**Measure(s):** Pediatric Medical Complexity Algorithm

**Measure Developer:** Center of Excellence on Quality of Care Measures for Children with Complex Needs (COE4CCN)

**Box showing: Numerator, Denominator, Exclusions, Data Sources**

**Numerator:** COE4CCN developed consensus definitions for three levels of medical complexity: children with complex chronic disease (C-CD), children with non-complex chronic disease (NC-CD), and children without chronic disease (CD). See **Table 1** for further description of these three populations.

**Denominator:** Pediatric Medical Complexity Algorithm (PMCA) was developed and tested in children 0 to 18 years old insured by Washington State Medicaid (WA-Medicaid) and seen at Seattle Children’s Hospital (SCH) for > 1 emergency department (ED) visit and/or inpatient stay in 2010. It can therefore be applied to large datasets representing hospital and health plan utilization by children.

**Exclusions:** Not applicable

**Data Sources:** Administrative Data (e.g claims data)

**Measure Importance:** As the Patient Protection and Affordable Care Act is implemented, Medicaid and the health care system increasingly need strategies to allocate resources. 1 Children with C-CD are most likely to benefit from care coordination and other resources, and accurate identification of this group is critical.2 These children may suffer the worst quality of care for many of the measures under development by the PQMP. Use of PMCA will allow us to address the legislative mandate to assess disparities by special health care need status and further test the hypothesis that children with C-CD experience poorer quality of care than either children with NC-CD or healthy children.

**Evidence Base for Focus of the Measure (s)** PMCA is a new publicly available algorithm that identifies children with complex chronic disease (who have accessed tertiary hospital care) with good sensitivity and good to excellent specificity when applied to either hospital discharge or Medicaid claims data.1

**Advantages of the Measure(s)**

* Use of PMCA enables assessment of disparities in care by special health care need status. As health care reform is implemented, use of PMCA will be critical to target resources and services such as care coordination to children with the most needs.
* PMCA has good sensitivity for correctly categorizing children with complex chronic disease and excellent sensitivity for correctly categorizing children without chronic disease in administrative data.
* For optimal identification of these three groups of children using Medicaid claims data, we recommend using the *more conservative* version of the PMCA code and up to three years of claims data when available.
* For hospital discharge data (limited to ED, inpatient, and day surgery claims), we recommend using the *least conservative* version of the PMCA code and up to three years of data when available.
* Despite its limitations and potential future revisions, PMCA is a new publicly available algorithm that identifies children with C-CD (who have accessed tertiary hospital care) with good sensitivity and good to excellent specificity when applied to either hospital discharge or Medicaid claims data.
* This algorithm is publicly available for noncommercial use.

**Levels of Aggregation Applicable to the Measure(s)**

Algorithm can be used to compare: states, other geographic levels, Medicaid or CHIP payment models, health plans, hospitals, and practices.

**Reliability and Validity of the Measure(s)**

* Reliability testing was not performed.
* Validity testing was performed by determining PMCA’s sensitivity and specificity for correctly classifying children into the three levels of complexity using Seattle Children’s Hospital discharge and WA-Medicaid claims data and comparing these categorizations to those obtained using medical record review (the gold standard). 1

**Measure Development and Testing**

PMCA represents a modification of CDPS that conforms to the COE4CCN consensus definitions for medical complexity. CDPS modification involved removing several types of *ICD-9-CM* codes, including those consistent with adult illness (e.g., myocardial infarction), related to childbirth, consistent with acute illness (e.g., acute otitis media), and representing pediatric chronic conditions that are most often mild in severity (e.g., eczema, myopia, iron deficiency anemia). Excluding codes for conditions with a substantial proportion of mild disease (e.g., eczema) from PMCA reduces the potential for overestimation of disease burden in the population (i.e., false positive findings). However, this process may result in children with more severe forms of such diseases not being captured or correctly classified (i.e., false negative findings).

Further modifications included the addition of “flags” to each retained *ICD-9-CM* code by 2 authors (T.S. and R.M.-S.). Conditions associated with deteriorating health and an increased risk of shorter life expectancy in adulthood (defined as death in the fourth to fifth decade [e.g., cystic fibrosis, complex congenital heart disease, malignancy]) were flagged as progressive; when consensus was not immediately reached, life expectancy data for the condition were reviewed and a final decision was made. Body system flags were also assigned to permit body system counts and subsequent classification to NC-CD (1 body system) or C-CD (≥2 body systems). A full list of the *ICD-9-CM* codes included in PMCA, and their progressive and body system flags, is available from COE4CCN personnel. SAS programming code (SAS Institute, Inc., Cary, NC) was subsequently developed for PMCA to categorize children into the 3 levels of medical complexity based on adjudicated claims.

Three versions of the PMCA SAS code were developed to characterize the timing and frequency of coded conditions from administrative data: the least, more, and most conservative versions described in **Table 2**.

Eligible children wererandomly selected with oversampling (n=500) for children with lifelong chronic conditions (groups 5b, 6, 7, 8, and 9 using3M Clinical Risk Group (CRG) software). Chart review was conducted and assignments made into one of three levels of medical complexity through review of all available SCH electronic medical records. Among the 1,000 randomly selected children, medical records were reviewed until the target gold standard population of 700 children was assembled. The target population included 350 children with complex chronic disease, 100 with non-complex chronic disease, and 250 without chronic disease. Then PMCA was run on their administrative data using three versions shown in **Table 2**, with results provided in **Table 3**.

**Selected Results from Tests of the Measure(s)**

* See Validity testing above with **Table 3** in particular for testing results.

**Caveats**

* Refinements to PMCA are underway to improve identification of children with NC-CD.
* PMCA currently applies to ICD-9 codes only.

**More Information:**

AHRQ: [CHIPRAqualitymeasures@ahrq.hhs.gov](mailto:CHIPRAqualitymeasures@ahrq.hhs.gov)

COE: [insert contacts and emails provided by COE]

Coming soon: Link to measure details on AHRQ Web site.

**Notes**

1. Simon TD, Cawthon ML, Stanford S, Popalisky J, Lyons D, Woodcox P, Hood M, Chen AY, Mangione-Smith R for the Center of Excellence on Quality of Care Measures for Children with Complex Needs (COE4CCN) Medical Complexity Working Group. Pediatric medical complexity algorithm: a new method to stratify children by medical complexity. *Pediatrics*. Volume 133, Number 6, June 2014, pp. e1647-54. PMID: 24819580, PMCID: 4035595 [PubMed - indexed for MEDLINE].Published online: May 12, 2014, doi: 10.1542/peds.2014.3875.

2. Cohen E, Kuo DZ, Agrawal R, et al. Children with medical complexity: an emerging population for clinical and research

initiatives. *Pediatrics.* Mar 2011;127(3):529-538.

[BOX: The Children’s Health Insurance Program Reauthorization Act (CHIPRA) called for establishment of a Pediatric Quality Measures Program (PQMP) as a followup to identifying the initial core set of children’s health care quality measures. This measure fact sheet was produced by the Agency for Healthcare Research and Quality, based on information provided by the AHRQ-CMS CHIPRA [INSERT NAME OF COE AND ACRONYM], which was funded by an AHRQ-CMS award. A listing of all submitted CHIPRA Centers of Excellence measures can be found at <https://www.ahrq.gov/policymakers/chipra/index.html>. All CHIPRA COE-developed measures are publicly available for noncommercial use.]

**Table 1.** COE4CCN consensus definitions of three levels of medical complexity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CONDITION DESCRIPTION** | **POTENTIAL EXAMPLES \*** | | |
| **Children with Complex Chronic Disease (C-CD)\*** | | |  |  |
|  | **Significant chronic conditions in two or more body systems:**  **Significant chronic condition** is defined as a physical, mental or developmental condition that can be expected to last at least a year, will use health care resources above the level for a healthy child, require treatment for control of the condition, and the condition can be expected to be episodically or continuously debilitating.  **Body systems** include: cardiac, craniofacial, dermatologic, endocrinologic, gastrointestinal, genetic, genitourinary, hematologic, immunologic, mental health, metabolic, musculoskeletal, neurologic, ophthalmologic, otologic, pulmonary/respiratory, and renal. | type 1 diabetes and static encephalopathy; type 1 diabetes and depression; developmental delay and chronic pulmonary conditions | | |
| OR | A progressive condition that is associated with deteriorating health with a decreased life expectancy in adulthood. | muscular dystrophy, cystic fibrosis, paraplegia, quadriplegia, malignancy | | |
| OR | Continuous dependence on technology for at least six months. | tracheostomy +/- ventilator assistance, renal dialysis, gastrostomy tube, CSF shunt | | |
| OR | Malignancies: Progressive or metastatic malignancies that impact life function. Exclude those in remission for more than 5 years. | lymphoma, leukemia, brain tumor | | |
| **Children with Non-Complex Chronic Disease (NC-CD)** | | |  |  |
|  | Chronic Conditions that last at least one year: These conditions are commonly lifelong but can be episodic with periods of good health in between episodes. They include  physical, developmental, or mental health conditions that  may persist into adulthood but may also resolve either secondary to the natural history of the disease or as a result of surgical intervention. These conditions involve a single body system, are not progressive, can vary widely in severity and result in highly variable health care utilization. | type 1 diabetes, atrial septal defect, asthma, depression, ADHD | | |
| **Children without Chronic Disease** | | |  |  |
|  | Acute Non-Chronic Conditions: A physical, developmental or mental health condition that is not expected to last more than a year. These children may temporarily (for < 1 year) utilize health care resources above the normal level for a healthy child. | ear infection, pneumonia, diarrhea and dehydration, bronchiolitis | | |
|  | Healthy: No acute or chronic health conditions. These children do not utilize health care resources above the normal level for a healthy child. | N/A | | |

\* The examples used in this document to illustrate definitions of medical complexity and chronicity are intended to demonstrate characteristics specified in the definition/descriptions.  It is not our intention to imply that specific diseases and conditions are by default linked to the categories that they were used to illustrate.

**Table 2.** Classification of disease complexity based on progressive and body system flags and frequency of encounters observed in administrative data

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Least Conservative Version** | **More Conservative Version** | **Most Conservative**  **Version** |
| **Complex Chronic Disease** | | |  |
| **Progressive Condition** | ≥ 1 claim | ≥ 1 claim | ≥ 1 claim |
| **Malignancy** | ≥ 1 claim | ≥ 1 claim | ≥ 1 claim |
| **Other** | ≥ 1 claim per body system for 2 different body systems during the measurement period\* | ≥ 2 claims per body system for 2 different body systems during the measurement period\* | ≥ 1 claim per body system *per year* for 2 different body systems during the measurement period\* |
| **Non-Complex Chronic Disease** | | |  |
|  | ≥ 1 claim for a single body system not flagged as progressive during the measurement period\* | ≥ 2 claims for a single body system not flagged as progressive during the measurement period\* | ≥ 1 claim per single body system *per year* not flagged as progressive during the measurement period\* |
| **Without Chronic Disease** | | |  |
|  | None of the above during the measurement period\* | None of the above during the measurement period\* | None of the above during the measurement period\* |

\*In the validation study a three year measurement period was used (1/1/09-12/31/11)

**Table 3.** Sensitivity and specificity for PMCA in Seattle Children’s Hospital (SCH) discharge and Washington State (WA) Medicaid claims data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Approach** Algorithm | **C-CD** | | **NC-CD** | | **Without CD** | |
|  | Sensitivity | Specificity | Sensitivity | Specificity | Sensitivity | Specificity |
| **SCH (n=700)\*** | **N=350\*** | **N=350\*** | **N=100\*** | **N=100\*** | **N=250\*** | **N=250\*** |
| **Least** PMCA † | 84%  (80%, 88%)\*\* | 92%  (89%, 94%) | 41%  (32%, 51%) | 92%  (85%, 96%) | 96%  (93%, 98%) | 90%  (86%, 93%) |
| **More** PMCA | 73%  (68%, 77%) | 96%  (93%, 98%) | 19%  (13%, 28%) | 94%  (88%, 97%) | 100%  (99%, 100%) | 72%  (66%, 77%) |
| **Most** PMCA | 66%  (61%, 71%) | 96%  (93%, 98%) | 1%  (0%, 5%) | 99%  (95%, 100%) | 100%  (99%, 100%) | 57%  (51%, 63%) |
| **WA Medicaid (n=678)\*** | **N=329\*** | **N=329\*** | **N=100\*** | **N=100\*** | **N=249\*** | **N=249\*** |
| **Least** PMCA | 91%  (87%, 94%) | 79%  (74%, 83%) | 37%  (28%, 47%) | 88%  (80%, 93%) | 69%  (63%, 74%) | 94%  (90%, 96%) |
| **More** PMCA † | 89%  (85%, 92%) | 85%  (81%, 89%) | 45%  (36%, 55%) | 91%  (84%, 95%) | 80%  (75%, 85%) | 91%  (87%, 94%) |
| **Most** PMCA | 78%  (73%, 82%) | 90%  (86%, 93%) | 16%  (10%, 24%) | 95%  (89%, 98%) | 95%  (92%, 97%) | 75%  (69%, 80%) |

\*Number of children from the gold standard sample included in the designated category

\*\*(95% confidence intervals)

†recommended algorithm

SCH Seattle Children’s Hospital

WA Washington State

C-CD Complex chronic disease

NC-CD Non-complex chronic disease

CD chronic disease