Overuse of Computed Tomography Scans for the Evaluation of Children with Atraumatic Headache

Section 1. Basic Measure Information

1.A. Measure Name

Overuse of Computed Tomography Scans for the Evaluation of Children with Atraumatic Headache

1.B. Measure Number

0206

1.C. Measure Description

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

This measure assesses the number of computed tomography (CT) scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children ages 4 through 17 years. For the purposes of this measure, indications for CT imaging include thunderclap headache, vascular disease, infections, lumbar puncture, new neurologic deficit, or signs and symptoms of increased intracranial pressure. A lower percentage indicates better performance, as reflected by avoidance of CT imaging when it is not indicated.

Headaches are common in the pediatric population (Lateef, Merikangas, He, et al., 2009b), and children with headaches are frequently evaluated in emergency departments (EDs) and primary care settings (Centers for Disease Control and Prevention [CDC], 2011; DeVries, Young, Wall, et al., 2013). Although most headaches are not symptomatic of underlying disease, the differential diagnosis list for headache is long, with over 300 different types and causes (Evans, 1996). Headaches are divided into two main classifications: primary headaches, such as migraine or tension headaches, and secondary headaches, which include headaches attributed to a separate condition, such as infection, trauma, tumors, or vascular problems (International Headache Society [IHS], 2014). For the purposes of this measure, atraumatic headaches are considered to be primary headaches or secondary headaches unrelated to injury.

CT is a radiologic modality used to create images of internal structures in a slice-by-slice manner, using radiation generated from a high-voltage tube. Rationales for obtaining a CT scan to characterize headache include evaluation for suspected arteriovenous malformation or tumor, patient and parental anxiety about the potential for underlying vascular problems or tumor related to severe and/or recurrent head pain, and legal concerns for a missed diagnosis on the part of healthcare providers.

CT scans are simple to order because the technology is readily available (Ginde, Foianini, Renner, et al., 2008), and image acquisition is fast. However, CT imaging for children with a headache who lack any indication of trauma, intracranial hemorrhage, or other time-sensitive conditions yields little information (American College of Radiology [ACR] Expert Panel, 2012; Evans, 1996; Lateef, Kriss, Carpenter, et al., 2012; Lateef, Grewal, McClintock, et al., 2009a) and exposes children to unnecessary risk from radiation. Nevertheless, neuroimaging is increasingly used to evaluate children who experience headache (Broder, Fordham, Warshauer, 2007; Graf, Kayyali, Alexander, et al., 2008; Larson, Johnson, Schnell, et al., 2011). In its guidelines for imaging children with secondary headaches accompanied by neurological signs or symptoms of increased intracranial pressure, the ACR recommends magnetic resonance imaging (MRI); CT is suggested as an alternative in instances where MRI is unavailable or problems with sedation arise (ACR, 2012).

This measure is focused on the overuse of CT in the setting of headache, a problem that has gained national attention in recent years (Loder, Weizenbaum, Frishbert, et al., 2013). Overuse has been defined as use in any patient who undergoes a procedure or test for an inappropriate indication (Lawson, Gibbons, Ko, et al., 2012). Imaging overuse subjects children to a number of risks (Malviya, Vopel-Lewis, Eldevik, et al., 2000; Mathews, Forsythe, Brady, et al., 2013; Pearce, Salotti, Little, 2012; Wachtel, Dexter, Dow, 2009). Children who undergo CT scans in early childhood tend to be at greater risk for developing leukemia, primary brain tumors, and other malignancies later in life (Mathews, et al., 2013; Pearce, et al., 2012). Children are also at risk for complications from sedation or anesthesia, which are often required for longer CT imaging sequences. These complications include compromised airway, hypoxia leading to central nervous system injury, and death. Additionally, CT overuse creates cost burdens for the patient, as well as for payers.

This measure uses administrative claims data and is calculated as the percentage of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children, ages 4 through 17 years.

1.D. Measure Owner

The Quality Measurement, Evaluation, Testing, Review, and Implementation Consortium (Q-METRIC).

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.**

   This measure is part of the Q-METRIC Overuse of Imaging for the Evaluation of Children with Headaches or Seizures measures collection.

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.**

   This measure is part of the Q-METRIC Overuse of Imaging for the Evaluation of Children with Headache measures set.

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

The numerator is the number of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children, ages 4 through 17 years.

Eligible children must be 4 through 17 years of age during the measurement year for which CT imaging of the head is obtained and must be continuously enrolled in their insurance plan during both the measurement year and the year prior. Table 1 [=IMG1] lists Current Procedural Terminology (CPT) codes associated with CT imaging of the head. International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes to identify atraumatic headache are shown in Table 2 [=IMG3]. Headache must occur on the day of or up to 30 days prior to imaging. Atraumatic headaches are those not associated with trauma occurring in the 7 days prior to imaging.

1.H. Numerator Exclusions

The following are excluded from the numerator:

Exclusions based on ICD-9-CM or CPT codes captured in administrative claims data:

- New neurologic deficits or signs or symptoms of increased intracranial pressure (Table 3 [=IMG II]) between the date of diagnosis and imaging study.

- Thunderclap headache (Table 2 [=IMG3]) on the day of or within 365 days prior to imaging.

- Vascular disease (Table 4 [=IMG8]) on the day of or within 365 days prior to imaging.

- Infections that would warrant imaging on the day of or within 365 days before the atraumatic headache (Table 5 [=IMG4]).

- Lumbar puncture (Table 6 [=IMG10]) during the visit (same date/date after) where imaging was obtained.

1.I. Denominator Statement

The denominator is the number of CT scans obtained on or within 30 days after the date of evaluation for atraumatic headache among children 4 through 17 years of age.

1.J. Denominator Exclusions

The following are excluded from the denominator (exclusions based on ICD-9-CM or CPT codes captured in administrative claims data):

- Trauma-related headache or pain (Table 2 [=IMG3]) on the day of or within 7 days prior to imaging.

- Head trauma or suspected abuse/neglect (Table 7 [=IMG9] or the presence of an E-code in claims data) on the day of or within 7 days prior to imaging.

- Imaging study obtained on the day of or within 180 days following neurosurgical intervention (Table 6 [=IMG10]).

Please note, Tables 1-7 are included in the Technical Specifications for this measure; see Supporting Documents.

1.K. Data Sources

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

Administrative data (e.g., claims data), specified and tested; paper medical record, tested; electronic medical record, tested.

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 the 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).**

Headache Prevalence and Incidence

Headaches are common in the pediatric population (Lateef, et al., 2009b), and children with headaches are frequently evaluated in EDs and primary care settings (CDC, 2011; DeVries et al., 2013). Headaches occur more often as children grow older (ACR, 2012). At age 7 years, prevalence ranges from 37 percent to 51 percent. By age 15 years, 57 percent to 82 percent of children have experienced headaches; and, among 16-year-olds, 93 percent or more have reported experiencing a severe headache (ACR, 2012). Before puberty, boys are more likely than girls to experience headache. The situation is reversed after puberty, when headaches are more commonly reported in girls (ACR, 2012).

Headache Pathology and Severity

Headaches can be classified as either primary (not a symptom of an underlying disease, condition, or trauma) or secondary (related to an existing condition). Examples of primary headaches include migraine and tension headaches. Examples of secondary headaches include headaches associated with dehydration, sinusitis, trauma, tumor, and vascular malformations. For the purposes of this measure, atraumatic headaches are considered to be primary headaches or secondary headaches unrelated to injury.

The precise pathophysiology of headaches is still not fully understood, but research suggests that complex interactions between the neural and vascular systems are involved (Edvinsson, 2001). The manifestation and perception of headache is unique and specific to the child who experiences it. Correspondingly, the management approach for children with headaches often focuses on reassurance and education by the clinician who evaluates the child (Brna, Dooley, 2006; Raieli, Compagno, Pandolfi, et al., 2010).

Burdens of Overuse of Imaging for Primary Headache

The literature offers many examples of the potential risks associated with overuse of imaging. Chief among these are risks related to radiation (Mathews, et al., 2013; Pearce, et al., 2012), sedation and/or anesthesia (Malviya, et al., 2000; Wachtel, et al., 2009), and intravenous contrast media (Zo'o, Hoermann, Balassy, et al., 2011). Cost is also an issue (Callaghan, Kerber, Pace, et al., 2014).

Radiation-Related Burden and Risk

Radiation exposure associated with CT-imaging introduces the possibility of chronic health risks related to malignancies sustained from radiation effects (Berrington de González, Mahesh, Kim, et al., 2009; Mathews, et al., 2013; Pearce, et al., 2012). Radiosensitive organs—including the brain, bone marrow, lens of the eye, and thyroid gland—can be exposed to radiation during CT of the head (Papadakis, Perisinakis, Oikonomou, et al., 2011). In children younger than 5 years of age, about 20 percent of the active bone marrow is in the cranium, compared with 8 percent in

adults (Christy, 1981). CT-based radiation dose for pediatric patients is highly problematic because the developing cellular structures and tissues of children are significantly more radiosensitive than those of adults; children, therefore, will be at substantially elevated risk for malignancy (ACR, 2012).

To conduct imaging studies with radiation dosing that is appropriate for children, many facilities follow policies and protocols using the concept of ALARA – As Low As Reasonably Achievable. ALARA principles deem any additional radiation beyond the minimum needed for interpretable images both detrimental and non-efficacious (ACR, 2009). Professional practice and patient advocacy groups including the ACR, the American Academy of Neurology (AAN), and the American Academy of Pediatrics (AAP) have developed and promoted ALARA protocols and policies; these guidelines support the use of CT imaging only when clinically indicated in children, decreasing the risk of harm from radiation.

Sedation- and Anesthesia-Related Burden and Risk

Some children will require sedation to ensure minimal movement during CT studies. Use of sedation is necessary to avoid motion artifacts, which invariably occur if the child moves during image acquisition, thus interfering with image quality. Motion artifacts sometimes undermine imaging quality to the point of rendering images unreadable. In the case of CT imaging, this may result in additional radiation exposure to obtain images sufficient for interpretation. Although the sedation used for pediatric imaging has been identified as low risk, it does have potential attendant complications (Cravero, Bilke, Beach, et al., 2006; Malviya, et al., 2000). Levels of sedation are on a continuum from minimal anxiolysis (administration of an anxiety-reducing agent) to deep sedation, in which the patient can be roused only via vigorous stimuli (Arthurs, Sury, 2013). Compared with minimal sedation, moderate and deep sedation carry a greater risk of airway compromise, hypoxia resulting in central nervous system injury, and death (Cravero, et al., 2006).

In certain instances, sedation may not be sufficient, and anesthesia will be required to complete imaging. Anesthesia includes administration of medication to the extent that there is some degree of respiratory suppression and potential for cardiac depression; the patient cannot be roused by external stimuli or commands (Arthurs, Sury, 2013). Administration of anesthesia raises risks related to the process of intubation for respiratory support. These risks include dental trauma; airway edema (swelling of the windpipe); vocal cord spasm or injury; regurgitation of stomach contents with subsequent aspiration (inhalation) pneumonia; injury to arteries, veins, or nerves; alterations in blood pressure; and/or irregular heart rhythms; the most severe, though rare, risks include brain damage and death (Society for Pediatric Anesthesia, 2014).

Intravenous Contrast-Related Burden and Risk

During the course of CT studies, intravenous (IV) contrast media may be used to enhance visualization of vascular structures and provide important information about neurologic anatomy. It is possible a child may experience an allergic reaction to IV contrast or subcutaneous fluid leakage (extravasation) during administration of IV contrast. IV contrast administration also includes the risk of contrast-induced nephrotoxicity (CIN) (Medscape Drugs and Diseases, 2014;

Zo'o, et al. 2011). Children with poor kidney function are at greater risk for developing CIN and, in rare cases, will develop renal failure requiring dialysis.

Cost-Related Burden

Overuse of imaging is costly and places additional strain on an already heavily burdened healthcare system (Callaghan, et al., 2014). As an example, charges for a CT of the brain can be as much as $2,000 and can vary substantially by region of the country. In addition, the likelihood that neuroimaging will result in the identification of clinically important structural abnormalities in this patient population is low. Incidental findings, however, may require follow-up testing with associated charges and potential complications (Lumbreras, Donat, Hernandez-Aquado, 2010; Rogers, Maher, Schunk, et al., 2013).

Performance Gap

Currently, professional guidelines do not support neuroimaging for atraumatic headache in pediatric patients in the absence of documented neurologic signs or symptoms that suggest increased intracranial pressure because the yield is low, and imaging without an indication exposes children to unnecessary risks.

While many children with headaches will not benefit from neuroimaging, children experiencing secondary headaches associated with trauma, new neurologic deficits, or signs and symptoms of increased intracranial pressure may require timely imaging. CT is usually the initial imaging modality of choice for patients who require timely imaging in the acute clinical setting (ACR, 2012). CT imaging is readily available in most EDs (Ginde, et al., 2008) and is the preferred imaging modality for post-traumatic headaches with features concerning for intracranial hemorrhage (ACR, 2012). The ACR Appropriateness Criteria (ACR, 2012) rank MRI as more appropriate than CT in patients with atraumatic headache. MRI may be a reasonable alternative to CT for children with atraumatic headaches, even for the evaluation of time-sensitive conditions, such as failure of a ventricular-peritoneal shunt (Boyle, Paldino, Kimia, et al., 2014; Kim, Torrey, Milla, et al., 2015). MRI will usually be the preferred modality instead of CT because MRI does not use radiation and tends to have improved spatial resolution.

This measure assesses the number of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children, ages 4 through 17 years. For the purposes of this measure, indications include thunderclap headache, vascular disease, infections, lumbar puncture, new neurologic deficit, or signs and symptoms of increased intracranial pressure.

A lower percentage indicates better performance, as reflected by avoidance of radiation exposure from CT when it is not indicated.

Drivers of Overuse

Headache experienced by a child, especially when recurrent, can be a stressful event that may prompt a parent to seek the assistance of a healthcare provider, at times emergently. Some providers may feel pressured by the parent to order imaging despite the lack of benefit

(Daymont, McDonald, Wittmeier, et al., 2014; Raieli, et al., 2010). This circumstance has a close parallel to parents who seek out antibiotics for their child who has viral respiratory symptoms. In these circumstances, the provider may deviate from established practice guidelines to placate the parent. In recent decades, this phenomenon has reached such wide-spread prominence as to prompt multidisciplinary initiatives targeted at fostering discussion and identifying common practices that should be questioned by parents and providers (AAP, 2013). An ongoing dialogue between providers and parents continues to be a key feature of optimal outcomes in the setting of headache.

The practice of defensive medicine is another reason an imaging study may be ordered without a clear indication. Physicians may be uncomfortable facing uncertainty regarding the etiology of headache in children they are evaluating and treating. Assurance behaviors (e.g., ordering additional tests) are expected when a malpractice-sensitive physician is faced with a potentially worrisome condition that can cause the symptom in question (Carrier, Reschovsky, Katz, et al., 2013). In a survey of physicians from six specialties at high risk of liability, emergency physicians ordered more unnecessary diagnostic tests than clinicians from any other specialty (Studdert, Mello, Sage, et al., 2005). Physicians practicing in the ED have the added challenge of limited access to detailed medical records, which increases uncertainty about prior evaluation of patients who are referred from an out-of-network provider or hospital. Overuse of neuroimaging is a potential result.

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).**

Virtually any alteration in resource utilization or expenditure substantially affects children covered by Medicaid or CHIP; in 2011 alone, 30.6 million or 40 percent of children through the age of 18 years were Medicaid recipients (Tang, 2011). Although there is no study on the number of children with headache who are enrolled in Medicaid or CHIP, curtailing the overuse of imaging will favorably reduce radiation exposure, poor anesthesia or sedation outcomes, and costs.

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).

We are unaware of any existing quality measures specific to the overuse of CT imaging for children with atraumatic headache.

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:** No.
d. **Service – preventive health, including services to promote healthy birth:** No.
e. **Service – care for acute conditions:** Yes.
f. **Service – care for children with special health care needs/chronic 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:** Yes.
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):** No.
p. **Population – infants (29 days to 1 year) (specify age range):** No.
q. **Population – pre-school age children (1 year through 5 years) (specify age range):** Yes; ages 4-5 years.
r. **Population – school-aged children (6 years through 10 years) (specify age range):** Yes; all ages in this range.
s. **Population – adolescents (11 years through 20 years) (specify age range):** Yes; adolescents 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.

This measure assesses the number of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children, 4 through 17 years of age. Well-established evidence shows that neuroimaging to characterize headache in the absence of documented neurologic signs or symptoms that suggest intracranial pathology is rarely clinically indicated and is potentially harmful (ACR, 2012; Lateef, et al., 2009a). When imaging is deemed necessary, providers must weigh the risks of radiation exposure and possibly sedation or anesthesia complications with the benefits of the available imaging modalities.

Table 8 (see Supporting Documents) summarizes key sources of evidence for this measure, using the U.S. Preventive Services Task Force (USPSTF) rankings (criteria denoted in a note to the table). The ACR, in addition to evidence-based guidelines, has also published specific "Appropriateness Criteria" for pediatric headache (Figures 1 and 2; see Supporting Documents).

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.

Not applicable.

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.

To evaluate the reliability of using administrative claims for the calculation of this measure, we conducted a signal-to-noise analysis. This analysis was focused on assessing the ability to confidently distinguish the performance of one State health plan from that of another State. To perform the signal-to-noise analysis, we used the Medicaid Analytic eXtract (MAX) administrative claims data provided by the Centers for Medicare & Medicaid Services (CMS) from 2006 to 2010 for seven diverse State Medicaid programs: Colorado, Florida, Illinois, Massachusetts, Michigan, Texas, and Utah. The number of CT scans per State and year are summarized in Table 9 (see Supporting Documents). The proportion of CT imaging without indication varied between States in 2006, ranging from a low of 79.8 percent in Michigan to a high of 90.5 percent in Texas. The lowest to highest proportion of CT imaging without indication within each State across the 5-year period was as follows: Colorado (81.5 percent to 84.8 percent); Florida (86.3 percent to 87.7); Illinois (86.9 percent to 88.8 percent); Massachusetts (84.7 percent to 87.8 percent); Michigan (79.8 percent to 85.2 percent); Texas (85.1 percent to 90.5 percent); and Utah (81.9 percent to 88.9 percent).

For this approach, reliability was estimated with a beta-binomial model (RAND Corporation, TR-653-NCQA, 2009). We tested the reliability using aggregate data from these seven States for the period 2006-2010.

Reliability results are detailed in Table 10 (see Supporting Documents). These results show that the reliability based on signal-to-noise analysis ranged from 0.61 to 0.99, with a median of 0.96.

In general, reliability scores can range from 0.0 (all variation is attributable to measurement error) to 1.0 (all variation is caused by real differences). While there is not a clear cut-off for a minimum reliability level, values above 0.7 are considered sufficient to distinguish differences between some health plans and the mean; reliability values above 0.9 are considered sufficient to see differences between health plans (RAND Corporation, TR-653-NCQA, 2009). In States where the denominator is large (at least 2,000 events), the reliability is very good; observed reliability was consistently greater than 0.80. However, in Utah, where the denominator is 672

CT imaging events, reliability was lower (0.61). This suggests that this measure should be used in health plans with over 2,000 CT imaging events in the denominator to facilitate comparisons between plans; comparison of this measure among smaller health plans should be interpreted with caution.

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).

Face validity is the degree to which the measure construct characterizes the concept being assessed. The face validity of this measure was established by a national panel of experts and parent representatives for families of children with headache and seizures convened by Q-METRIC. The Q-METRIC panel included nationally recognized experts in the area of imaging children, representing general pediatrics, pediatric radiology, pediatric neurology, pediatric neurosurgery, pediatric emergency medicine, general emergency medicine, and family medicine. In addition, face validity of this measure was considered by experts in State Medicaid program operations, health plan quality measurement, health informatics, and healthcare quality measurement. In total, the Q-METRIC imaging panel included 15 experts, providing a comprehensive perspective on imaging children and the measurement of quality metrics for States and health plans.

The Q-METRIC expert panel concluded that this measure has a high degree of face validity through a detailed review of concepts and metrics considered to be essential to appropriately image children. Concepts and draft measures were rated by this group for their relative importance. This measure received an average score of 7.3 (with 9 as the highest possible score).

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

The data collected for performance scores did not include race/ethnicity information.

7.B. Special Health Care Needs

The data collected for performance scores did not include information about special healthcare needs.

7.C. Socioeconomic Status

The data collected for performance scores did not include information about socioeconomic status.

7.D. Rurality/Urbanicity

The data collected for performance scores did not include information about rural/urban residence.

7.E. Limited English Proficiency (LEP) Populations

The data collected for performance scores did not include information about LEP.

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?

This measure was tested using administrative claims data. Administrative data needed for this measure include date of birth, diagnosis, revenue and procedure codes, and dates. These data generally are available, although collecting them may require a restricted-use agreement and Institutional Review Board (IRB) approval.

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?

Continuing advances in the development and implementation of electronic health records (EHRs) may prompt providers to document key elements needed for application of inclusion and exclusion criteria necessary for this measure. Advances would further allow for electronic capture of structured clinical information needed to determine if and when CT imaging has been overused in the evaluation of children experiencing atraumatic headache without indication of

thunderclap headache, vascular disease, infections, lumbar puncture, new neurologic deficit, or signs and symptoms of increased intracranial pressure.

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.

To our knowledge, this measure is not currently in use anywhere in the United States.

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?

Not applicable.

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

Not applicable.

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)**
No.

Data Sources: **Are data sources available to support reporting at this level?**
Not applicable.

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?**
Not applicable.

Reliability & Validity: **Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?**
Not applicable.

Unintended consequences: **What are the potential unintended consequences of reporting at this level of aggregation?**
Not applicable.

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)**
No.

Data Sources: **Are data sources available to support reporting at this level?**
Not applicable.

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?**
Not applicable.

Reliability & Validity: **Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?**
Not applicable.

Unintended consequences: **What are the potential unintended consequences of reporting at this level of aggregation?**
Not applicable.

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?**
Not applicable.

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?**
Not applicable.

Reliability & Validity: **Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?**
Not applicable.

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?**
This measure requires administrative claims data.

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?**
We recommend at least 2,000 CT scans for evaluation of an atraumatic headache be available within a health plan to allow for reliable comparisons among health plans.

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?**
Unknown.

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?**
Not applicable.

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?**
Not applicable.

Reliability & Validity: **Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?**
Not applicable.

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?**
This measure requires administrative claims data.

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?**
This measure has not been tested at the hospital level and, consequently, the minimum number of patients per hospital has not been determined.

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?**
Unknown.

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?**
Not applicable.

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?**
Not applicable.

Reliability & Validity: **Is there published evidence about the reliability and validity of the measure when reported at this level of aggregation?**
Not applicable.

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).

This measure provides a simple and straightforward means for providers, purchasers, and others to assess the extent to which CT studies are being overused for the evaluation of children with atraumatic headache. This measure has not been formally assessed for comprehension. However, high rates of overuse are easily understood to be unsatisfactory. The primary information needed for this measure is sourced from administrative claims data and includes basic demographics, diagnostic codes, and procedure codes, all of which are widely available.

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.

Health information technology (IT) provides a platform that can support various new uses of the measure. First, health IT can show feedback at the time of order entry. Health IT can also provide education about alternatives to imaging. Alerts and reminders, given to patients as well as providers, might also enhance use.

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.

This information will be captured through order entry systems. Importantly, for this measure to be accurate, it may be necessary to combine data from multiple EHR systems. The use of Health Information Exchange (HIE), especially using the DIRECT protocol for exchange across individual EHRs, would be an important tactical step to enable this measure. Another change is the need to identify when a neurological baseline has been achieved, so that orders after that time can be recorded for the measure.

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 (ONC) criteria (see healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__standards_ifr/1195)?

Yes.

If yes, please describe.

The ONC standards include the following specific requirements in the Certification criteria (ONC, 2010) pertaining to Stage 2 Meaningful Use requirements:

Stage 2 (beginning in 2013): CMS proposed that its goals for the Stage 2 meaningful use criteria expand upon the Stage 1 criteria to encourage the use of health IT for continuous quality improvement at the point of care. In addition, the exchange of information in the most structured format possible is encouraged. This can be accomplished through mechanisms such as the electronic transmission of orders entered using computerized provider order entry (CPOE) and the electronic transmission of diagnostic test results. Electronic transmission of diagnostic test results includes a broad array of data important to quality measurement and, for this measure, specifically includes radiology studies such as CT imaging and the radiation dose delivered.

11.E. Health IT Calculation

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

Missing or ambiguous information in the following areas could lead to missing cases or calculation errors:

1. Child's date of birth.
2. ICD-9-CM or ICD-10-CM codes.
3. Date and time of treatment.
4. Type of tests administered.
5. Date of tests performed.
6. Care setting.
7. Lack of a consistent radiation dose monitoring strategy.
8. Possibly a scanned or electronic clinical document in the medical record.

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?

As noted above, this measure requires the use of HIE for optimal understanding of previous imaging studies For many sites, duplicative testing is an alternative to HIE, which may be impossible in the early mornings or at off hours from a primary care site. Implementation of HIE is one aspect that will enhance performance. Another might be the use of clinical decision support to understand when CT is not indicated. Information buttons could link to educational resources at the point of care to discourage unnecessary ordering and could be used to link previous study results with the act of ordering, which has been shown to decrease the rate of ordering.

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).

This measure assesses the number of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children ages 4 through 17 years. For the purposes of this measure, indications for CT imaging include thunderclap headache, vascular disease, infections, lumbar puncture, new neurologic deficit, or signs and symptoms of increased intracranial pressure. A lower percentage indicates better performance, as reflected by avoidance of CT imaging when it is not indicated.

In future implementations, some considerations may further strengthen this measure and potentially ease the burden of data collection. Continuing advances in the development and implementation of EHRs may prompt providers to document key elements needed for application of inclusion and exclusion criteria necessary for this measure.

In future implementation, we recommend considering the inclusion of the ordering of neuroimaging studies as opposed to limiting the measure to obtained neuroimaging studies. This would address the potential for delays between the time an order is placed and the time that a study can be scheduled. Including orders for neuroimaging studies decreases the potential for underestimation of overuse that would occur if a study could not be obtained within the 30-day timeframe set for this measure. In addition, future specifications may consider including a denominator exclusion of a documented contraindication to MRI, as CT would be the only imaging option in this population.

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.

This measure assesses the number of CT scans obtained without indication on or within 30 days after the date of evaluation for atraumatic headache among children ages 4 through 17 years. For the purposes of this measure, indications for neuroimaging include thunderclap headache, vascular disease, infections, lumbar puncture, new neurologic deficit, or signs and symptoms of increased intracranial pressure. A lower percentage indicates better performance, as reflected by avoidance of CT imaging when it is not indicated. This measure was tested using administrative

claims data. There are currently no known existing quality measures specific to CT imaging of children with atraumatic headache.

Headaches are common in the pediatric population, and children with headaches are frequently evaluated in EDs and primary care settings. As a diagnostic tool, CT scans are simple to order because the technology is readily available, and image acquisition is fast. However, CT imaging for children with an atraumatic headache who lack any indication of trauma, intracranial hemorrhage, or other time-sensitive condition yields little information and exposes children to unnecessary risk from radiation. Children who have CT scans in early childhood tend to be at greater risk for developing leukemia, primary brain tumors, and other malignancies later in life. Young children are also at risk for complications from sedation or anesthesia, which are often required for longer CT imaging sequences. In addition, the cost burden associated with imaging is high.

Q-METRIC testing results indicate that this measure is feasible using existing data sources. This measure is specified using administrative claims. The proportion of children who received a CT image without indication after an atraumatic headache ranged from approximately 80 percent to 90 percent across seven State Medicaid programs from 2006-2010.

This measure provides a means to assess the extent to which CT studies are being overused for the evaluation of children with atraumatic headache. High rates of overuse are easily understood to be unsatisfactory. The primary information needed for this measure includes basic demographics, diagnostic codes, and procedure codes, all of which are widely available, though access may require a restricted-use data agreement and IRB approval. Advances would further allow for electronic capture of clinical information needed to determine if and when neuroimaging has been overused in the evaluation of children experiencing an atraumatic headache.

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Section 14: Identifying Information for the Measure Submitter

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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.