of care for patients ≥ 18 years, 0 days old at the time of discharge
- Episodes of care with a discharge disposition of death
- Episodes of care with a discharge disposition of leaving the hospital against medical advice
- Episodes of care for which 30 days of follow-up data are unavailable, either (a) because the dataset's time range for claims does not include the full 30 days, or (b) because, for single-payer analyses, the patient was not enrolled with the payer for the full 30 days (i.e., the difference between ins_end and end_service_dt is less than 30 days)
- Episodes of care that either do not have a primary ICD-9 or principal ICD-10 LRI diagnosis or do not have a secondary ICD-9 or additional ICD-10 LRI diagnosis plus a primary ICD-9 or principal ICD-10 diagnosis of asthma, respiratory failure, or sepsis/bacteremia (i.e., lri = 0)

The above exclusions are applied without deleting the records from the dataset as these episodes of care may still meet criteria for readmissions.

Exclusions at the Hospital Level for Defining Index Admissions:

- Hospitals with less than 80% of records with complete unique patient identifier, admission date, and end-of-service date
- Hospitals with less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis code
- Out-of-state hospitals

Hospitals meeting the above exclusion criteria were identified in Step 2, above. The dichotomous variable hosp_noindex was created in Step 2 and coded 1 for hospitals meeting the above criteria and 0 for all other hospitals. Episodes of care for hospitals with hosp_noindex = 1 are therefore excluded from index admissions.

Although these hospitals' episodes of care should not be evaluated as index admissions (i.e., readmission rates should not be calculated for these hospitals), their episodes of care should remain in the dataset so they can be evaluated as potential readmissions for other hospitals.

[Response Ends]

sp.19. Provide all information required to stratify the measure results, if necessary.

Include the stratification variables, definitions, specific data collection items/responses, code/value sets, and the risk-model covariates and coefficients for the clinically-adjusted version of the measure when appropriate. Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format in the Data Dictionary field.

[Response Begins]

N/A

[Response Ends]

sp.20. Is this measure adjusted for socioeconomic status (SES)?

[Response Begins]

No

[Response Ends]

sp.21. Select the risk adjustment type.

Select type. Provide specifications for risk stratification and/or risk models in the Scientific Acceptability section.

[Response Begins]

Statistical risk model

[Response Ends]

sp.22. Select the most relevant type of score.

Attachment: If available, please provide a sample report.

[Response Begins]

Rate/proportion

[Response Ends]

sp.23. Select the appropriate interpretation of the measure score.

Classifies interpretation of score according to whether better quality or resource use is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score

[Response Begins]

Better quality = Lower score

[Response Ends]

sp.24. Diagram or describe the calculation of the measure score as an ordered sequence of steps.

Identify the target population; exclusions; cases meeting the target process, condition, event, or outcome; time period of data, aggregating data; risk adjustment; etc.

[Response Begins]

PREPARATION OF DATA AND IDENTIFICATION OF MEASURE COHORT

Identify Hospitals Eligible for Inclusion in the Measure

1. Starting with the complete set of claims from the time period being analyzed, exclude hospitalizations that occurred at specialty or non-acute care hospitals or at hospitals for which hospital type is missing.

Identify Hospitals for which Readmission Rates Should Not Be Calculated

2. Identify and flag out-of-state hospitals and hospitals with incomplete data for key variables for more than 20% of records.

Exclude Patients Who Have Missing or Invalid Data for Analyzing Readmissions

3. Exclude patients whose records use procedure codes other than ICD-9 or ICD-10 codes or have missing or invalid data for 1 or more of the following variables: patient identifier, hospital identifier, admission date, end-of-service date, disposition status, date of birth, and gender.

Specify Variables Defined at the Record Level

4. Define variables for measure cohort exclusions and readmission analysis that should be created at the record level.

Define Episodes of Care

5. For hospitalizations with data contained in more than 1 claim, combine the multiple claims into a single record for each hospitalization.

Specify Variables Defined at the Episode of Care Level

6. Define variables for measure cohort exclusions and readmission analysis that should be created at the episode of care level.

Define Episodes of Care Eligible for Inclusion in Measure Cohort

7. Exclude hospitalizations with a missing primary ICD-9 or principal ICD-10 diagnosis code.

8. Exclude hospitalizations with an admission date occurring after a previous hospitalization with a disposition status of death.

9. Exclude hospitalizations for patients older than 18 years, 29 days at the time of admission.

10. Exclude hospitalizations for obstetric conditions, mental health conditions, and birth of healthy newborns.

DEFINE INDEX HOSPITALIZATIONS

11. Exclude hospitalizations for patients 18 years, 0 days old or older at the time of discharge.

12. Exclude hospitalizations with a discharge disposition of death.

13. Exclude hospitalizations with a discharge disposition of leaving against medical advice.

14. Exclude hospitalizations for which 30 days of follow-up data are not available for assessing readmissions.

15. Exclude hospitalizations that do not have a primary ICD-9 or principal ICD-10 diagnosis code for an LRI or a secondary ICD-9 or additional ICD-10 diagnosis code for an LRI plus a primary ICD-9 or principal ICD-10 diagnosis code for asthma, respiratory failure, or sepsis/bacteremia.

16. Exclude hospitalizations that occurred at hospitals that (a) have less than 80% of records with complete patient identifier, admission date, and end-of-service date; (b) have less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis codes; or (c) are located in a state not being analyzed.

DEFINE READMISSIONS

17. Identify index hospitalizations followed by one or more readmissions within 30 days.

18. When identifying readmissions, exclude hospitalizations with (a) a primary ICD-9 or principal ICD-10 procedure code for a planned procedure or (b) a primary ICD-9 or principal ICD-10 diagnosis code or procedure code for chemotherapy.

CASE-MIX ADJUSTMENT MODEL FITTING AND DIRECT STANDARDIZATION

19. Fit the case-mix adjustment model to the prepared dataset to estimate coefficients for the case-mix variables (age, gender, presence of chronic conditions in each of 17 body systems, and number of body systems affected by chronic conditions) and a hospital random intercept for each hospital.

20. Perform direct standardization by fitting the model again for each hospital. Use the hospital's random intercept, adjusted for its own case-mix, from Step 19, but instead of using the hospital's own case-mix data, use a hypothetical dataset in which (a) all admissions are re-coded as if they are from the hospital for which a readmission rate is being estimated and (b) the readmission outcome has been set to missing. Each hospital's predicted probabilities for all records are summed by hospital and divided by the total number of index admissions in the dataset to produce the hospital-specific standardized readmission rate.

21. The upper confidence bound for this estimate is calculated as the mean of the upper confidence bound for each index admission's probability of leading to a readmission. The corresponding procedure is followed to estimate the lower confidence bound.

22. Finally, the point estimate and bound values are multiplied by a factor that corrects for estimation error produced by transformations used during estimation. The bias correction factor is a constant value specified as the observed number of readmissions across all hospitals in the dataset divided by the predicted number of readmissions across all hospitals in the dataset.

23. The resulting hospital-specific standardized readmission rate can be interpreted as the readmission rate the hospital would have if it treated a patient cohort with the case-mix composition of all eligible index admissions within the entire dataset.

Detailed Methods for Implementing Direct Standardization in SAS

One method to implement direct standardization in SAS involves obtaining the predicted values of every patient in the dataset in each hospital using the steps listed below. This is the method used in the SAS program we have prepared for the measure.

1. For each hospital being standardized, create a duplicate copy of the original dataset. The duplicate dataset should contain exactly the same variables and records as in the original dataset for all hospitals.
2. Set the outcome (readmission) in the duplicate dataset to missing. This prevents these duplicate records from being used in model estimation.
3. For ALL records in the duplicate dataset, set the hospital identifier to the hospital identifier of the hospital being standardized. Add a variable to the dataset that indicates that these records contain hypothetical data.
4. Concatenate the duplicate datasets to the original dataset. If the concatenated dataset is too large to handle, the same procedure may be conducted for subgroups of hospitals, or for 1 hospital at a time, and the results combined afterward.
5. Fit the case-mix adjustment model to the dataset created in the previous step. In SAS, the model will be fitted only on the original data since the outcome is missing for the duplicate data. This process will produce a case-mix-adjusted random intercept for each hospital. However, the procedure will also produce predicted probabilities for both original and duplicate records (SAS calculates predicted probabilities for any record in which the predictors are not missing, regardless of whether the outcome is missing).
6. Calculate the mean predicted probability and lower and upper bounds for only the duplicate records (those flagged as containing hypothetical data) in order to obtain the predicted readmission rate for the hospital being standardized. This rate represents the readmission rate for this hospital if it were to treat the entire dataset's population mix.

[Response Ends]

sp.27. If measure testing is based on a sample, provide instructions for obtaining the sample and guidance on minimum sample size.

Examples of samples used for testing:

- *Testing may be conducted on a sample of the accountable entities (e.g., hospital, physician). The analytic unit specified for the particular measure (e.g., physician, hospital, home health agency) determines the sampling strategy for scientific acceptability testing.*
- *The sample should represent the variety of entities whose performance will be measured. The [2010 Measure Testing Task Force](#) recognized that the samples used for reliability and validity testing often have limited generalizability because measured entities volunteer to participate. Ideally, however, all types of entities whose performance will be measured should be included in reliability and validity testing.*
- *The sample should include adequate numbers of units of measurement and adequate numbers of patients to answer the specific reliability or validity question with the chosen statistical method.*
- *When possible, units of measurement and patients within units should be randomly selected.*

[Response Begins]

N/A

[Response Ends]

sp.30. Select only the data sources for which the measure is specified.

[Response Begins]

Claims

[Response Ends]

sp.31. Identify the specific data source or data collection instrument.

For example, provide the name of the database, clinical registry, collection instrument, etc., and describe how data are collected.

[Response Begins]

The measure could be used with state Medicaid or all-payer databases. There are several options for calculating rates that could be compared nationally. CMS could analyze Medicaid claims from multiple states. A private payer with data from multiple states could compare hospitals from across state lines. Multiple states with all-payer databases could combine them to enable cross-state comparisons. Individual states could calculate nationally comparable rates using a method we have developed by which readmission rates can be estimated for Medicaid-insured patients and standardized using a MAX reference dataset. Please see the Detailed Measure Specifications (provided in the Appendix) for instructions on implementing this method.

[Response Ends]

sp.32. Provide the data collection instrument.

[Response Begins]

No data collection instrument provided

[Response Ends]

2ma.01. Indicate whether additional empirical reliability testing at the accountable entity level has been conducted. If yes, please provide results in the following section, Scientific Acceptability: Reliability - Testing. Include information on all testing conducted (prior testing as well as any new testing).

Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:

Current Submission:

Updated testing information here.

Previous Submission:

Testing from the previous submission here.

[Response Begins]

No

[Response Ends]

2ma.02. Indicate whether additional empirical validity testing at the accountable entity level has been conducted. If yes, please provide results in the following section, Scientific Acceptability: Validity - Testing. Include information on all testing conducted (prior testing as well as any new testing).

Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:

Current Submission:

Updated testing information here.

Previous Submission:

Testing from the previous submission here.

[Response Begins]

No

[Response Ends]

2ma.03. For outcome, patient-reported outcome, resource use, cost, and some process measures, risk adjustment/stratification may be conducted. Did you perform a risk adjustment or stratification analysis?

[Response Begins]

Yes

[Response Ends]

2ma.04. For maintenance measures in which risk adjustment/stratification has been performed, indicate whether additional risk adjustment testing has been conducted since the most recent maintenance evaluation. This may include updates to the risk adjustment analysis with additional clinical, demographic, and social risk factors.

Please update the Scientific Acceptability: Validity - Other Threats to Validity section.

Note: This section must be updated even if social risk factors are not included in the risk adjustment strategy.

[Response Begins]

No additional risk adjustment analysis included

[Response Ends]

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 fields in the Scientific Acceptability sections of the Measure Submission Form.

- Measures must be tested for all the data sources and levels of analyses that are specified. If there is more than one set of data specifications or more than one level of analysis, contact NQF staff about how to present all the testing information in one form.
- All required sections must be completed.
- For composites with outcome and resource use measures, Questions 2b.23-2b.37 (Risk Adjustment) also must be completed.
- If specified for multiple data sources/sets of specifications (e.g., claims and EHRs), Questions 2b.11-2b.13 also must be completed.
- An appendix for supplemental materials may be submitted (see Question 1 in the Additional section), but there is no guarantee it will be reviewed.
- Contact NQF staff with any questions. Check for resources at the [Submitting Standards webpage](#).
- For information on the most updated guidance on how to address social risk factors variables and testing in this form refer to the release notes for the [2021 Measure Evaluation Criteria and Guidance](#).

Note: The information provided in this form is intended to aid the Standing Committee and other stakeholders in understanding to what degree the testing results for this measure meet NQF's evaluation criteria for testing.

2a. Reliability testing demonstrates the measure data elements are repeatable, producing the same results a high proportion of the time when assessed in the same population in the same time period and/or that the measure score is precise. For instrument-based measures (including PRO-PMs) and composite performance measures, reliability should be demonstrated for the computed performance score.

2b1. Validity testing demonstrates that the measure data elements are correct and/or the measure score correctly reflects the quality of care provided, adequately identifying differences in quality. For instrument based measures (including PRO-PMs) and composite performance measures, validity should be demonstrated for the computed performance score.

2b2. Exclusions are supported by the clinical evidence and are of sufficient frequency to warrant inclusion in the specifications of the measure;

AND

If patient preference (e.g., informed decision-making) is a basis for exclusion, there must be evidence that the exclusion impacts performance on the measure; in such cases, the measure must be specified so that the information about patient preference and the effect on the measure is transparent (e.g., numerator category computed separately, denominator exclusion category computed separately).

2b3. For outcome measures and other measures when indicated (e.g., resource use):

- an evidence-based risk-adjustment strategy (e.g., risk models, risk stratification) is specified; is based on patient factors (including clinical and social risk factors) that influence the measured outcome and are present at start of care; 14,15 and has demonstrated adequate discrimination and calibration
- rationale/data support no risk adjustment/ stratification.

2b4. Data analysis of computed measure scores demonstrates that methods for scoring and analysis of the specified measure allow for identification of statistically significant and practically/clinically meaningful 16 differences in performance;

OR

there is evidence of overall less-than-optimal performance.

2b5. If multiple data sources/methods are specified, there is demonstration they produce comparable results.

2b6. Analyses identify the extent and distribution of missing data (or nonresponse) and demonstrate that performance results are not biased due to systematic missing data (or differences between responders and non-responders) and how the specified handling of missing data minimizes bias.

2c. For composite performance measures, empirical analyses support the composite construction approach and demonstrate that:

2c1. the component measures fit the quality construct and add value to the overall composite while achieving the related objective of parsimony to the extent possible; and

2c2. the aggregation and weighting rules are consistent with the quality construct and rationale while achieving the related objective of simplicity to the extent possible.

(if not conducted or results not adequate, justification must be submitted and accepted)

Definitions

Reliability testing applies to both the data elements and computed measure score. Examples of reliability testing for data elements include, but are not limited to: inter-rater/abstractor or intra-rater/abstractor studies; internal consistency for multi-item scales; test-retest for survey items. Reliability testing of the measure score addresses precision of measurement (e.g., signal-to-noise).

Validity testing applies to both the data elements and computed measure score. Validity testing of data elements typically analyzes agreement with another authoritative source of the same information. Examples of validity testing of the measure score include, but are not limited to: testing hypotheses that the measures scores indicate quality of care, e.g., measure scores are different for groups known to have differences in quality assessed by another valid quality measure or method; correlation of measure scores with another valid indicator of quality for the specific topic; or relationship to conceptually related measures (e.g., scores on process measures to scores on outcome measures). Face validity of the measure score as a quality indicator may be adequate if accomplished through a systematic and transparent process, by identified experts, and explicitly addresses whether performance scores resulting from the measure as specified can be used to distinguish good from poor quality. The degree of consensus and any areas of disagreement must be provided/discussed.

Examples of evidence that an exclusion distorts measure results include, but are not limited to: frequency of occurrence, variability of exclusions across providers, and sensitivity analyses with and without the exclusion.

Patient preference is not a clinical exception to eligibility and can be influenced by provider interventions.

Risk factors that influence outcomes should not be specified as exclusions.

With large enough sample sizes, small differences that are statistically significant may or may not be practically or clinically meaningful. The substantive question may be, for example, whether a statistically significant difference of one percentage point in the percentage of patients who received smoking cessation counseling (e.g., 74 percent v. 75 percent) is clinically meaningful; or whether a statistically significant difference of \$25 in cost for an episode of care (e.g., \$5,000 v. \$5,025) is practically meaningful. Measures with overall less-than-optimal performance may not demonstrate much variability across providers.

Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:

Current Submission:

Updated testing information here.

Previous (Year) Submission:

Testing from the previous submission here.

2a.01. Select only the data sources for which the measure is tested.

[Response Begins]

Claims

[Response Ends]

2a.02. If an existing dataset was used, identify the specific dataset.

The dataset used for testing must be consistent with the measure specifications for target population and healthcare entities being measured; e.g., Medicare Part A claims, Medicaid claims, other commercial insurance, nursing home MDS, home health OASIS, clinical registry).

[Response Begins]

We developed and tested the measure using Medicaid Analytic eXtract (MAX) data for 26 states, which include Medicaid claims from children's and non-children's hospitals.

[Response Ends]

2a.03. Provide the dates of the data used in testing.

Use the following format: "MM-DD-YYYY - MM-DD-YYYY"

[Response Begins]

We used MAX data for hospitalizations with discharge dates from 12-01-2007 – 12-31-2008.

[Response Ends]

2a.04. Select the levels of analysis for which the measure is tested.

Testing must be provided for all the levels specified and intended for measure implementation, e.g., individual clinician, hospital, health plan.

Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.

Please do not select:

- *Clinician: Clinician*
- *Population: Population*

[Response Begins]

Facility

[Response Ends]

2a.05. List the measured entities included in the testing and analysis (by level of analysis and data source).

Identify the number and descriptive characteristics of measured entities included in the analysis (e.g., size, location, type); if a sample was used, describe how entities were selected for inclusion in the sample.

[Response Begins]

The MAX dataset includes 1,743 hospitals with ≥ 1 pediatric hospitalization for LRI. The median hospital volume of annual pediatric LRI index hospitalizations for these hospitals was 58 (IQR 18-189). Characteristics of these hospitals are detailed below.

Table 5 – MAX Cohort Hospital Characteristics (Total N = 1,743)

Hospital Characteristics	Hospitals	Index Hospitalizations
Children's hospital [Number (%) of hospitals]	78 (4.5%)	14,734 (21.9%)
Teaching hospital [Number (%) of hospitals]	114 (6.6%)	15,769 (23.5%)
Rural/urban location [Number (%) of hospitals]	*	*
Urban	608 (34.9%)	44,561 (66.4%)
Suburban	88 (5.1%)	992 (1.5%)
Large town	390 (22.4%)	13,198 (19.7%)
Small town	455 (26.1%)	6,522 (9.7%)
Rural	200 (11.5%)	1,865 (2.8%)

This table displays MAX cohort hospital characteristics, including the number and frequency of children's hospitals, teaching hospitals, and a breakdown by location.

*Cell intentionally left empty

[Response Ends]

2a.06. Identify the number and descriptive characteristics of patients included in the analysis (e.g., age, sex, race, diagnosis), separated by level of analysis and data source; if a sample was used, describe how patients were selected for inclusion in the sample.

If there is a minimum case count used for testing, that minimum must be reflected in the specifications.

[Response Begins]

Table 6 – MAX Cohort Patient Characteristics (Total N = 67,191)

Patient Characteristic	*	Number (%) of Index Hospitalizations
Age	< 1 year	33,175 (49.4)
*	1 to < 5 years	24,715 (36.8)
*	5 to < 8 years	4,501 (6.7)
*	8 to <12 years	2,544 (3.8)
*	12 to < 18 years	2,257 (3.4)
Gender	Female	29,008 (43.2)
Chronic Condition Indicators (CCIs)	CCI 1 - Infectious and parasitic disease	27 (0.04)
*	CCI 2 - Neoplasms	224 (0.3)

Patient Characteristic	*	Number (%) of Index Hospitalizations
*	CCI 3 - Endocrine, nutritional, and metabolic diseases and immunity disorders	1,762 (2.6)
*	CCI 4 - Diseases of blood and blood-forming organs	2,464 (3.7)
*	CCI 5 - Mental disorders	1,620 (2.4)
*	CCI 6 - Diseases of the nervous system and sense organs	2,586 (3.8)
*	CCI 7 - Diseases of the circulatory system	1,115 (1.7)
*	CCI 8 - Diseases of the respiratory system	18,377 (27.4)
*	CCI 9 - Diseases of the digestive system	2,756 (4.1)
*	CCI 10 - Diseases of the genitourinary system	123 (0.2)
*	CCI 12 - Diseases of the skin and subcutaneous tissue	213 (0.3)
*	CCI 13 - Diseases of the musculoskeletal system	246 (0.4)
*	CCI 14 - Congenital anomalies	3,798 (5.6)
*	CCI 15 - Certain conditions originating in the perinatal period	27 (0.04)
*	CCI 16 - Symptoms, signs, and ill-defined conditions	114 (0.2)
*	CCI 17 - Injury and poisoning	6 (0.01)
*	CCI 18 - Factors influencing health status and contact with health services	1,924 (2.9)
CCI count	0 or 1 body system	60,576 (90.1)
*	2 body systems	4,204 (6.3)
*	3 body systems	1,567 (2.3)
*	4+ body systems	844 (1.3)
Race/ethnicity	Asian/Pacific Islander	861 (1.4)
*	Black	14,051 (22.6)
*	Latino	19,444 (31.2)
*	Mixed	520 (0.8)
*	Native American	3,403 (5.5)
*	White	24,010 (38.6)
Rural/urban residence	Urban	37,235 (55.6)
*	Suburban	4,839 (7.2)
*	Large town	11,867 (17.7)
*	Small town	7,899 (11.8)
*	Rural	5,109 (7.6)

This table displays MAX cohort patient characteristics, including the number and frequency of index hospitalizations by age, gender, CCI category, CCI count, race/ethnicity, and rural/urban residence.

*Cell intentionally left empty

[Response Ends]

2a.07. If there are differences in the data or sample used for different aspects of testing (e.g., reliability, validity, exclusions, risk adjustment), identify how the data or sample are different for each aspect of testing.

[Response Begins]

To evaluate the criterion validity of the measure—its ability to identify correctly the outcome of interest, readmission—we assessed performance of the measure against the gold standard of chart reviews. To perform this analysis, we used administrative data and electronic health records for patients admitted to Boston Children’s Hospital between March 1, 2012 and February 28, 2013. The table below describes the characteristics of patients with index hospitalizations during this time period (for patents for whom these data were available).

Table 7 – Boston Children’s Hospital Cohort Patient Characteristics (Total N = 8,387)

Patient Characteristic	*	Number (%) of Index Hospitalizations
Age	< 1 year	2,113 (25.2)
*	1 to < 5 years	2,041 (24.3)
*	5 to < 8 years	978 (11.7)
*	8 to <12 years	1,123 (13.4)
*	12 to < 18 years	2,132 (25.4)
Gender	Female	3,956 (47.2)
CCIs	CCI 1 - Infectious and parasitic disease	11 (0.1)
*	CCI 2 - Neoplasms	272 (3.2)
*	CCI 3 - Endocrine, nutritional, and metabolic diseases and immunity disorders	873 (10.4)
*	CCI 4 - Diseases of blood and blood-forming organs	471 (5.6)
*	CCI 5 - Mental disorders	805 (9.6)
*	CCI 6 - Diseases of the nervous system and sense organs	1,234 (14.7)
*	CCI 7 - Diseases of the circulatory system	878 (10.5)
*	CCI 8 - Diseases of the respiratory system	1,042 (12.4)
*	CCI 9 - Diseases of the digestive system	557 (6.6)
*	CCI 10 - Diseases of the genitourinary system	157 (1.9)
*	CCI 12 - Diseases of the skin and subcutaneous tissue	69 (0.8)
*	CCI 13 - Diseases of the musculoskeletal system	337 (4.0)
*	CCI 14 - Congenital anomalies	2,212 (26.4)
*	CCI 15 - Certain conditions originating in the perinatal period	6 (0.1)

Patient Characteristic	*	Number (%) of Index Hospitalizations
*	CCI 16 - Symptoms, signs, and ill-defined conditions	44 (0.5)
*	CCI 17 - Injury and poisoning	16 (0.2)
*	CCI 18 - Factors influencing health status and contact with health services	420 (5.0)
CCI count	0 or 1 body system	5,858 (69.8)
*	2 body systems	1,793 (21.4)
*	3 body systems	602 (7.2)
*	4+ body systems	134 (1.6)
Race/ethnicity	Asian/Pacific Islander	290 (3.4)
*	Black	852 (10.2)
*	Latino	826 (9.8)
*	Mixed	15 (0.2)
*	Native American	731 (8.7)
*	White	5,054 (60.3)
*	Missing	618 (7.4)

This table displays Boston Children's Hospital cohort patient characteristics, including the number and frequency of index hospitalizations by age, gender, CCI category, CCI count, and race/ethnicity.

*Cell intentionally left empty

[Response Ends]

2a.08. List the social risk factors that were available and analyzed.

For example, patient-reported data (e.g., income, education, language), proxy variables when social risk data are not collected from each patient (e.g. census tract), or patient community characteristics (e.g. percent vacant housing, crime rate) which do not have to be a proxy for patient-level data.

[Response Begins]

Age, Gender, Presence of chronic conditions, Number of body systems affected by chronic conditions

[Response Ends]

Note: If accuracy/correctness (validity) of data elements was empirically tested, separate reliability testing of data elements is not required – in 2a.09 check patient or encounter-level data; in 2a.010 enter “see validity testing section of data elements”; and enter “N/A” for 2a.11 and 2a.12.

2a.09. Select the level of reliability testing conducted.

Choose one or both levels.

[Response Begins]

Accountable Entity Level (e.g., signal-to-noise analysis)

[Response Ends]

2a.10. For each level of reliability testing checked above, describe the method of reliability testing and what it tests.

Describe the steps—do not just name a method; what type of error does it test; what statistical analysis was used.

[Response Begins]

We evaluated the reliability of hospital-level readmission rates using the following formula:

$$\text{Reliability} = \sigma^2 / (\sigma^2 + V)$$

where σ^2 is the systematic variance among hospitals and V is the sampling variance of the sample estimate of a hospital's rate (both on the probability scale):

$$\bullet \sigma^2 = \sigma_L^2 \cdot p^2 \cdot (1-p)^2$$

where σ_L^2 = variance component from model output in logit scale

$$\bullet V = p \cdot (1-p) / N,$$

where p = the overall readmission rate across all hospitals and N = the hospital's volume

[Response Ends]

2a.11. For each level of reliability testing checked above, what were the statistical results from reliability testing?

For example, provide the percent agreement and kappa for the critical data elements, or distribution of reliability statistics from a signal-to-noise analysis. For score-level reliability testing, when using a signal-to-noise analysis, more than just one overall statistic should be reported (i.e., to demonstrate variation in reliability across providers). If a particular method yields only one statistic, this should be explained. In addition, reporting of results stratified by sample size is preferred (pg. 18, [NQF Measure Evaluation Criteria](#)).

[Response Begins]

Using the MAX dataset, we found that among the 1,743 total hospitals, 229 hospitals had a readmission rate reliability ≥ 0.5 ; these hospitals accounted for 62% of total LRI index hospitalizations. The readmission rate reliability was ≥ 0.7 for 70 hospitals, accounting for 35% of total LRI index hospitalizations.

Because hospitals with few pediatric patients would be less likely to participate in measuring pediatric readmissions, we evaluated readmission rate reliability for hospitals meeting selected minimum thresholds of pediatric all-condition and LRI index hospitalizations per year. We determined that among the 539 hospitals with ≥ 100 annual index hospitalizations for any condition and ≥ 25 annual LRI index hospitalizations, readmission rate reliability was ≥ 0.5 for 229 hospitals, accounting for 74% of the LRI index hospitalizations at hospitals in this volume category. Readmission rate reliability was ≥ 0.7 for 70 hospitals, accounting for 42% of LRI index hospitalizations at hospitals in this volume category.

We found that among the 179 hospitals with ≥ 500 annual index hospitalizations and ≥ 25 annual LRI index hospitalizations, readmission rate reliability was ≥ 0.5 for 146 hospitals, accounting for 95% of the LRI index hospitalizations at hospitals in this volume category. Readmission rate reliability was ≥ 0.7 for 69 hospitals, accounting for 67% of LRI index hospitalizations at hospitals in this volume category.

[Response Ends]

2a.12. Interpret the results, in terms of how they demonstrate reliability.

(In other words, what do the results mean and what are the norms for the test conducted?)

[Response Begins]

Reliability values range from 0 to 1. If perfect information from a very large sample were available for a hospital, so that the hospital's random effect could be determined with perfect precision, then the reliability of that hospital's readmission rate would approach 1. If no information were available for a hospital, then the reliability of that hospital's readmission rate would be 0. Our results indicate that LRI readmission rates are reliable for hospitals accounting for a large proportion of index hospitalizations.

[Response Ends]

2b.01. Select the level of validity testing that was conducted.

[Response Begins]

Empirical validity testing

[Response Ends]

2b.02. For each level of testing checked above, describe the method of validity testing and what it tests.

Describe the steps—do not just name a method; what was tested, e.g., accuracy of data elements compared to authoritative source, relationship to another measure as expected; what statistical analysis was used.

[Response Begins]

CONSTRUCT VALIDITY

As detailed in Section 1a.2.1 of the Evidence form, many studies have provided evidence that readmission rates serve as a measure of healthcare quality. Use of approaches to diagnosis, treatment, and monitoring of disease that adhere to clinical practice guidelines has been correlated with lower readmission rates.^{1–3} Likewise, improvements in the quality of clinical management have been associated with reductions in readmissions.^{4–6} Readmission rates have also been found to reflect the quality of discharge and care transition processes. Several studies, mostly in adults, have demonstrated that interventions focused on improving these processes have been linked with decreased readmissions, suggesting that the quality of these processes is associated with readmission risk.^[1-20]

Although the medical literature provides ample evidence for the relationship between quality of care and pediatric and adult readmission risk, assessing the construct validity of pediatric readmission rates directly by examining the correlation of rates with other pediatric measures of quality does not appear to be currently feasible. To perform this analysis, pediatric inpatient claims-based quality measures or large, multi-hospital datasets of scores from pediatric quality measures would be required. However, to our knowledge, no other publicly available claims based pediatric inpatient quality measures exist, including among the Healthcare Effectiveness Data and Information Set (HEDIS) measures, the CHIPRA Initial Core Set of Children's Health Care Quality Measures, and other measure collections that we examined. There also do not appear to be large datasets with scores from pediatric inpatient quality measures.

CRITERION VALIDITY

We evaluated the ability of our measure to identify the outcome of interest, readmission, from administrative data by comparing the measure's performance against the gold standard of chart reviews. We performed this analysis using administrative data and electronic health records for patients admitted to Boston Children's Hospital over a

1-year period (see Section 1.7 above for a summary of patient characteristics). We determined from the administrative data that 8,833 index hospitalizations occurred during this time period. We then identified hospitalizations that met measure criteria for readmissions (i.e., the readmissions were not for a planned procedure or chemotherapy) in 2 ways: (1) analysis of the administrative data using the measure program and (2) review of electronic health records. We assessed the health records by first examining whether each index hospitalization was followed by a readmission within 30 days based on presence of inpatient admission orders (such an order is entered for every hospitalization). We then reviewed clinical documentation, including admission notes, discharge summaries, and procedure notes, for 500 randomly selected readmissions to determine whether the readmission had been for a planned procedure or chemotherapy. The results of our analysis of criterion validity are provided in response to item 2b.03.

VALIDITY OF PLANNED PROCEDURE ALGORITHM

We also verified the face validity of the planned procedure algorithm used to identify hospitalizations for planned procedures. We sought public comments on the algorithm in a Federal Register Notice.[21] No comments were submitted to suggest that procedures be removed from the list of planned procedures because they are not typically planned or are not a reason for hospitalization. Twenty-four procedures were submitted with the suggestion that they be added to the list of planned procedures. Of these, 7 were already included on the planned procedure list; our expert clinicians in 3 relevant specialties reviewed the remaining 17 procedures. Most of the remaining codes were for procedures for which patients are not hospitalized. Based on the experts' review, however, 2 procedures, both organ transplantation procedures, were added to the planned procedure list. These transplantation procedures originally had been excluded because they did not meet our operational definition of "planned" (i.e., scheduled at least 24 hours in advance), but it was agreed that they should be added as a special case of procedures for which the need is typically known in advance, even though the actual operation occurs urgently once an organ becomes available. For the same reason, 9 other transplantation procedures were also added to the planned procedure list.

IDENTIFICATION OF INTERNATIONAL CLASSIFICATION OF DISEASES, 10TH REVISION (ICD-10) CODES

To identify ICD-10 codes for chronic conditions, mental health conditions, and obstetric conditions, we used AHRQ's ICD-10 version of its Chronic Condition Indicator tool. For all other codes used in the measure, we obtained ICD-10 codes by performing conversions from the ICD-9 codes we had selected during measure development. Our goal for the conversions was to compile an ICD-10 code set that was fully consistent with the intent of the original ICD-9 set. We carried out the conversions using the 3M™ Code Translation Tool and reviewed all conversions to ensure that the resulting ICD-10 codes captured the intended concepts, removing ICD-10 codes from the code set as appropriate.

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[Response Ends]

2b.03. Provide the statistical results from validity testing.

Examples may include correlations or t-test results.

[Response Begins]

The sensitivity and specificity of the measure for identifying eligible readmissions from administrative data were 87.0% and 99.7%, respectively.

[Response Ends]

2b.04. Provide your interpretation of the results in terms of demonstrating validity. (i.e., what do the results mean and what are the norms for the test conducted?)

[Response Begins]

The measure is able to identify eligible readmissions from administrative data with high sensitivity and specificity.[1–4] We found face validity for our planned procedure algorithm.

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[Response Ends]

2b.05. Describe the method for determining if statistically significant and clinically/practically meaningful differences in performance measure scores among the measured entities can be identified.

Describe the steps—do not just name a method; what statistical analysis was used? Do not just repeat the information provided in Importance to Measure and Report: Gap in Care/Disparities.

[Response Begins]

We identified hospitals with meaningfully different readmission performance based on their excess readmission ratio, calculated using NQF-endorsed methods.³⁵ For each hospital, the numerator of the ratio, its number of adjusted actual readmissions, is calculated by estimating the probability of readmission for each patient at that hospital and adding the probabilities for all of the hospital's patients. The denominator of the ratio, its number of expected readmissions, is calculated by estimating the probability of readmission for each of the hospital's patients if he or she had been at an average hospital and then adding the probabilities for all of the hospital's patients.

Numerator – Adjusted Actual Readmissions

Each patient's predicted probability of readmission = $1 / (1 + e^{-Z_a})$

Z_a = hospital-specific effect + $X\beta$

where $X\beta$ = intercept + case-mix adjustment coefficients

Denominator – Expected Readmissions

Each patient's predicted probability of readmission = $1 / (1 + e^{-Z_e})$

Z_e = $X\beta$

where $X\beta$ = intercept + case-mix adjustment coefficients

[Response Ends]

2b.06. Describe the statistical results from testing the ability to identify statistically significant and/or clinically/practically meaningful differences in performance measure scores across measured entities.

Examples may include number and percentage of entities with scores that were statistically significantly different from mean or some benchmark, different from expected; how was meaningful difference defined.

[Response Begins]

Of 1,743 hospitals, 561 (32%) had an excess readmission ratio > 1, indicating that their number of adjusted actual readmissions was higher than would be expected at an average hospital. Among hospitals with an excess readmission ratio > 1, the median ratio was 1.18 (IQR 1.09–1.33). In other words, for half of the hospitals with an excess readmission ratio > 1, their number of adjusted actual readmissions exceeded their number of expected readmissions by > 18%.

[Response Ends]

2b.07. Provide your interpretation of the results in terms of demonstrating the ability to identify statistically significant and/or clinically/practically meaningful differences in performance across measured entities.

In other words, what do the results mean in terms of statistical and meaningful differences?

[Response Begins]

The measure can identify hospitals with meaningfully different readmission performance.

[Response Ends]

2b.08. Describe the method of testing conducted to identify the extent and distribution of missing data (or non-response) and demonstrate that performance results are not biased due to systematic missing data (or differences between responders and non-responders). Include how the specified handling of missing data minimizes bias.

Describe the steps—do not just name a method; what statistical analysis was used.

[Response Begins]

To address potential issues with data completeness, we have included criteria for assessing records and excluding them from the measure if they have missing values for key variables.

We exclude hospitalizations from the measure (numerator and denominator) if they contain incomplete data for variables needed to assess eligibility for the measure or calculate readmission rates, including hospital type, patient identifier, admission date, discharge date, disposition status, date of birth, primary ICD-9 or principal ICD-10 diagnosis and procedure codes, or gender.

We exclude hospitalizations from the denominator only if they meet any of the following criteria:

1. The hospital has less than 80% of records with complete patient identifier, admission date, and discharge date or less than 80% of records with complete primary ICD-9 or principal ICD-10 diagnosis codes. (Records for these hospitals are still assessed as possible readmissions, but readmission rates are not calculated for these hospitals due to their lack of complete data.)
2. The hospital is in a state not being analyzed.
3. Thirty days of follow-up data are not available for assessing readmissions.

[Response Ends]

2b.09. Provide the overall frequency of missing data, the distribution of missing data across providers, and the results from testing related to missing data.

For example, provide results of sensitivity analysis of the effect of various rules for missing data/non-response. If no empirical sensitivity analysis was conducted, identify the approaches for handling missing data that were considered and benefits and drawbacks of each).

[Response Begins]

N/A

[Response Ends]

2b.10. Provide your interpretation of the results, in terms of demonstrating that performance results are not biased due to systematic missing data (or differences between responders and non-responders), and how the specified handling of missing data minimizes bias.

In other words, what do the results mean in terms of supporting the selected approach for missing data and what are the norms for the test conducted; if no empirical analysis was conducted, justify the selected approach for missing data.

[Response Begins]

N/A

[Response Ends]

Note: This item is directed to measures that are risk-adjusted (with or without social risk factors) OR to measures with more than one set of specifications/instructions (e.g., one set of specifications for how to identify and compute the measure from medical record abstraction and a different set of specifications for claims or eQMs). It does not apply to measures that use more than one source of data in one set of specifications/instructions (e.g., claims data to identify the denominator and medical record abstraction for the numerator). Comparability is not required when comparing performance scores with and without social risk factors in the risk adjustment model. However, if comparability is not demonstrated for measures with more than one set of specifications/instructions, the different specifications (e.g., for medical records vs. claims) should be submitted as separate measures.

2b.11. Indicate whether there is more than one set of specifications for this measure.

[Response Begins]

No, there is only one set of specifications for this measure

[Response Ends]

2b.12. Describe the method of testing conducted to compare performance scores for the same entities across the different data sources/specifications.

Describe the steps—do not just name a method. Indicate what statistical analysis was used.

[Response Begins]

[Response Ends]

2b.13. Provide the statistical results from testing comparability of performance scores for the same entities when using different data sources/specifications.

Examples may include correlation, and/or rank order.

[Response Begins]

[Response Ends]

2b.14. Provide your interpretation of the results in terms of the differences in performance measure scores for the same entities across the different data sources/specifications.

In other words, what do the results mean and what are the norms for the test conducted.

[Response Begins]

[Response Ends]

2b.15. Indicate whether the measure uses exclusions.

[Response Begins]

Yes, the measure uses exclusions.

[Response Ends]

2b.16. Describe the method of testing exclusions and what was tested.

Describe the steps—do not just name a method; what was tested, e.g., whether exclusions affect overall performance scores; what statistical analysis was used?

[Response Begins]

We chose to exclude hospitalizations with a primary mental health diagnosis from the measure cohort after evaluating the relationship between the primary diagnosis and the readmission outcome. We fitted a hierarchical random slopes regression model to the data. The model consisted of patients nested within hospitals at the first level and 2 random slope indicator variables at the second level: (a) an indicator variable for the primary diagnosis of interest alone and (b) an indicator variable for all other possible primary diagnoses.

[Response Ends]

2b.17. Provide the statistical results from testing exclusions.

Include overall number and percentage of individuals excluded, frequency distribution of exclusions across measured entities, and impact on performance measure scores.

[Response Begins]

We excluded 1,211,196 total hospitalizations from the measure. Of these, 25,459 (2.1%) were excluded for a primary diagnosis of a mental health condition. The median hospital percentage of index hospitalizations with a primary diagnosis of a mental health condition was 0.0% (IQR 0.0%–1.6%). In the analysis described in Section 2b3.1, we found that for primary diagnoses other than mental health conditions, the regression coefficient for the primary diagnosis of interest had a positive correlation with the regression coefficient for all other diagnoses, suggesting that performance on readmissions for the primary diagnosis of interest tends to correspond with performance on readmissions for all other diagnoses (the converse is also true). However, the regression

coefficient for primary mental health diagnoses had a negative correlation with the coefficient for non-mental health diagnoses, suggesting that performance on readmissions for mental health conditions does not tend to correspond with performance on readmissions for non-mental health conditions.

[Response Ends]

2b.18. Provide your interpretation of the results, in terms of demonstrating that exclusions are needed to prevent unfair distortion of performance results.

In other words, the value outweighs the burden of increased data collection and analysis. Note: If patient preference is an exclusion, the measure must be specified so that the effect on the performance score is transparent, e.g., scores with and without exclusion.

[Response Begins]

Hospitalizations with a primary diagnosis code for a mental health condition are excluded from the measure cohort because we found that hospitals with high readmission rates for mental health hospitalizations tend to have low readmission rates for hospitalizations for other conditions, and vice versa.

[Response Ends]

2b.19. Check all methods used to address risk factors.

[Response Begins]

Statistical risk model with risk factors (specify number of risk factors)

[Statistical risk model with risk factors (specify number of risk factors) Please Explain]

20 fixed effect variables representing 4 types of risk factors

[Response Ends]

2b.20. If using statistical risk models, provide detailed risk model specifications, including the risk model method, risk factors, risk factor data sources, coefficients, equations, codes with descriptors, and definitions.

[Response Begins]

CASE-MIX ADJUSTMENT MODEL

The case-mix adjustment model consists of a 2-level logistic regression model with fixed effect variables for patient case-mix at the first level and random intercepts for hospitals at the second level.

The model estimates 3 types of parameters. First, the coefficients of patient demographic and clinical characteristics represent the influence of these characteristics on predicted probabilities of readmission for an individual patient. Second, hospital-level random intercept estimates (evaluated for each hospital) represent the greater or lesser adjusted probability of readmission, not explained by patient-level fixed effects, for patients discharged from each hospital within a given state. Finally, variance estimates of the hospital random effects summarize the amount of variation among the intercepts for different hospitals and hence summarize the amount of variation in adjusted readmission rates across hospitals, at least some of which may be due to variation in health system quality. See the Data Dictionary submitted in Section S.2b.

The following case-mix variables, defined from the index admission, are included in the model:

- Age group
- Gender
- Presence of chronic conditions in each of 17 body systems (organ systems, disease categories, or other categories)

- Number of body systems affected by chronic conditions

After the case-mix-adjusted coefficients and hospital-level random intercept for each record are calculated, the hospital-specific case-mix-adjusted readmission rate is estimated through direct standardization using a case-mix representative of all hospitals in the entire dataset. The resulting estimates represent the readmission rate that each hospital would have if it served the same representative case-mix and are therefore conducive to comparisons among hospitals.

DIRECT STANDARDIZATION

Hospital populations in the dataset have differing case-mix compositions, making meaningful interpretations of comparisons of readmission rates across hospitals challenging. The hospital estimate from the fitted equation above is an estimate of the random effects intercept, which is not a readily interpretable quantity. We therefore use direct standardization to generate readmission rates that have a meaningful interpretation across hospitals. The interpretation that can be posited from this methodology is that the predicted readmission rate estimated for each hospital represents the readmission rate it would have if the hospital treated a patient cohort with the case-mix composition of all eligible index admissions within the entire dataset.

We first fit a 2-level hierarchical logistic regression model to the observed data to obtain hospital-specific random intercepts that are adjusted for each hospital's case-mix. In order to implement direct standardization, we apply the estimates from the model to a hypothetical dataset in which (a) all admissions are re-coded as if they are from the hospital for which a readmission rate is being estimated and (b) the readmission outcome has been set to missing. Otherwise, the dataset is identical to the actual observed data from all hospitals in the cohort. This methodology uses the hospital's own random intercept, which is case-mix adjusted by its own specific index admission population, to determine the probability that a record in the dataset will generate a readmission.

Each hospital's predicted probabilities for all records are summed by hospital and divided by the total number of index admissions in the dataset to produce the hospital-specific standardized readmission rate. The upper confidence bound for this estimate is calculated as the mean of the upper confidence bound for each index admission's probability of leading to a readmission. The corresponding procedure is followed to estimate the lower confidence bound. Finally, the point estimate and bound values are multiplied by a factor that corrects for estimation error produced by transformations used during estimation. The bias correction factor is a constant value specified as the observed number of readmissions across all hospitals in the dataset divided by the predicted number of readmissions across all hospitals in the dataset. After calculating the point estimates and confidence intervals of hospital-specific readmission rates for each hospital using this methodology, hospitals are identified as outliers if the confidence bounds around their predicted readmission rates do not overlap with the overall observed readmission rate across the entire dataset.

ESTIMATION OF NATIONALLY COMPARABLE HOSPITAL- OR STATE-LEVEL READMISSION RATES

There are several options for calculating rates that could be compared nationally. CMS could analyze Medicaid claims from multiple states. A private payer with data from multiple states could compare hospitals from across state lines. Multiple states with all-payer databases could combine them to enable cross-state comparisons. Individual states could calculate nationally comparable rates using a method we have developed by which readmission rates can be estimated for Medicaid-insured patients and standardized using a Medicaid Analytic eXtract (MAX) reference dataset. Please see the Detailed Measure Specifications (provided in the Appendix) for instructions on implementing this method. Readmission rates are standardized using a reference dataset, consisting of MAX data for 26 states (Alabama, Arizona, Connecticut, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Montana, New Jersey, New Mexico, New York, North Carolina, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Vermont, Virginia, Wisconsin, and Wyoming). The 26 states, which are diverse in size and represent each geographic region (Northeast, Midwest, South, West), were chosen based on quality and completeness of their data for readmission analyses; to our knowledge, the combined data for these states comprise the most nationally representative dataset available to standardize readmission rates for Medicaid-insured children.

[Response Ends]

2b.21. If an outcome or resource use measure is not risk-adjusted or stratified, provide rationale and analyses to demonstrate that controlling for differences in patient characteristics (i.e., case mix) is not needed to achieve fair comparisons across measured entities.

[Response Begins]

[Response Ends]

2b.22. Select all applicable resources and methods used to develop the conceptual model of how social risk impacts this outcome.

[Response Begins]

Published literature

[Response Ends]

2b.23. Describe the conceptual and statistical methods and criteria used to test and select patient-level risk factors (e.g., clinical factors, social risk factors) used in the statistical risk model or for stratification by risk.

Please be sure to address the following: potential factors identified in the literature and/or expert panel; regression analysis; statistical significance of $p < 0.10$ or other statistical tests; correlation of x or higher. Patient factors should be present at the start of care, if applicable. Also discuss any “ordering” of risk factor inclusion; note whether social risk factors are added after all clinical factors. Discuss any considerations regarding data sources (e.g., availability, specificity).

[Response Begins]

IDENTIFICATION OF CANDIDATE VARIABLES FOR THE CASE-MIX ADJUSTMENT MODEL

To choose candidate variables for possible inclusion in the case-mix adjustment model, we considered patient demographic and clinical characteristics based on review of readmission studies and other readmission measures. We selected as candidate variables patient characteristics that (1) may differ in their distribution across hospitals, (2) may be related to readmission risk, and (3) are less likely to be related to variation in pediatric quality across health systems. Adjusting for such variables accounts for the variation in readmission rates that is attributable to differences in the distribution of patient characteristics across hospitals. In deciding on variables for the final model, we also took into account the variables and variable specifications used in the case-mix adjustment model for our Pediatric All-Condition Readmission Model, thus ensuring measure harmonization. We examined the following candidate case-mix variables for use in the measure model: age, gender, presence of chronic conditions in 18 different body systems, and number of body systems affected by chronic conditions.

METHODS FOR VARIABLE SELECTION

Step 1: Determine Bivariate Relationship with Readmission and Select Parsimonious Specifications of Candidate Variables

We assessed the relationship between each candidate variable and readmission risk in bivariate analysis. The analysis included the candidate variable as well as a hospital random intercept. We excluded variables from further analysis if no specification for the candidate variable was found to have a statistically significant relationship with readmission. Throughout the variable selection process, we used a p -value $< .05$ as the criterion for statistical significance. For candidate variables that were significantly related to readmission and could be specified in > 1 way (e.g., age can be expressed as a continuous or categorical variable), we evaluated multiple potential variable specifications. Candidate variables that could be specified either continuously or categorically were created using both approaches to assess whether a linear specification provided the best fit. For variables that were specified both continuously and categorically, and for differing specifications of cut-points for the levels of categorical variables, we determined the best-fitting specification of each variable based on the likelihood ratio chi-square

values. If 2 specifications had close likelihood ratios, we chose which specification of the variable to evaluate further in multivariate analysis based on parsimony and clinical face validity.

Step 2: Determine Statistical Significance of Candidate Variables in Multivariate Analysis

We used a multivariate model to assess whether variables that were statistically significant in bivariate analysis remained significant in multivariate analysis.

[Response Ends]

2b.24. Detail the statistical results of the analyses used to test and select risk factors for inclusion in or exclusion from the risk model/stratification.

[Response Begins]

Age

We found that age had a non-linear statistically significant relationship with 30-day readmission in both bivariate and multivariate analysis (see Table 5). The final specification for age is detailed below. We chose the specification because (a) the categorical variable captures the non-linear relationship of age with the outcome of readmission, (b) the specification has a high likelihood ratio chi-square relative to other less parsimonious specifications, and (c) the age group categories are clinically and developmentally meaningful.

Table 8 – Bivariate and Multivariate Results for Age

Age (agegroup)	Bivariate Analysis		Multivariate Analysis	
Likelihood ratio 139.70	OR	p-value	OR	p-value
1 = 0 ≤ age < 1	reference	*	reference	*
2 = 1 ≤ age < 5	0.70	< .001	0.62	< .001
3 = 5 ≤ age < 8	0.55	< .001	0.42	< .001
4 = 8 ≤ age < 12	0.74	.001	0.45	< .001
5 = 12 ≤ age < 18	1.10	.26	0.59	< .001

This table displays the bivariate and multivariate results in terms of odds-ratios by age group.

*Cell intentionally left empty

Gender

We found that male gender was significantly associated with increased odds of readmission in bivariate and multivariate analysis (see Table 6) and therefore retained the variable in our model.

Table 9 – Bivariate and Multivariate Results for Gender

Gender (male)	Bivariate Analysis		Multivariate Analysis	
Likelihood ratio 19.72	OR	p-value	OR	p-value
0 = female	reference	*	reference	*

Gender (<i>male</i>)	Bivariate Analysis		Multivariate Analysis	
1 = male	1.15	< .001	1.14	< .001

This table displays the bivariate and multivariate results in terms of odds-ratios by gender.

*Cell intentionally left empty

Chronic Conditions

To account for chronic disease comorbidity, we used the AHRQ CCI tool to classify ICD-9-CM diagnosis codes for chronic conditions into 18 body systems (organ systems, disease categories, or other categories). We created a dichotomous variable for each body system, with a value of 1 if ≥ 1 chronic condition was present (coded as a primary or secondary diagnosis for an index hospitalization) in that body system or 0 if no chronic condition was present in that body system. We examined each of the 18 CCI variables in relation to the outcome of readmission in bivariate and multivariate analysis, using absence of a chronic condition in the body system in question as the reference.

We found that 12 of the 18 dichotomous variables were significantly related to readmission in bivariate analysis and 11 of the 18 were significantly related in multivariate analysis.

We chose to retain all but the CCI for body system 11, "Complications of pregnancy, childbirth, and the puerperium," in the final model (a) to maintain, to the extent possible, the coherence of the complete AHRQ CCI tool, (b) because most of the CCI variables had a statistically significant relationship with the outcome of readmission, and (c) for harmonization with our Pediatric All-Condition Readmission Measure. Patients who have a primary diagnosis code for an obstetric condition or any diagnosis or procedure code for delivery are excluded from the measure cohort. We have found using various datasets that this exclusion leaves very few (or sometimes no) patients who have a secondary diagnosis code for a chronic condition within body system 11, which could create model-fitting problems if CCI 11 were included in the case-mix-adjustment model.

Table 10 – Bivariate and Multivariate Results for CCIs

CCI (<i>cci</i>)		Bivariate		Multivariate	
Likelihood ratio range: 0.19 (<i>cci1</i>) to 340.07 (<i>cci14</i>)		OR	p-value	OR	p-value
1	Infectious and parasitic disease	1.41	.64	1.19	0.82
2	Neoplasms	2.26	< .001	2.75	< .001
3	Endocrine, nutritional, and metabolic diseases and immunity disorders	2.34	< .001	2.19	< .001
4	Diseases of blood and blood-forming organs	1.40	< .001	1.66	< .001
5	Mental disorders	1.95	< .001	1.51	< .001
6	Diseases of the nervous system and sense organs	3.00	< .001	2.49	< .001
7	Diseases of the circulatory system	2.49	< .001	1.79	< .001
8	Diseases of the respiratory system	0.92	.03	1.18	< .001

CCI (<i>cci</i>)		Bivariate		Multivariate	
9	Diseases of the digestive system	2.55	< .001	2.05	< .001
10	Diseases of the genitourinary system	3.79	< .001	2.43	< .001
11	Complications of pregnancy, childbirth, and the puerperium	No cases	No cases	No cases	No cases
12	Diseases of the skin and subcutaneous tissue	1.53	.09	1.44	.17
13	Diseases of the musculoskeletal system	1.69	.01	1.08	.76
14	Congenital anomalies	2.82	< .001	2.23	< .001
15	Certain conditions originating in the perinatal period	1.72	.38	1.24	.73
16	Symptoms, signs, and ill-defined conditions	0.43	.15	0.34	.07
17	Injury and poisoning	3.61	.25	1.70	.67
18	Factors influencing health status and contact with health services	3.50	< .001	2.51	< .001

This table displays the bivariate and multivariate results in terms of odds-ratios by CCI category.

Number of body systems affected by chronic conditions

We also evaluated a count variable of the number of body systems in which a chronic condition was present for each index hospitalization. To avoid problems with model estimation, we top-coded the variable at ≥ 4 systems affected by a chronic disease because there were few index admissions with diagnoses in ≥ 5 systems.

The CCI count variable had a statistically significant relationship with readmission in bivariate and multivariate analysis. In multivariate analysis, an increasing count was associated with decreasing odds of readmission. This finding indicates that the presence of chronic conditions in multiple body systems confers a readmission risk that is lower than the sum of the risk of chronic conditions in each of the individual body systems, such that the CCI count variable serves to prevent overestimation of the risk associated with having chronic conditions in multiple body systems. We chose to retain *cci count* as an ordinal variable based on (a) its statistically significant relationship with the outcome of readmission and (b) because it adjusts the readmission risk associated with having chronic conditions in multiple body systems.

Table 11 – Bivariate and Multivariate Results for CCI Count

CCI Count (<i>cci count</i>)	Bivariate		Multivariate	
Likelihood ratio 547.89	OR	p-value	OR	p-value
1 = 0 to 1	reference	*	reference	*
2 = 2	2.46	< .001	0.93	< .001

CCI Count (<i>cci count</i>)	Bivariate		Multivariate	
3 = 3	3.65	< .001	0.74	< .001
4 = 4 or more	4.45	< .001	0.40	< .001

This table displays the bivariate and multivariate results in terms of odds-ratios by CCI count.

*Cell intentionally left empty

[Response Ends]

2b.25. Describe the analyses and interpretation resulting in the decision to select or not select social risk factors.

Examples may include prevalence of the factor across measured entities, availability of the data source, empirical association with the outcome, contribution of unique variation in the outcome, or assessment of between-unit effects and within-unit effects. Also describe the impact of adjusting for risk (or making no adjustment) on providers at high or low extremes of risk.

[Response Begins]

Age

We found that age had a non-linear statistically significant relationship with 30-day readmission in both bivariate and multivariate analysis (see Table 5). The final specification for age is detailed below. We chose the specification because (a) the categorical variable captures the non-linear relationship of age with the outcome of readmission, (b) the specification has a high likelihood ratio chi-square relative to other less parsimonious specifications, and (c) the age group categories are clinically and developmentally meaningful.

Gender

We found that male gender was significantly associated with increased odds of readmission in bivariate and multivariate analysis (see Table 6) and therefore retained the variable in our model.

Chronic Conditions

To account for chronic disease comorbidity, we used the AHRQ CCI tool to classify ICD-9-CM diagnosis codes for chronic conditions into 18 body systems (organ systems, disease categories, or other categories). We created a dichotomous variable for each body system, with a value of 1 if ≥ 1 chronic condition was present (coded as a primary or secondary diagnosis for an index hospitalization) in that body system or 0 if no chronic condition was present in that body system. We examined each of the 18 CCI variables in relation to the outcome of readmission in bivariate and multivariate analysis, using absence of a chronic condition in the body system in question as the reference.

We found that 12 of the 18 dichotomous variables were significantly related to readmission in bivariate analysis and 11 of the 18 were significantly related in multivariate analysis.

We chose to retain all but the CCI for body system 11, "Complications of pregnancy, childbirth, and the puerperium," in the final model (a) to maintain, to the extent possible, the coherence of the complete AHRQ CCI tool, (b) because most of the CCI variables had a statistically significant relationship with the outcome of readmission, and (c) for harmonization with our Pediatric All-Condition Readmission Measure. Patients who have a primary diagnosis code for an obstetric condition or any diagnosis or procedure code for delivery are excluded from the measure cohort. We have found using various datasets that this exclusion leaves very few (or sometimes no) patients who have a secondary diagnosis code for a chronic condition within body system 11, which could create model-fitting problems if CCI 11 were included in the case-mix-adjustment model.

Number of body systems affected by chronic conditions

We also evaluated a count variable of the number of body systems in which a chronic condition was present for each index hospitalization. To avoid problems with model estimation, we top-coded the variable at ≥ 4 systems affected by a chronic disease because there were few index admissions with diagnoses in ≥ 5 systems.

The CCI count variable had a statistically significant relationship with readmission in bivariate and multivariate analysis. In multivariate analysis, an increasing count was associated with decreasing odds of readmission. This finding indicates that the presence of chronic conditions in multiple body systems confers a readmission risk that is lower than the sum of the risk of chronic conditions in each of the individual body systems, such that the CCI count variable serves to prevent overestimation of the risk associated with having chronic conditions in multiple body systems. We chose to retain *cci count* as an ordinal variable based on (a) its statistically significant relationship with the outcome of readmission and (b) because it adjusts the readmission risk associated with having chronic conditions in multiple body systems.

[Response Ends]

2b.26. Describe the method of testing/analysis used to develop and validate the adequacy of the statistical model or stratification approach (describe the steps—do not just name a method; what statistical analysis was used). Provide the statistical results from testing the approach to control for differences in patient characteristics (i.e., case mix) below. If stratified ONLY, enter “N/A” for questions about the statistical risk model discrimination and calibration statistics.

Validation testing should be conducted in a data set that is separate from the one used to develop the model.

[Response Begins]

We assessed the discriminative ability of the model using the c-statistic.[1,2] Discrimination refers to how well the model distinguishes between subjects with and without the outcome (in this case, readmission).[1] The c-statistic is a unitless measure of the probability that a randomly selected subject who experienced readmission will have a higher predicted probability of having been readmitted than a randomly selected subject who did not experience readmission.[1]

We assessed model calibration with a chi-square goodness-of-fit test analogous to the Hosmer-Lemeshow test.[3] We used the test, which evaluates how well observed outcomes correspond to those predicted by the fitted logistic regression model,[3] to determine how well observed and predicted numbers of readmissions matched for the levels of the 2 ordinal variables in our case-mix adjustment model, age and CCI count. The lack of a significant difference between observed and predicted values indicates good model calibration.

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1. Austin PC, Steyerberg EW. Interpreting the concordance statistic of a logistic regression model: relation to the variance and odds ratio of a continuous explanatory variable. *BMC Med Res Methodol.* 2012;12:82.
2. Steyerberg EW, Vickers AJ, Cook NR, Gerds T, Gonen M, Obuchowski N, Pencina MJ, Kattan MW. Assessing the performance of prediction models: a framework for traditional and novel measures. *Epidemiology.* 2010;21(1):128–138.
3. Hosmer DW, Hosmer T, Le Cessie S, Lemeshow S. A comparison of goodness-of-fit tests for the logistic regression model. *Stat Med.* 1997;16(9):965–980.

[Response Ends]

2b.27. Provide risk model discrimination statistics.

For example, provide c-statistics or R-squared values.

[Response Begins]

The c-statistic for our case-mix adjustment model, when applied to the MAX dataset, was 0.71.

[Response Ends]

2b.28. Provide the statistical risk model calibration statistics (e.g., Hosmer-Lemeshow statistic).

[Response Begins]

When we stratified records by age categories, the p-value for the chi-square goodness-of-fit test was not significant ($p = .56$).

Table 12 – Chi-Square Goodness-of-Fit Test for Lower Respiratory Infection Readmissions: Age

Age Group	Number of Index Admissions	Predicted Cases of Readmissions		Observed Cases of Readmissions	
		n (%)		n (%)	
0 years	33,149	2,105	(6.4%)	2,152	(6.5%)
1-4 years	24,710	1,154	(4.7%)	1,182	(4.8%)
5-7 years	4,501	167	(3.7%)	171	(3.8%)
8-11 years	2,544	127	(5.0%)	130	(5.1%)
12-17 years	2,256	170	(7.5%)	173	(7.7%)

This table displays the number and percent of predicted cases of readmissions compared to the number and percent of observed cases of readmissions, stratified by age categories.

When we stratified records by categories of the number of body systems affected by chronic conditions, the p-value for the chi-square goodness-of-fit test also was not significant ($p = .32$).

Table 13 – Chi-Square Goodness-of-Fit Test for Lower Respiratory Infection Readmissions: CCI Count

CCI Count	Number of Index Admissions	Predicted Cases of Readmissions		Observed Cases of Readmissions	
		n (%)		n (%)	
0 or 1 body systems	60,546	2,881	(4.8%)	2,959	(4.9%)
2 body systems	4,203	435	(10.3%)	440	(10.5%)
3 body systems	1,567	252	(16.1%)	254	(16.2%)
4+ body systems	844	154	(18.3%)	155	(18.4%)

This table displays the number and percent of predicted cases of readmissions compared to the number and percent of observed cases of readmissions, stratified by the number of body systems affected by chronic conditions.

[Response Ends]

2b.29. Provide the risk decile plots or calibration curves used in calibrating the statistical risk model.

The preferred file format is .png, but most image formats are acceptable.

[Response Begins]

Figure 1 – Chi-Square Goodness-of-Fit Test for Lower Respiratory Infection Readmissions: Age

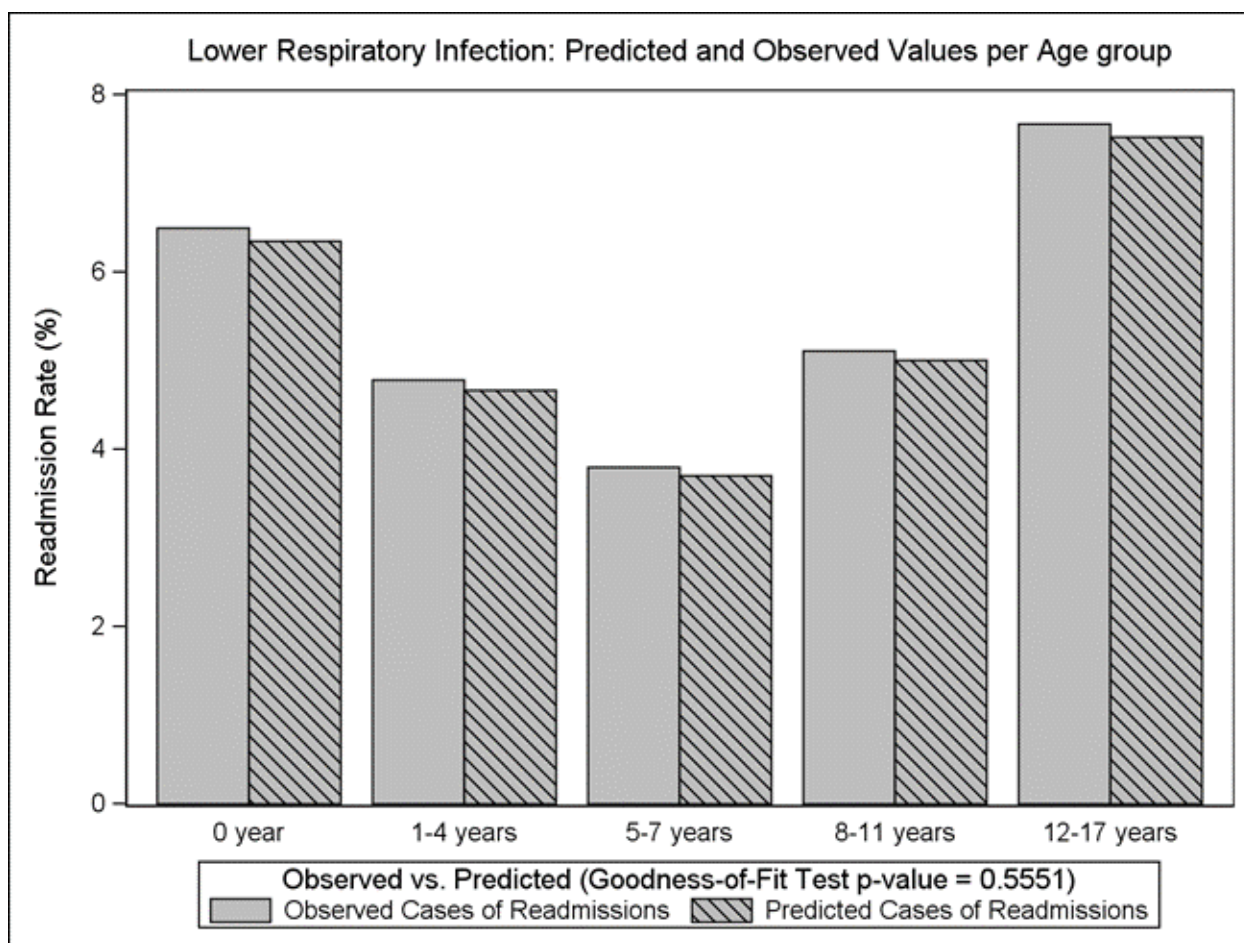
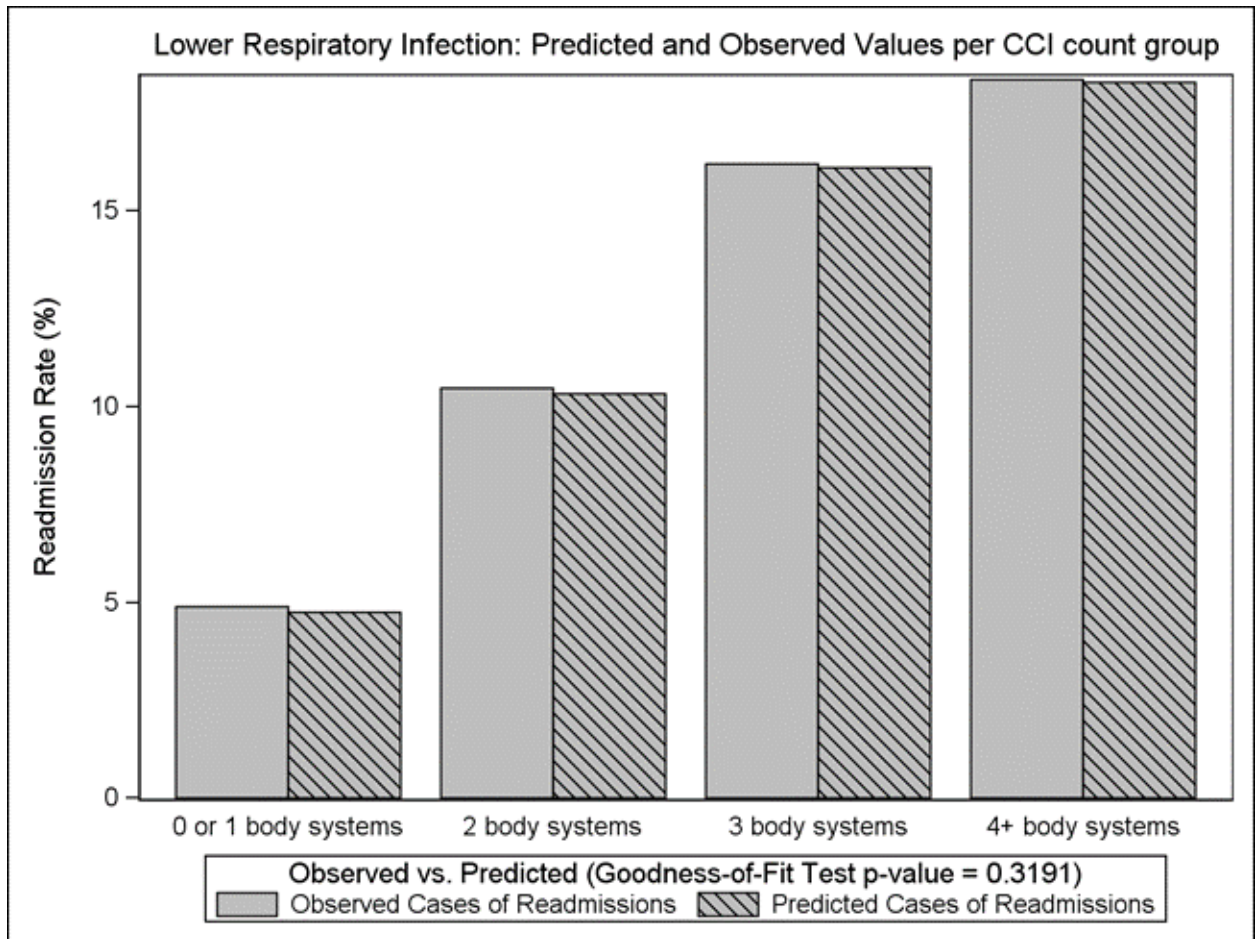


Figure 2 – Chi-Square Goodness-of-Fit Test for Lower Respiratory Infection Readmissions: CCI Count



[Response Ends]

2b.30. Provide the results of the risk stratification analysis.

[Response Begins]

N/A

[Response Ends]

2b.31. Provide your interpretation of the results, in terms of demonstrating adequacy of controlling for differences in patient characteristics (i.e., case mix).

In other words, what do the results mean and what are the norms for the test conducted?

[Response Begins]

The discriminative ability of the case-mix adjustment model is good, with a c-statistic that is very similar to that of other 30-day readmission measures.[28–31] The model calibration is also good, with a close match between observed and predicted numbers of readmissions.

REFERENCES

28. Horwitz L, Partovian C, Lin Z, Herrin J, Grady J, Conover M, Montague J, Dillaway C, Bartczak K, Suter L, Ross J, Bernheim S, Krumholz H, Drye E. Hospital-Wide All-Cause Unplanned Readmission Measure: Final Technical Report.; 2012.

29. Grosso LM, Curtis JP, Lin Z, Geary LL, Vellanky S, Oladele C, Ott LS, Parzynski C, Bernheim S, Suter LG, Drye EE, Krumholz HM. Hospital-level 30-Day All-Cause Risk- Standardized Readmission Rate Following Elective Primary Total Hip Arthroplasty (THA) And/Or Total Knee Arthroplasty (TKA): Measure Methodology Report.; 2012.

30. Grady JN, Lin Z, Wang C, Keenan M, Nwosu C, Bhat KR, Horwitz LI, Drye EE, Krumholz HM, Bernheim SM. 2013 Measures Updates and Specifications Report: Hospital-Level 30-Day Risk-Standardized Readmission Measures for Acute Myocardial Infarction, Heart Failure, and Pneumonia (Version 6.0); 2013.

31. Rice-Townsend S, Hall M, Barnes JN, Lipsitz S, Rangel SJ. Variation in risk-adjusted hospital readmission after treatment of appendicitis at 38 children's hospitals: an opportunity for collaborative quality improvement. *Ann Surg.* 2013;257(4):758–765.

[Response Ends]

2b.32. Describe any additional testing conducted to justify the risk adjustment approach used in specifying the measure.

Not required but would provide additional support of adequacy of the risk model, e.g., testing of risk model in another data set; sensitivity analysis for missing data; other methods that were assessed.

[Response Begins]

N/A

[Response Ends]

3. Feasibility

Extent to which the specifications including measure logic, require data that are readily available or could be captured without undue burden and can be implemented for performance measurement.

3.01. Check all methods below that are used to generate the data elements needed to compute the measure score.

[Response Begins]

Coded by someone other than person obtaining original information (e.g., DRG, ICD-10 codes on claims)

[Response Ends]

3.02. Detail to what extent the specified data elements are available electronically in defined fields.

In other words, indicate whether data elements that are needed to compute the performance measure score are in defined, computer-readable fields.

[Response Begins]

ALL data elements are in defined fields in electronic claims

[Response Ends]

3.03. If ALL the data elements needed to compute the performance measure score are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using data elements not from electronic sources.

[Response Begins]

N/A

[Response Ends]

3.04. Describe any efforts to develop an eCQM.

[Response Begins]

N/A

[Response Ends]

3.06. Describe difficulties (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.

[Response Begins]

The measure uses pediatric inpatient claims data. These data are readily available to hospitals and payers, including State Medicaid programs and private insurers. In addition, several States maintain or are implementing all-payer claims databases.

To address potential issues with data quality or completeness, we have provided in the measure specifications guidelines for assessing records and excluding them from the measure if they contain indicators of poor data quality (e.g., an inconsistent date of birth for the same patient across records) or have missing values for key variables.

[Response Ends]

Consider implications for both individuals providing data (patients, service recipients, respondents) and those whose performance is being measured.

3.07. Detail any fees, licensing, or other requirements to use any aspect of the measure as specified (e.g., value/code set, risk model, programming code, algorithm),

Attach the fee schedule here, if applicable.

[Response Begins]

No fees or licensures apply to the measure.

[Response Ends]

4. Usability and Use

Extent to which potential audiences (e.g., consumers, purchasers, providers, policy makers) are using or could use performance results for both accountability and performance improvement to achieve the goal of high-quality, efficient healthcare for individuals or populations.

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.

NQF-endorsed measures are expected to be used in at least one accountability application within 3 years and publicly reported within 6 years of initial endorsement, in addition to demonstrating performance improvement.

4a.01. Check all current uses. For each current use checked, please provide:

- Name of program and sponsor
- URL
- Purpose
- Geographic area and number and percentage of accountable entities and patients included
- Level of measurement and setting

[Response Begins]

Other (specify)

[Other (specify) Please Explain]

Name of program and sponsor: New York State Department of Health

Purpose: We partnered with the New York Office of Quality and Patient Safety to test implementation of our pediatric lower respiratory infection readmission measure on its Medicaid and all-payer inpatient claims databases.

Geographic area and number and percentage of accountable entities and included: New York State children

Level of measurement and setting: Hospital-level inpatient setting.

Name of program and sponsor: MassHealth

Purpose: We partnered with MassHealth to test implementation of our pediatric lower respiratory infection readmission measure on its Medicaid claims databases.

Geographic area and number and percentage of accountable entities and included: Massachusetts children on Medicaid

Level of measurement and setting: Hospital-level inpatient setting.

[Response Ends]

4a.02. Check all planned uses.

[Response Begins]

Public reporting

Public Health/Disease Surveillance

Payment Program

Quality Improvement with Benchmarking (external benchmarking to multiple organizations)

Quality Improvement (internal to the specific organization)

[Response Ends]

4a.03. If not currently publicly reported OR used in at least one other accountability application (e.g., payment program, certification, licensing), explain why the measure is not in use.

For example, do policies or actions of the developer/steward or accountable entities restrict access to performance results or block implementation?

[Response Begins]

Public reporting does not include many pediatric measures. It is also difficult to identify when pediatric measures are being used in accountability applications as it is difficult to query state-based programs. Medicare-based public reporting and accountability programs do not apply to pediatric patients.

[Response Ends]

4a.04. If not currently publicly reported OR used in at least one other accountability application, provide a credible plan for implementation within the expected timeframes: used in any accountability application within 3 years, and publicly reported within 6 years of initial endorsement.

A credible plan includes the specific program, purpose, intended audience, and timeline for implementing the measure within the specified timeframes. A plan for accountability applications addresses mechanisms for data aggregation and reporting.

[Response Begins]

AHRQ and CMS intend that the measure be available for public use and the full measure specifications are provided on the AHRQ website. For ease of implementation, we have prepared Detailed Measure Specifications and SAS programs for data preparation and estimation of adjusted readmission rates. Our testing has shown that the measure is straightforward to implement using either Medicaid or all-payer claims data. A state quality improvement program, for example, could access the measure materials and easily be able to calculate and report hospital- or state-level rates.

[Response Ends]

4a.05. Describe how performance results, data, and assistance with interpretation have been provided to those being measured or other users during development or implementation.

Detail how many and which types of measured entities and/or others were included. If only a sample of measured entities were included, describe the full population and how the sample was selected.

[Response Begins]

We utilized large multi-state databases in developing the Pediatric Lower Respiratory Infection Readmissions measure and thus were not able to provide individual hospitals with their results. However, we did collaborate with two states to test the measure to ensure validity, feasibility, and usability for states, health plans, and hospitals, and to further develop strategies to streamline data collection and measure reporting. In that context, we provided direct assistance to both in implementing the measure and interpreting the results.

[Response Ends]

4a.06. Describe the process for providing measure results, including when/how often results were provided, what data were provided, what educational/explanatory efforts were made, etc.

[Response Begins]

As described above, we collaborated with two states to test the measure to ensure validity, feasibility, and usability for states, health plans, and hospitals, and to further develop strategies to streamline data collection and measure reporting. They measured readmissions rates at the state- and hospital-level on an annual basis.

[Response Ends]

4a.07. Summarize the feedback on measure performance and implementation from the measured entities and others. Describe how feedback was obtained.

[Response Begins]

Feedback from two states on their testing experiences indicated that the measure is straightforward and can be implemented quickly. Based on helpful suggestions from the states, we improved the clarity of the detailed measure specifications, particularly with regard to use of certain ICD-9-CM codes for applying clinical exclusions and identifying chronic conditions for case-mix adjustment.

[Response Ends]

4a.08. Summarize the feedback obtained from those being measured.

[Response Begins]

N/A

[Response Ends]

4a.09. Summarize the feedback obtained from other users.

[Response Begins]

N/A

[Response Ends]

4a.10. Describe how the feedback described has been considered when developing or revising the measure specifications or implementation, including whether the measure was modified and why or why not.

[Response Begins]

Testing the measure on the states' databases also illustrated potential model-fitting issues that may result when a variable has a very rare value. We have revised the specification of case-mix variables to help avoid these model-fitting issues and included guidance in the detailed measure specifications for evaluating and troubleshooting such issues.

[Response Ends]

4b.01. You may refer to data provided in Importance to Measure and Report: Gap in Care/Disparities, but do not repeat here. Discuss any progress on improvement (trends in performance results, number and percentage of people receiving high-quality healthcare; Geographic area and number and percentage of accountable entities and patients included). If no improvement was demonstrated, provide an explanation. If not in use for performance improvement at the time of initial endorsement, provide a credible rationale that describes how the performance results could be used to further the goal of high-quality, efficient healthcare for individuals or populations.

[Response Begins]

POTENTIAL FOR LRI QUALITY IMPROVEMENT

As mentioned above in Section 1b.03, studies have shown hospital-level variation in pediatric readmission rates for LRI, suggesting there is potential for improvement in the quality of LRI care. One study found significant variation among children's hospitals in 3-day pediatric bronchiolitis readmission rates, which ranged from 0% to 2.7% ($p < .001$).¹ Another study of children's hospitals found significant variation in risk-adjusted 30-day readmission rates for admission diagnoses of bronchiolitis and pneumonia.²

Effective interventions to reduce LRI readmissions have been demonstrated.³⁻⁵ For bronchiolitis, for example, implementation of a clinical pathway with management and discharge criteria significantly reduced 14-day readmission rates.³ For pneumonia, improvements during hospitalization in use of recommended antibiotics, communication of discharge information to patients, and use of electronic medical records have reduced readmission rates.⁶⁻⁷

Unplanned readmissions following hospitalization for LRI care are commonly for complications of the original disease. Interventions aimed at preventing these complications when possible, or better managing them when they occur, could potentially reduce readmissions. The most common complications for bronchiolitis are asthma and other chronic respiratory problems.⁸⁻⁹ Neurologic conditions are increasingly frequent complications of influenza.¹⁰⁻¹² Local complications of pneumonia, such as empyema, lung abscess, and necrotizing pneumonia, are becoming more prevalent, particularly in younger children.¹²⁻¹³

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[Response Ends]

4b.02. Explain any unexpected findings (positive or negative) during implementation of this measure, including unintended impacts on patients.

[Response Begins]

No unintended negative consequences were identified during implementation.

[Response Ends]

4b.03. Explain any unexpected benefits realized from implementation of this measure.

[Response Begins]

No unintended benefits were identified during implementation.

[Response Ends]

5. Comparison to Related or 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.

If you are updating a maintenance measure submission for the first time in MIMS, please note that the previous related and competing data appearing in question 5.03 may need to be entered in to 5.01 and 5.02, if the measures are NQF endorsed. Please review and update questions 5.01, 5.02, and 5.03 accordingly.

5.01. Search and select all NQF-endorsed related measures (conceptually, either same measure focus or target population).

(Can search and select measures.)

[Response Begins]

0329: Risk-Adjusted 30-Day All-Cause Readmission Rate

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

0695: Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

1551: Hospital-level 30-day risk-standardized readmission rate (RSRR) following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA)

1768: Plan All-Cause Readmissions (PCR)

1891: Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following chronic obstructive pulmonary disease (COPD) hospitalization

[Response Ends]

5.02. Search and select all NQF-endorsed competing measures (conceptually, the measures have both the same measure focus or target population).

(Can search and select measures.)

[Response Begins]

[Response Ends]

5.03. If there are related or competing measures to this measure, but they are not NQF-endorsed, please indicate the measure title and steward.

[Response Begins]

N/A

[Response Ends]

5.04. If this measure conceptually addresses EITHER the same measure focus OR the same target population as NQF-endorsed measure(s), indicate whether the measure specifications are harmonized to the extent possible.

[Response Begins]

No

[Response Ends]

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

[Response Begins]

Our candidate measure fills a gap in pediatric quality measurement by addressing the current dearth of inpatient care measures. The measure also addresses the need for readmission measures developed for use in children. We have harmonized our measure with the CMS Hospital-Level 30-Day Risk-Standardized Readmission for Pneumonia (NQF# 0506) for adults. Like the adult measure, our measure calculates unplanned readmissions following hospitalization for pneumonia, where a readmission is defined as the first unplanned admission to any acute care hospital within 30 days of discharge from a prior hospitalization at an acute care hospital. However, the adult measure allows each hospitalization to potentially count as both an index admission and a readmission and permits multiple index admissions per patient within a 30-day period. For our measure, in contrast, additional admissions within 30 days from discharge from an index admission are not counted as index admissions. An admission more than 30 days from discharge from an index admission is counted as a new index admission. We chose this approach to increase the independence of observations and thus avoid having readmission rates dominated by the- relatively few children with multiple readmissions within short time periods. Our measure covers the pediatric population, with an age eligibility criterion (less than 18 years old) that is complementary to that of the adult measure (18 years or older). Like the adult measure, our measure also uses a statistical model to case-mix adjust readmission rates but our model was specifically developed for pediatric patients. Our measure also uses an algorithm for identifying hospitalizations for planned procedures and excluding them from readmissions. However, we developed the algorithm specifically for pediatric patients through a process in which pediatric expert clinicians reviewed ICD-9-CM procedure codes and indicated whether each procedure is typically planned in advance for children. We do not anticipate that differences between our measure and the adult measure would affect the interpretability or data collection burden of our measure.

[Response Ends]

5.06. Describe why this measure is superior to competing measures (e.g., a more valid or efficient way to measure quality). Alternatively, justify endorsing an additional measure.

Provide analyses when possible.

[Response Begins]

Not applicable. This measure does not conceptually address the same focus and target population as NQF-endorsed measure(s).

[Response Ends]

Appendix

Supplemental materials may be provided in an appendix.:

Available in attached file

Attachment: 2414_2414_Pediatric_Lower_Respiratory_Infection_Readmission_Measure_-NQF-_2414-_Appendix_2014-02-05-508.pdf

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Additional Information

1. Provide any supplemental materials, if needed, as an appendix. All supplemental materials (such as data collection instrument or methodology reports) should be collated one file with a table of contents or bookmarks. If material pertains to a specific criterion, that should be indicated.

[Response Begins]

Available in attached file

[Response Ends]

Attachment: 2414_2414_Pediatric_Lower_Respiratory_Infection_Readmission_Measure_-NQF-_2414-_Appendix_2014-02-05-508.pdf

2. List the workgroup/panel members' names and organizations.

Describe the members' role in measure development.

[Response Begins]

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Our Scientific Advisory Board, consisting of representatives from Boston Children's Hospital, the larger Harvard community, and organizations such as the National Initiative for Children's Healthcare Quality, as well as our National Stakeholder Panel, which includes representatives from diverse national organizations representing

patients and families, providers, payers, and health services researchers, provided guidance and feedback on the measure. We also received comments on the measure from the Massachusetts Child Health Quality Coalition, which includes patient and family advocates, as well as representatives from academic, community, and state institutions.

[Response Ends]

3. Indicate the year the measure was first released.

[Response Begins]

2013

[Response Ends]

4. Indicate the month and year of the most recent revision.

[Response Begins]

December 2016

[Response Ends]

5. Indicate the frequency of review, or an update schedule, for this measure.

[Response Begins]

N/A

[Response Ends]

6. Indicate the next scheduled update or review of this measure.

[Response Begins]

November 2022

[Response Ends]

7. Provide a copyright statement, if applicable. Otherwise, indicate "N/A".

[Response Begins]

N/A

[Response Ends]

8. State any disclaimers, if applicable. Otherwise, indicate "N/A".

[Response Begins]

N/A

[Response Ends]

9. Provide any additional information or comments, if applicable. Otherwise, indicate "N/A".

[Response Begins]

N/A

[Response Ends]