

Pediatric Lower Respiratory Infection Readmission Measure

Section 1. Basic Measure Information

1.A. Measure Name

Pediatric Lower Respiratory Infection Readmission Measure

1.B. Measure Number

0131

1.C. Measure Description

Please provide a non-technical description of the measure that conveys what it measures to a broad audience.

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

1.D. Measure Owner

Center of Excellence for Pediatric Quality Measurement

1.E. National Quality Forum (NQF) ID (if applicable)

Not applicable.

1.F. Measure Hierarchy

Please note here if the measure is part of a measure hierarchy or is part of a measure group or composite measure. The following definitions are used by AHRQ:

- 1. Please identify the name of the collection of measures to which the measure belongs (if applicable). A collection is the highest possible level of the measure hierarchy. A collection may contain one or more sets, subsets, composites, and/or individual measures.**

Not applicable.

- 2. Please identify the name of the measure set to which the measure belongs (if applicable). A set is the second level of the hierarchy. A set may include one or more subsets, composites, and/or individual measures.**

Not applicable.

- 3. Please identify the name of the subset to which the measure belongs (if applicable). A subset is the third level of the hierarchy. A subset may include one or more composites, and/or individual measures.**

Not applicable.

- 4. Please identify the name of the composite measure to which the measure belongs (if applicable). A composite is a measure with a score that is an aggregate of scores from other measures. A composite may include one or more other composites and/or individual measures. Composites may comprise component measures that can or cannot be used on their own.**

Not applicable.

1.G. Numerator Statement

Hospitalizations at general acute care hospitals for LRI in patients less than 18 years old that are followed by one or more readmissions to general acute care hospitals within 30 days.

1.H. Numerator Exclusions

Readmissions are excluded from the numerator if the readmission was for a planned procedure or for chemotherapy.

Readmissions for planned procedures (as measured by our planned procedures algorithm, described in Section 2, Detailed Measure Specifications, below) 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.

1.I. Denominator Statement

Hospitalizations at general acute care hospitals for LRI in patients less than 18 years old. These hospitalizations are identified using a case definition that requires either a primary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code or a principal International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis code for bronchiolitis, influenza, or community-acquired pneumonia (CAP) or a secondary ICD-9-CM or additional ICD-10-CM diagnosis code for one of these LRIs plus a primary ICD-9-CM or a principal ICD-10-CM diagnosis code for asthma, respiratory failure, or

sepsis/bacteremia. We provide ICD-9-CM and ICD-10-CM codes for case ascertainment and clinical exclusions in Section 2.

1.J. Denominator Exclusions

We exclude certain hospitalizations from the measure 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. We provide the rationale for each exclusion in Section 2 (see Supporting Documents).

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

1. The patient was 18 years old or greater at the time of discharge.
2. The hospitalization was for birth of a healthy newborn.
3. The hospitalization was for obstetric care, including labor and delivery.
4. The primary diagnosis code was for a mental health condition.
5. The hospitalization was at a specialty or non-acute-care hospital.
6. The discharge disposition was death.
7. The discharge disposition was leaving the hospital against medical advice.
8. 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 diagnosis code, or gender.
9. The hospital is in a State not being analyzed. (Records for these hospitalizations are still assessed as possible readmissions, but readmission rates are not calculated for the out-of-State hospitals due to their lack of complete data.)
10. Thirty days of follow-up data are not available for assessing readmissions.
11. The hospital has less than 80 percent of records with complete patient identifier, admission date, and discharge date or less than 80 percent of records with complete primary 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.)
12. 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 discharge status of death during a prior hospitalization.
13. Codes other than ICD-9-CM procedure codes or International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) procedure codes are used for the primary procedure.

1.K. Data Sources

Check all the data sources for which the measure is specified and tested.

Administrative data (e.g., claims data).

If other, please list all other data sources in the field below.

Not applicable.

Section 2: Detailed Measure Specifications

Provide sufficient detail to describe how a measure would be calculated from the recommended data sources, uploading a separate document (+ Upload attachment) or a link to a URL. Examples of detailed measure specifications can be found in the CHIPRA Initial Core Set Technical Specifications Manual 2011 published by the Centers for Medicare & Medicaid Services. Although submission of formal programming code or algorithms that demonstrate how a measure would be calculated from a query of an appropriate electronic data source are not requested at this time, the availability of these resources may be a factor in determining whether a measure can be recommended for use.

Please see Supporting Documents for detailed measure specifications.

Section 3. Importance of the Measure

In the following sections, provide brief descriptions of how the measure meets one or more of the following criteria for measure importance (general importance, importance to Medicaid and/or CHIP, complements or enhances an existing measure). Include references related to specific points made in your narrative (not a free-form listing of citations).

3.A. Evidence for General Importance of the Measure

Provide evidence for all applicable aspects of general importance:

- **Addresses a known or suspected quality gap and/or disparity in quality (e.g., addresses a socioeconomic disparity, a racial/ethnic disparity, a disparity for Children with Special Health Care Needs (CSHCN), a disparity for limited English proficient (LEP) populations).**
- **Potential for quality improvement (i.e., there are effective approaches to reducing the quality gap or disparity in quality).**
- **Prevalence of condition among children under age 21 and/or among pregnant women**
- **Severity of condition and burden of condition on children, family, and society (unrelated to cost)**

- **Fiscal burden of measure focus (e.g., clinical condition) on patients, families, public and private payers, or society more generally, currently and over the life span of the child.**
- **Association of measure topic with children’s future health – for example, a measure addressing childhood obesity may have implications for the subsequent development of cardiovascular diseases.**
- **The extent to which the measure is applicable to changes across developmental stages (e.g., infancy, early childhood, middle childhood, adolescence, young adulthood).**

Importance of LRIs and LRI Readmission

LRIs, consisting of bronchiolitis, influenza, and CAP, are among the most common reasons for pediatric hospitalization. Bronchiolitis and CAP are also two of the ten admission diagnoses with the highest readmission prevalence in children (Berry, Toomey, Zaslavsky, et al., 2013). Hospitalizations for LRI-related care impose significant clinical, social, and financial burdens on patients and families. Reducing LRI readmissions could alleviate these burdens and reduce health care costs.

Prevalence of LRI

Bronchiolitis, influenza, and CAP are highly prevalent in the pediatric population. Annually, bronchiolitis affects 26 in 1,000 children 0 to 2 years old (Pelletier, Mansbach, Camargo Jr, 2006; Mansbach, Emond, Carmago Jr, 2005). Respiratory syncytial virus (RSV), the leading cause of bronchiolitis, infects nearly 90 percent of children during the first 2 years of life, 40 percent of whom develop bronchiolitis (American Academy of Pediatrics [AAP], 2006). Influenza attack rates are highest in children and range from 15 percent to 70 percent annually Carr, 2012). Influenza most commonly affects children 5 to 18 years old (Carr, 2012). During the 2009 A(H1N1) pandemic alone, 20 million children acquired the infection (Chang, Jordan-Villegas, Evans, et al., 2012). The prevalence of pediatric CAP decreases with age. A study using 2006 data from children’s and non-children’s hospitals estimated that 912 in 100,000 children less than 1 year of age acquired CAP. The corresponding rates for children 1 to 5, 6 to 12, and 13 to 18 years old were 390/100,000, 84/100,000, and 62/100,000, respectively (Lee, Lorch, Sheffler-Collins, et al., 2010).

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 a readmission is substantial. Overall, readmissions within 30 days occur for 2 percent to 6 percent of pediatric hospitalizations Berry, et al., 2013; Jencks, Williams, Coleman, 2009; Jiang, Wier, 2006; Wick, Shore, Hirose, 2011). Thirty-day readmissions occur for 3.7 percent to 4.5 percent of pediatric bronchiolitis hospitalizations and 4.5 percent of pediatric pneumonia hospitalizations (Berry, et al., 2013; Kemper, Kennedy, Dechert, et al., 2005). Because LRIs are such a common reason for hospitalization, the absolute number of readmissions following LRI hospitalizations is high. Readmissions signal the quality of disease management, indicating a worsening of health status that in some cases may have been prevented. They also 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 than those without such conditions to develop influenza complications and are at a higher risk for readmission following hospitalization for influenza (Bhat, Wright, Broder, et al., 2005).

LRI Hospitalizations and Readmission Rates Vary by Age

The prevalence of LRI-related hospitalizations and readmissions varies significantly by age. Bronchiolitis is the leading cause of hospitalization in infants (Pelletier, et al., 2006). Influenza hospitalization rates are highest for children <6 months old (Carr, 2012). The rate of pneumonia hospitalization is highest in children <2 years old, at 1,000 hospitalizations per 100,000 children, and decreases with age (Griffin, Zhu, Moore, et al., 2013). The relationship of age to bronchiolitis or influenza readmission risk has not yet been reported. Readmissions for pneumonia are most prevalent in older children. One study found that readmission rates following pneumonia hospitalizations were 1.9 percent for children 12 to 18 years old, 1.2 percent in children 1 to 5 years old, and 0.9 percent in children 6 to 11 years old ($p < 0.001$) (Weiss, Hall, Lee, et al., 2011). Another study found a similar age-associated trend in pediatric pneumonia readmission rates (Brogan, Hall, Williams, et al., 2012).

Social and Clinical Burdens of LRI and LRI Readmissions

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 (Rennick, Johnston, Dougherty, et al., 2002; Shudy, de Almeida, Ly, et al., 2006). Infants hospitalized for bronchiolitis, for example, are commonly discharged prior to full recovery. As a result, parents must take time off from work, keep their child out of day care, and schedule additional medical visits (Robbins, Kotagal, Kini, et al., 2006). Readmission also exposes patients to additional hospital days and thus increased potential for further infections and medical errors (Institute of Medicine, 2000, 2006).

Fiscal Burden of LRI and LRI Readmissions

LRIs and LRI readmissions among pediatric patients are costly. The average cost of a bronchiolitis-associated hospitalization is \$9,063 per child (Wilson, Landrigan, Horn, et al., 2003). Furthermore, the development of chronic complications from bronchiolitis, such as asthma, poses a significant long-term financial burden (AAP, 2006). The total estimated annual cost of pediatric influenza is \$1.67 billion, with costs of approximately \$55 million per hospital annually (Ampofo, Gesteland, Bender, et al., 2006; Molinari, Ortega-Sanchez, Messonnier, et al., 2007). Costs of influenza hospitalization to patients and families are also substantial and include direct costs of medical care and indirect costs, such as school absenteeism and parental work loss (Weycker, Edelsberg, Halloran, 2005). The average cost of hospitalization for CAP (for children and adults) is \$12,000 per patient (Paladino, Adelman, Schentag, 2007).

Association of Readmission with Children's Future Health

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 (Worchel-Prevatt, Heffer, Prevatt, et al., 1998). Frequently

hospitalized adolescents are more likely to drop out of school than their healthy peers (Kearney, 2008; Weitzman, Klerman, Lamb, et al., 1982). School reintegration can be complicated by side effects caused by treatment or the illness itself or by increased social, emotional, and behavioral problems (Shaw, McCabe, 2008).

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 percent to 2.7 percent ($p < 0.001$) (Christakis, Cowan, Garrison, et al., 2005). Another study of children's hospitals found significant variation in risk-adjusted 30-day readmission rates for admission diagnoses of bronchiolitis and pneumonia (Berry, et al., 2013). Effective interventions to reduce LRI readmissions have been demonstrated (Cheney, Barber, Altamirano, et al., 2005; Dean, Bateman, Donnelly, et al., 2006; Pillai, Song, Pastor, et al., 2011).

For bronchiolitis, for example, implementation of a clinical pathway with management and discharge criteria significantly reduced 14-day readmission rates (Cheney, et al., 2005). 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 (Jones, Friedberg, Schneider, 2011; Schmeida, Savrin, 2012). 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 (Bacharier, Cohen, Schweiger, et al., 2012; Wilson, et al., 2003). Neurologic conditions are increasingly frequent complications of influenza (Bhat, et al., 2005; Effler, 2012; Keren, Zaoutis, Bridges, et al., 2005). Local complications of pneumonia, such as empyema, lung abscess, and necrotizing pneumonia, are becoming more prevalent, particularly in younger children (Grijalva, Nuorti, Zhu, et al., 2010; Keren, et al., 2005).

3.B. Evidence for Importance of the Measure to Medicaid and/or CHIP

Comment on any specific features of this measure important to Medicaid and/or CHIP that are in addition to the evidence of importance described above, including the following:

- **The extent to which the measure is understood to be sensitive to changes in Medicaid or CHIP (e.g., policy changes, quality improvement strategies).**
- **Relevance to the Early and Periodic Screening, Diagnostic and Treatment benefit in Medicaid (EPSDT).**
- **Any other specific relevance to Medicaid/CHIP (please specify).**

Measuring readmission rates among Medicaid-insured patients is particularly important because multiple analyses have demonstrated that they are at higher risk of readmission than privately insured patients. An analysis of the 2007 Healthcare Cost and Utilization Project (HCUP) State

Inpatient Databases (see <https://www.ahrq.gov/research/data/hcup/index.html>) for 10 States found that the 30-day readmission rate for pediatric Medicaid beneficiaries (ages 0 to 20 years, including newborns but excluding obstetric patients) was 3.1 percent, compared with 2.0 percent for privately-insured children ($p < 0.05$). Readmission rates were higher for Medicaid-insured patients than for their privately-insured counterparts in every age and gender category except for the subcategory of 13- to 20-year-old females who were admitted for obstetric care (Jiang, et al., 2007). An analysis using our candidate measure also found that compared with Medicaid-insured children, children with private insurance (odds ratio (OR) 0.79 [95 percent confidence interval (CI) 0.73 to 0.85], $p < 0.001$); other types of insurance, such as Medicare or other government-sponsored insurance (OR 0.71 [95 percent CI 0.53 - 0.94], $p < 0.001$); or self-pay status (OR 0.75 [95 percent CI 0.64 to 0.88], $p < 0.001$) are at lower risk of LRI readmission.

Given their higher risk of readmission, Medicaid-insured children are a vulnerable population, and targeted interventions to reduce readmissions among this population are especially critical. Interventions that reduce hospital readmission rates by improving hospital discharge, transition, and post-discharge care, as well as disease management, should be beneficial to all patients, including those insured by Medicaid. Interventions that specifically address the complex needs of Medicaid-insured patients may be particularly effective in reducing readmission rates in this group. The impact of insurance type on LRI-related readmissions has not been studied specifically, and interventions to reduce readmission rates targeted specifically for Medicaid beneficiaries with LRIs have not yet been reported. However, interventions that have effectively reduced readmission rates for other conditions in Medicaid-insured patients could also be effective in preventing readmission for LRIs.

The Care Transitions Innovation (C-TraIn) is a low-cost, multi-component transitional care intervention that has decreased readmission rates in uninsured and Medicaid-insured populations (Englander, Kansagara, 2012). The intervention helps remove financial barriers to care by providing inpatient pharmacy consultation, a 30-day supply of medications for use after discharge, payment for medical homes for uninsured patients who lack access to outpatient care, and access to a transitional care nurse to bridge care between the inpatient and outpatient settings. This low cost intervention illustrates how investing a relatively small amount of resources upfront could potentially avert the much greater cost of hospital readmission.

North Carolina has demonstrated that interventions implemented via a Medicaid program can be highly effective in reducing readmissions. Its statewide initiative focused on comprehensive transitional care for Medicaid beneficiaries with complex chronic medical conditions, with the intensity of the intervention tailored to patients' readmission risk (Jackson, Trygstad, Dewalt, et al., 2013). Patients who received the intervention were 20 percent less likely to experience a readmission during the subsequent year than clinically similar patients who received routine care. Additionally, patients who received the transitional care were less likely than routine-care patients to experience multiple readmissions. These findings suggest that transitional care interventions targeted to address the particular needs of Medicaid-insured patients can reduce hospital readmissions among this high-risk population. A pediatric readmission measure could be used to track the impact of similar interventions in Medicaid-insured children after hospitalization for LRI.

3.C. Relationship to Other Measures (if any)

Describe, if known, how this measure complements or improves on an existing measure in this topic area for the child or adult population, or if it is intended to fill a specific gap in an existing measure category or topic. For example, the proposed measure may enhance an existing measure in the initial core set, it may lower the age range for an existing adult-focused measure, or it may fill a gap in measurement (e.g., for asthma care quality, inpatient care measures).

The 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. Readmissions have become a major focus for quality improvement. The Centers for Medicare & Medicaid Services (CMS) publicly reports readmission rates for Medicare-insured adults and, starting in October 2012, began reducing Medicare payments to hospitals with excess readmissions following hospitalizations for acute myocardial infarction, heart failure, or pneumonia. Some State Medicaid programs are working to benchmark State-level readmission rates and to reduce readmissions (Agency for Healthcare Research and Quality [AHRQ], 2011; Massachusetts Executive Office of Health and Human Services, 2017). To date, however, most readmission measures have been developed for use only in adult patients.

Our candidate measure complements the CMS Hospital-Level 30-Day Risk-Standardized Readmission Measure for Pneumonia (NQF# 0506) for adults. Like the adult measure, our measure calculates 30-day unplanned readmissions after hospitalization for pneumonia. Our measure covers the pediatric population, however, with an age eligibility criterion (less than 18 years old) complementary to that of the adult measure (18 years or older) and a case-mix adjustment model specifically developed for pediatric patients. Our measure also includes readmissions following hospitalization for bronchiolitis and influenza, two other important LRIs in children.

Section 4. Measure Categories

CHIPRA legislation requires that measures in the initial and improved core set, taken together, cover all settings, services, and topics of health care relevant to children. Moreover, the legislation requires the core set to address the needs of children across all ages, including services to promote healthy birth. Regardless of the eventual use of the measure, we are interested in knowing all settings, services, measure topics, and populations that this measure addresses. These categories are not exclusive of one another, so please indicate "Yes" to all that apply.

Does the measure address this category?

- a. Care Setting – ambulatory:** Yes.
- b. Care Setting – inpatient:** Yes.
- c. Care Setting – other – please specify:** Yes; because the measure assesses health system quality, it addresses all of these care settings: home, school, other community and public health settings, and long-term care.

- d. **Service – preventive health, including services to promote healthy birth:** No.
- e. **Service – care for acute conditions:** Yes.
- f. **Service – care for children with acute conditions:** Yes.
- g. **Service – other (please specify):** No.
- h. **Measure Topic – duration of enrollment:** No.
- i. **Measure Topic – clinical quality:** Yes.
- j. **Measure Topic – patient safety:** No.
- k. **Measure Topic – family experience with care:** No.
- l. **Measure Topic – care in the most integrated setting:** No.
- m. **Measure Topic other (please specify):** No.
- n. **Population – pregnant women:** No.
- o. **Population – neonates (28 days after birth) (specify age range):** Yes; 0-28 days.
- p. **Population – infants (29 days to 1 year) (specify age range):** Yes; 29-364 days.
- q. **Population – pre-school age children (1 year through 5 years) (specify age range):**
Yes; 1-5 years.
- r. **Population – school-aged children (6 years through 10 years) (specify age range):**
Yes; 6-10 years.
- s. **Population – adolescents (11 years through 20 years) (specify age range):** Yes; 11-17
years.
- t. **Population – other (specify age range):** No.
- u. **Other category (please specify):** Not applicable.

Section 5. Evidence or Other Justification for the Focus of the Measure

The evidence base for the focus of the measures will be made explicit and transparent as part of the public release of CHIPRA deliberations; thus, it is critical for submitters to specify the scientific evidence or other basis for the focus of the measure in the following sections.

5.A. Research Evidence

Research evidence should include a brief description of the evidence base for valid relationship(s) among the structure, process, and/or outcome of health care that is the focus of the measure. For example, evidence exists for the relationship between immunizing a child or adolescent (process of care) and improved outcomes for the child and the public. If sufficient evidence existed for the use of immunization registries in practice or at the State level and the provision of immunizations to children and adolescents, such evidence would support the focus of a measure on immunization registries (a structural measure).

Describe the nature of the evidence, including study design, and provide relevant citations for statements made. Evidence may include rigorous systematic reviews of research literature and high-quality research studies.

Evidence suggests that readmission rates provide a useful measure of health care quality (see Tables 8 and 9 in the Supporting Documents). The use of effective, evidence-based approaches to diagnosis, treatment, and monitoring of disease leads to fewer complications and decreased exacerbations, which in turn can result in a decreased frequency of hospitalizations. Therefore, readmission rates reflect, in part, the quality of clinical care and resulting disease outcomes.

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 (Anderson, Deepak, Amoateng-Adjepong, et al., 2005; Balaban, Weissman, Samuel, et al., 2008; Bradley, Curry, Horwitz, et al., 2013; Coleman, Parry, Chalmers, et al., 2006; Costantino, Frey, Hall, et al., 2013; Evans, Hendricks, 1993; Flood, MacLennan, McGrew, et al., 2013; Harrison, Hara, Pope, et al., 2011; Inglis, Clark, McAlister, et al., 2010; Jack, Chetty, Anthony, et al., 2009; Koehler, Richter, Youngblood, et al., 2009; Leschke, Panepinto, Nimmer, et al., 2012; Naylor, Brooten, Campbell, et al., 2004; Naylor, Brooten, Jones, et al., 1994; Phillips, Wright, Kern, et al., 2004; Rich, Beckham, Wittenberg, et al., 1995; Scott, 2010; Shepperd, Lannin, Clemson, et al., 2013; Sochalski, Jaarsma, Krumholz, et al., 2009). 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 (Anderson, et al., 2005; Balaban, et al., 2008; Coleman, et al., 2006; Evans, et al., 1993; Jack, et al., 2009; Koehler, et al., 2009; Leschke, et al., 2012; Naylor, 1994, 2004); Phillips, et al., 2004; Rich, et al., 1995; Scott, 2010; Shepperd, et al., 2013).

Project RED (AHRQ, 2013) and the Care Transition Measure are two 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 (Coleman, et al., 2006; Markley, Andow, Sabharwal, 2013).

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. Parental perception that a child is not healthy enough for discharge is associated with a greater risk of subsequent, unplanned 30-day readmission (Berry, Ziniel, Freeman, et al., 2013). Responding to parental concerns about a child's health prior to hospital discharge may help mitigate readmission risk.

Regarding LRI readmissions specifically, several studies have examined the relationship in adults between readmissions and the quality of care for LRIs (Boulding, Glickman, Manary, et al., 2011; Dean, et al., 2006; McHugh, Ma, 2013; Schmeida, Savrin, 2012). Interventions that

target improvements in discharge processes and hospital staffing have been associated with reduced 30-day readmission rates for adults hospitalized with pneumonia. For example, improvements in the dissemination of discharge information to patients and patient satisfaction with discharge planning were associated with reduced readmission rates (Boulding, et al., 2011; Schmeida, Savrin, 2012). Additionally, increases in hospital nurse-to-patient ratios have been associated with decreased risk of readmission (McHugh, Ma, 2013). These strategies, while drawn from studies in the adult population, have broad applications and potentially could be effective in children.

5.B. Clinical or Other Rationale Supporting the Focus of the Measure (optional)

Provide documentation of the clinical or other rationale for the focus of this measure, including citations as appropriate and available.

Readmission rates signal the quality of disease management in that more effective clinical care leads to decreased exacerbations, severity, and complications, and in turn, can lead to a reduced need for rehospitalization. Readmission rates therefore reflect the quality of 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 (Bozic, Maselli, Pekow, et al., 2010; Ludke, MacDowell, Booth, et al., 1990). 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 (Ashton, Kuykendall, Johnson, et al., 1995; Bozic, et al., 2010; Fassl, Nkoy, Stone, et al., 2012; Ludke, et al., 1990).

With regard to LRI care specifically (Kotagal, Robbins, Kini, et al., 2002; Neuman, Hall, Hersh, et al., 2012; Ralston, Garber, Narang, et al., 2013; Sandweiss, Mundorff, Hill, et al., 2013), interventions that aim to standardize diagnosis and treatment protocols for LRI have been associated with reduced pediatric readmission rates in multiple (but not all) studies (Cheney, et al., 2005; Pillai, et al., 2011; Kotagal, et al., 2002; Neuman, et al., 2012; Ralston, et al., 2013; Sandweiss, et al., 2013). For example, introduction of a clinical pathway for treatment of infants hospitalized with acute viral bronchiolitis resulted in a significant reduction in 14-day readmission rates (Cheney, et al., 2005). Implementation of a literature-based diagnosis and management algorithm for the treatment of childhood pneumonia resulted in reductions in readmissions (Pillai, et al., 2011). These findings suggest an association between the quality of the diagnosis and treatment processes for LRI and readmission rates.

Section 6. Scientific Soundness of the Measure

Explain the methods used to determine the scientific soundness of the measure itself. Include results of all tests of validity and reliability, including description(s) of the study sample(s) and methods used to arrive at the results. Note how characteristics of other data systems, data sources, or eligible populations may affect reliability and validity.

6.A. Reliability

Reliability of the measure is the extent to which the measure results are reproducible when conditions remain the same. The method for establishing the reliability of a measure will depend on the type of measure, data source, and other factors.

Explain your rationale for selecting the methods you have chosen, show how you used the methods chosen, and provide information on the results (e.g., the Kappa statistic). Provide appropriate citations to justify methods.

We developed and tested the measure using multiple claims datasets. These included 2008 Medicaid Analytic eXtract (MAX) data for 26 States, which include Medicaid claims from children's and non-children's hospitals; 2005-2009 AHRQ Revisit data for New York and Nebraska, which include claims for all payers from children's and non-children's hospitals; July 2009 to June 2010 National Association of Children's Hospitals and Related Institutions (NACHRI) case mix data, which include claims for all payers from 72 acute care children's hospitals in 34 States; and the 2009 Kids' Inpatient Database (KID), which includes claims for all payers from children's and non-children's hospitals in 44 States. For the MAX and AHRQ Revisit datasets, we chose which States' data to use based on assessment of data quality and completeness. All of the datasets except the KID can be used to evaluate readmissions (although the NACHRI case mix data only allow identification of readmissions back to the same hospital); the KID provides other useful information about pediatric hospitalizations, such as frequencies of specific conditions and procedures, and can be weighted to produce national estimates.

We evaluated the reliability of hospital-level readmission rates using the formula shown in the supplemental materials (see Supporting Documents, Section 6-A, Reliability Formula). Reliability values range from 0 to 1. If perfect information from a very large sample was available for a hospital, so 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 was available for a hospital, then the reliability of that hospital's readmission rate would be 0.

Using our 26-State MAX dataset, we determined that for hospitals with at least 25 pediatric LRI admissions annually, the median reliability for hospital-level LRI readmission rates was 0.46 (interquartile range 0.35 to 0.61). Reliability was >0.5 for hospitals with at least 76 index admissions annually. We found that 73 percent of index hospitalizations occurred at hospitals whose readmission rate reliability was at least 0.5, while 41 percent of index hospitalizations occurred at hospitals whose readmission rate reliability was at least 0.7.

Use of hospital random effects in our case-mix adjustment model adjusts the readmission rate estimate toward the mean rate for the entire cohort of hospitals, more so for hospitals with low volume and correspondingly low readmission rate reliability (because for a hospital with little available data, estimation of the hospital's rate relies more on assumptions about the distribution of hospital rates than for a hospital with a large amount of data). As a result, a hospital that has a high or low unadjusted readmission rate but insufficient volume to estimate its readmission rate precisely is prevented from appearing to be an outlier when it might not be.

6.B. Validity

Validity of the measure is the extent to which the measure meaningfully represents the concept being evaluated. The method for establishing the validity of a measure will depend on the type of measure, data source, and other factors.

Explain your rationale for selecting the methods you have chosen, show how you used the methods chosen, and provide information on the results (e.g., R2 for concurrent validity).

We evaluated the validity of the measure's case-mix adjustment model by assessing the discriminative ability of the model using the concordance (c-) statistic (Austin, Steyerberg, 2012; Steyerberg, Vickers, Cook, et al., 2010). Discrimination refers to how well the model distinguishes between subjects with and without the outcome (in this case, readmission) (Austin, Steyerberg, 2012). The c-statistic is a unit-less 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 (Austin, Steyerberg, 2012). The c-statistic for our case-mix adjustment model, when applied to our 26-State MAX dataset, was 0.71, which is very much in range with results for other 30-day readmission models (Grady, Lin, Wang, 2013; Grosso, Curtis, Lin, et al., 2012; Horwitz, Partovian, Lin, 2012; Rice-Townsend, Hall, Barnes, 2013).

Section 7. Identification of Disparities

CHIPRA requires that quality measures be able to identify disparities by race, ethnicity, socioeconomic status, and special health care needs. Thus, we strongly encourage nominators to have tested measures in diverse populations. Such testing provides evidence for assessing measure's performance for disparities identification. In the sections below, describe the results of efforts to demonstrate the capacity of this measure to produce results that can be stratified by the characteristics noted and retain the scientific soundness (reliability and validity) within and across the relevant subgroups.

7.A. 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 our 26-State 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 and Hispanic patients had higher odds of readmission ($p < 0.001$ for each comparison), independent of case-mix (age, gender, and chronic conditions) and index admission hospital (see Table 10 in the Supporting Documents materials).

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 ($p = 0.021$) and Native American patients ($p = 0.010$) but not black or Latino patients (see Table 11 in the Supporting Documents).

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 and between Hispanic and white patients 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 (see Table 12 in the Supporting Documents).

7.B. Special Health Care Needs

The measure cannot be used to evaluate disparities in readmission risk associated with special health care needs. The measure relies solely on inpatient claims data, which contain insufficient information to distinguish whether differences in readmission risk for children with special health care needs compared with other children are due to differences in quality of care or in disease severity and progression. The measure could potentially be modified to incorporate richer clinical information from electronic health record (EHR) data once these data are more widely available. If approaches based on EHR data were developed to identify readmissions that could have been avoided through better care, the measure might then be used to assess disparities associated with special health care needs.

7.C. Socioeconomic Status

We assessed disparities in readmission risk associated with socioeconomic status by using insurance status as a proxy measure, with Medicaid coverage as a marker of low socioeconomic status. We performed this analysis using 2005-2009 AHRQ Revisit New York and Nebraska data and found that compared with Medicaid-insured patients, the odds of readmission were significantly lower for those who had private insurance, other types of insurance (such as Medicare or other government-sponsored insurance), or self-pay status ($p < 0.001$ for each comparison), independent of case-mix (age, gender, and chronic conditions) and index admission hospital (see Table 13 in the Supporting Documents).

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.

7.D. Rurality/Urbanicity

Using our 26-State MAX dataset, we assessed disparities in readmission risk associated with residence in rural versus urban areas. We used patients' five-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 (WWAMI Rural Health Research Center). We then used the RUCA codes to assign the area of each patient's residence to one of five levels of a rurality/urbanicity classification scheme created by the Dartmouth Atlas Working Group: urban core, suburban, large town, small town, or isolated rural (Dartmouth Atlas Working Group, 2007).

Controlling for case-mix (age, gender, and chronic conditions) and index admission hospital, we found that readmission risk did not vary significantly among the five levels of rurality/urbanicity ($p = 0.37$ for chi-square test) (see Table 14 in the Supporting Documents).

7.E. Limited English Proficiency (LEP) Populations

Because the measure uses inpatient claims data, which do not include information on English proficiency for patients or their families, the measure cannot be used to identify disparities in readmission risk based on limited English proficiency. The measure could potentially be modified to incorporate language proficiency information from EHR data once these data are more widely available and language proficiency is documented in EHRs in a more standard and consistent way. The measure might then be used to assess disparities associated with limited English proficiency.

Section 8. Feasibility

Feasibility is the extent to which the data required for the measure are readily available, retrievable without undue burden, and can be implemented for performance measurement. Using the following sections, explain the methods used to determine the feasibility of implementing the measure.

8.A. Data Availability

1. What is the availability of data in existing data systems? How readily are the data available?

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 (APCD Council).

To address potential issues with data quality or completeness, we have provided 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 (see Supporting Documents, Section 2).

2. If data are not available in existing data systems or would be better collected from future data systems, what is the potential for modifying current data systems or creating new data systems to enhance the feasibility of the measure and facilitate implementation?

Pediatric inpatient claims data are widely available, but the data are presently aggregated at the level of the hospital, payer, or State (e.g., for Medicaid or all-payer databases) but not at the Federal level. Although Medicaid data are compiled into Medicaid Analytic eXtract (MAX) files for research use, MAX nevertheless consists of 51 separate State-specific datasets, with variability in completeness of data elements and inconsistencies in provider identifiers and coding practices across States (Bencio, 2010; CMS, 2013). In addition, data availability lags by about 3 years, preventing assessment of quality for more recent time periods (CMS, 2013). Thus, while Medicare data serve as a national database for quality measurement in adult patients, there currently is no analogous national database of pediatric claims from all States and all types of hospitals.

Such a national pediatric claims database would be valuable in permitting national comparisons not only for readmission analyses but also for other pediatric quality measurement efforts. In order for hospital, payer, or State outcome measures to be comparable at a national level, they must be standardized at a national level. For example, comparisons of readmission rates calculated and standardized using data from one State with those calculated and standardized using data from another State are not fully valid because the case-mix may differ in health systems in one State versus another State. Without a unified dataset, an individual State can calculate, case-mix adjust, and compare readmission rates among its own health systems, but comparisons of its rates with those of other States may have limited validity.

In the absence of a national pediatric claims database, we have developed a method, described in Section 2 (see Supporting Documents), by which hospital- or State-level readmission rates can be calculated for Medicaid-insured patients and standardized using our 26-State MAX reference dataset, thus generating rates that can be compared nationally.

8.B. Lessons from Use of the Measure

1. Describe the extent to which the measure has been used or is in use, including the types of settings in which it has been used, and purposes for which it has been used.

We have partnered with the New York Office of Quality and Patient Safety to test implementation of our candidate measure on its Medicaid and all-payer claims databases.

2. If the measure has been used or is in use, what methods, if any, have already been used to collect data for this measure?

Like several other States, New York already maintains annual Medicaid and all-payer claims databases for other purposes, and so we did not have to undertake new data collection to test our measure.

3. What lessons are available from the current or prior use of the measure?

Feedback from New York on its testing experience indicated that the measure is straightforward and can be implemented quickly. Based on helpful suggestions from New York, 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. Testing the measure on New York's 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 (see Supporting Documents) for evaluating and troubleshooting such issues.

Section 9. Levels of Aggregation

CHIPRA states that data used in quality measures must be collected and reported in a standard format that permits comparison (at minimum) at State, health plan, and provider levels. Use the following table to provide information about this measure's use for reporting at the levels of aggregation in the table.

For the purpose of this section, please refer to the definitions for provider, practice site, medical group, and network in the Glossary of Terms.

If there is no information about whether the measure could be meaningfully reported at a specific level of aggregation, please write "Not available" in the text field before progressing to the next section.

Level of aggregation (Unit) for reporting on the quality of care for children covered by Medicaid/ CHIP†:

State level Can compare States*

Intended use: Is measure intended to support meaningful comparisons at this level? (Yes/No)

Yes.

Data Sources: Are data sources available to support reporting at this level?

Yes; data sources are available for Medicaid-insured children. Comparison of readmission rates among States (whether for children covered by Medicaid or with other insurance statuses) would be fully valid only if the rates were standardized at a national level to account for potential differences in case-mix among health systems in different States. A national database would be ideal for this purpose but does not exist as yet. In the absence of a national database, we have developed a method, described in detail in Section 2 (see Supporting Documents), for standardizing hospital- or State-level readmission rates for Medicaid-insured children using our 26-State Medicaid reference dataset such that the rates can be compared across States. Using our 26-State Medicaid dataset, we determined that the median number of annual index hospitalizations per State was 3,176 (range 238 to 28,750).

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

All States achieved the minimum sample size of 25 index hospitalizations that is used by CMS in its Medicare readmission measures.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

None.

Other geographic level: Can compare other geographic regions (e.g., MSA, HRR)

Intended use: Is measure intended to support meaningful comparisons at this level? (Yes/No)

Yes.

Data Sources: Are data sources available to support reporting at this level?

No; comparison of readmission rates among other geographic levels, such as hospital referral regions (HRRs), would be valid only if the rates were standardized at a national level to account for potential differences in case-mix among health systems in different geographic regions. A national database would be necessary for this purpose but does not exist yet. Although we have developed, as described above, a method for using our 26-State Medicaid reference dataset to standardize hospital- and State-level rates for Medicaid-insured patients, we are unaware of a reference dataset providing sufficient representation of geographic levels such as metropolitan statistical areas (MSAs) or HRRs for use in a similar method. The typical sample size available for each unit is therefore not available.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

Not applicable.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

None.

Medicaid or CHIP Payment model: Can compare payment models (e.g., managed care, primary care case management, FFS, and other models)

Intended use: Is measure intended to support meaningful comparisons at this level? (Yes/No)

No.

Data Sources: Are data sources available to support reporting at this level?

No.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

Not applicable.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

Not applicable.

Health plan*: Can compare quality of care among health plans.

Intended use: Is measure intended to support meaningful comparisons at this level? (Yes/No)

Yes.

Data Sources: Are data sources available to support reporting at this level?

Yes; State all-payer claims databases could be used to measure and compare readmission rates among health plans. However, such analyses would require fitting a non-nested mixed model, which is a procedure generally beyond the capabilities of current statistical software. Such analyses might become more feasible as software becomes more sophisticated.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

The typical sample size for each unit is not available.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

None.

Provider Level

Individual practitioner: Can compare individual health care professionals

Intended use: Is measure intended to support meaningful comparisons at this level?

(Yes/No)

No.

Data Sources: Are data sources available to support reporting at this level?

No.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

Not applicable.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

Not applicable.

Provider Level

Hospital: Can compare hospitals

Intended use: Is measure intended to support meaningful comparisons at this level?

(Yes/No)

Yes.

Data Sources: Are data sources available to support reporting at this level?

Yes; hospital claims datasets are widely available. Comparison of readmission rates among hospitals would be fully valid only if the rates were standardized using a combined dataset of claims from all hospitals being compared (e.g., as in a State Medicaid or all-payer database). To

permit comparisons among hospitals at a national level, we have developed a method, described in detail in Section 2 (see Supporting Documents) for standardizing hospital- or State-level readmission rates for Medicaid-insured children using our 26-State Medicaid reference dataset such that the rates can be compared across States.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

Using our 26-State Medicaid dataset, we determined that the median number of annual index hospitalizations per hospital was 13 (range 1 to 1,351); 36 percent of hospitals (accounting for 88 percent of index hospitalizations) achieved the minimum sample size of 25 index hospitalizations that is used by CMS in its Medicare readmission measures.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

Lengths of stay could increase if hospitals delay discharging patients to reduce the likelihood of their being readmitted.

Provider Level

Practice, group, or facility:** Can compare: (i) practice sites; (ii) medical or other professional groups; or (iii) integrated or other delivery networks

Intended use: Is measure intended to support meaningful comparisons at this level?

(Yes/No)

No.

Data Sources: Are data sources available to support reporting at this level?

No.

Sample Size: What is the typical sample size available for each unit at this level? What proportion of units at this level of aggregation can achieve an acceptable minimum sample size?

Not applicable.

In Use: Have measure results been reported at this level previously?

No.

Reliability & Validity: Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?

No.

Unintended consequences: What are the potential unintended consequences of reporting at this level of aggregation?

Not applicable.

Section 10. Understandability

CHIPRA states that the core set should allow purchasers, families, and health care providers to understand the quality of care for children. Please describe the usefulness of this measure toward achieving this goal. Describe efforts to assess the understandability of this measure (e.g., focus group testing with stakeholders).

Readmissions are already a focus of quality measurement and quality improvement efforts. Particularly with public reporting of readmission rates on the CMS Hospital Compare Web site starting in 2009 and initiation of the Medicare Hospital Readmission Reduction Program in 2012, readmissions have received increasing attention, not just among policymakers, payers, and health care providers but also in the popular press (Aizenman, 2013; America's Health Insurance Plans [AHIP], 2013; Clune, 2013; Fontanarosa, McNutt, 2013; Goodman, Fisher, Chang, 2013; Ness, Kramer, 2013; Skinner, 2013; Zamosky, 2013).

CMS's Hospital Compare Web site provides explanations to help make readmission rates understandable to patients and families (CMS Web site; L&M Policy Research, 2013). This information exemplifies recommended practices for public reporting, such as using everyday language and relating quality measures to outcomes that matter to patients and families: "Rates of readmission show whether a hospital is doing its best to prevent complications, provide clear discharge instructions to patients, and ensure patients make a smooth transition to their home or another setting" (AHRQ, 2013a, 2013b; CMS Web site). The information includes guidance on interpretation of readmission rates, clarifying that low rates are desirable: "You can see whether the rate of readmission for a hospital is lower (better) than the national rate, no different than the national rate, or higher (worse) than the national rate, given how sick patients were when they were admitted to the hospital" (AHRQ, 2013a; CMS Web site).

The emphasis on measuring, publicly reporting, and preventing readmissions has created an environment in which we anticipate stakeholders will readily understand pediatric readmission rates.

We have presented our candidate measure to 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. We have also presented the measure to the Massachusetts Child Health Quality Coalition, which includes patient and family advocates, as well as representatives from academic, community, and State institutions. In addition, we have partnered with the New York Office of Quality and Patient Safety to test implementation of our candidate measure on their Medicaid and all-payer inpatient claims databases. Comments and feedback from these various stakeholders indicate that they

find the concept of readmission understandable and believe a measure focused on pediatric LRI readmission rates would be useful.

Section 11. Health Information Technology

Please respond to the following questions in terms of any health information technology (health IT) that has been or could be incorporated into the measure calculation.

11.A. Health IT Enhancement

Please describe how health IT may enhance the use of this measure.

We developed our candidate measure to use inpatient claims as the sole data source because these data are readily available. In the future, however, as EHRs are adopted by more health systems and include more advanced capabilities for quality measurement, the measure could be modified to incorporate EHR data. Such data could potentially be valuable for enhancing case-mix adjustment, refining identification of planned admissions, and enabling evaluation of disparities associated with special health care needs or limited English proficiency.

11.B. Health IT Testing

Has the measure been tested as part of an electronic health record (EHR) or other health IT system?

No.

If so, in what health IT system was it tested and what were the results of testing?

Not applicable.

11.C. Health IT Workflow

Please describe how the information needed to calculate the measure may be captured as part of routine clinical or administrative workflow.

Not applicable.

11.D. Health IT Standards

Are the data elements in this measure supported explicitly by the Office of the National Coordinator for Health IT Standards and Certification criteria (see healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__standards_ifr/1195)?

No.

If yes, please describe.

Not applicable.

11.E. Health IT Calculation

Please assess the likelihood that missing or ambiguous information will lead to calculation errors.

Not applicable.

11.F. Health IT Other Functions

If the measure is implemented in an EHR or other health IT system, how might implementation of other health IT functions (e.g., computerized decision support systems in an EHR) enhance performance characteristics on the measure?

Not applicable.

Section 12. Limitations of the Measure

Describe any limitations of the measure related to the attributes included in this CPCF (i.e., availability of measure specifications, importance of the measure, evidence for the focus of the measure, scientific soundness of the measure, identification of disparities, feasibility, levels of aggregation, understandability, health information technology).

Identification of Factors Contributing to Readmission

A concern that has been raised about using readmission rates as a quality measure is that multiple factors, within and outside of health systems, affect readmission risk (Alverson, O’Callaghan, 2013; Srivastava, Keren, 2013). Some reasons for readmission, such as inevitable disease progression, cannot be avoided. Readmission for these reasons is appropriate, and even under ideal circumstances, one would not expect readmissions to drop to zero. Other factors leading to readmission, such as challenges to achieving or maintaining health associated with low socioeconomic status, are difficult to address solely through interventions within health systems. At the same time, however, as described in Sections 3 and 5 of this report, ample evidence exists that interventions to improve care delivery and disease management can significantly reduce readmissions (Ashton, et al., 1995; Berry, et al., 2013; Bozic, et al., 2010; Chen, et al., 2012; Fassl, et al, 2012; Harrison, et al., 2011; Inglis, et al., 2010; Jackson, et al., 2013; Jha, et al., 2009; Ludke, et al., 1990; Tsai, et al, 2013). The success of such efforts shows that health systems, while not the only player in influencing readmissions, are an important one.

Another concern is that readmission rates are used as hospital quality measures even though hospitals are not solely responsible for them (Alverson, O’Callaghan, 2013). However, calculating rates at the hospital level does not limit their use to only assessing hospital quality. Hospital-level rates reflect the quality of care provided, not by just the hospital but also by the wider system in which it operates. Among the most effective interventions for reducing readmissions are those that engage multiple stakeholders within health systems, including patients, ambulatory providers, and hospitals (Anderson, et al., 2005; Balaban, et al., 2008; Berry, et al., 2013; Bradley, et al., 2013; Coleman, et al., 2006; Costantino, et al., 2013; Evans, Hendricks, 1993; Flood, et al, 2013; Harrison, et al., 2011; Inglis, et al., 2010; Jack, et al, ,2009;

Jackson, et al., 2013; Koehler, et al., 2009; Leschke, et al., 2012; Naylor, et al., 1994, 2004; Phillips, et al., 2004; Rich, et al., 1995; Scott, 2010; Sochalski, et al., 2009).

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.

Use of Claims Data to Measure Readmissions

We developed our candidate measure to use inpatient claims, which are widely available, such that use of the measure would be highly feasible. A major limitation of claims data, however, is that they capture clinical information only through diagnosis and procedure codes (and in some datasets, through pharmacy or diagnostic testing charges). Claims data may not provide a full or accurate clinical picture because billing codes lack details, such as disease status; coding is driven by payment rules rather than a goal of conveying information for quality improvement; and coding practices vary across institutions and States (ResDAC, 2012). Using claims data alone, it is not possible to fully case-mix adjust for disease severity. For our measure, we seek to exclude readmissions for planned procedures, but distinguishing all planned and unplanned readmissions with perfect accuracy using claims data is not possible. In the future, when EHRs have been more widely adopted and possess more advanced features to support quality measurement, EHR data could be incorporated into the measure to help address these limitations.

Section 13. Summary Statement

Provide a summary rationale for why the measure should be selected for use, taking into account a balance among desirable attributes and limitations of the measure. Highlight specific advantages that this measure has over alternative measures on the same topic that were considered by the measure developer or specific advantages that this measure has over existing measures. If there is any information about this measure that is important for the review process but has not been addressed above, include it here.

Readmissions have become a major focus for improving the quality of health systems. CMS publicly reports readmission rates for Medicare-insured adults and, starting in October 2012, began reducing Medicare payments to hospitals with excess readmissions following hospitalizations for acute myocardial infarction, heart failure, or pneumonia. Some State Medicaid programs are working to benchmark State-level readmission rates and to reduce readmissions (AHRQ, 2011; Massachusetts Executive Office of Health and Human Services, 2017). To date, however, most readmission measures have been developed for use only in adult patients.

Readmissions signal the quality of disease management, indicating a worsening of health status that in some cases may have been preventable, 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 by addressing the current dearth of inpatient care measures and the need for readmission measures developed for use in children. It 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 younger than 18 years of age, thus complementing adult readmission measures, including the CMS all-cause and condition-specific measures and the National Committee on Quality Assurance (NCQA) all-cause readmission measure (NCQA, 2016). Our measure 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.

The measure employs inpatient claims data, which are readily available, thus making its use highly feasible. LRI readmission rates are reliable for hospitals accounting for a large proportion of index hospitalizations, and the validity of the case-mix adjustment model is good, with a C-statistic that is very similar to that of other 30-day readmission measures. The measure has been presented to diverse stakeholders, who found it easily understandable, and testing has shown that it is straightforward to implement. The measure could serve as a valuable tool to assess health system quality and motivate improvements in adherence to evidence-based clinical practices and in care delivery across health care settings.

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Section 14: Identifying Information for the Measure Submitter

First Name: Mark
Last Name: Schuster, MD, PhD
Title: William Berenberg Professor of Pediatrics, Harvard Medical School
Chief of General Pediatrics and Vice Chair for Health Policy
Department of Medicine, Boston Children's Hospital
Organization: Center of Excellence for Pediatric Quality Measurement
Mailing Address: Boston Children's Hospital, 300 Longwood Avenue
City: Boston
State: MA
Postal Code: 02115
Telephone: 617-355-5859
Email: cepqm@childrens.harvard.edu

The CHIPRA Pediatric Quality Measures Program (PQMP) Candidate Measure Submission Form (CPCF) was approved by the Office of Management and Budget (OMB) in accordance with the Paperwork Reduction Act.

The OMB Control Number is 0935-0205 and the Expiration Date is December 31, 2015.

Public Disclosure Requirements

Each submission must include a written statement agreeing that, should U.S. Department of Health and Human Services accept the measure for the 2014 and/or 2015 Improved Core Measure Sets, full measure specifications for the accepted measure will be subject to public disclosure (e.g., on the Agency for Healthcare Research and Quality [AHRQ] and/or Centers for Medicare & Medicaid Services [CMS] websites), except that potential measure users will not be permitted to use the measure for commercial use. In addition, AHRQ expects that measures and full measure specifications will be made reasonably available to all interested parties. "Full measure specifications" is defined as all information that any potential measure implementer will need to use and analyze the measure, including use and analysis within an electronic health record or other health information technology. As used herein, "commercial use" refers to any sale, license or distribution of a measure for commercial gain, or incorporation of a measure into any product or service that is sold, licensed or distributed for commercial gain, even if there is no actual charge for inclusion of the measure. This statement must be signed by an individual authorized to act for any holder of copyright on each submitted measure or instrument. The authority of the signatory to provide such authorization should be described in the letter.

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