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# Vision and Eye Health in Children 36 to <72 Months: Proposed Data Definitions

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## ABSTRACT

**Purpose.** To recommend a standardized approach for measuring progress toward national goals to improve preschool children's eye health.

**Methods.** A multidisciplinary panel of experts reviewed existing measures and national vision-related goals during a series of face-to-face meetings and conference calls. The panel used a consensus process, informed by existing data related to delivery of eye and non-eye services to preschool children.

**Results.** Currently, providers of vision screening and eye examinations lack a system to provide national- or state-level estimates of the proportion of children who receive either a vision screening or an eye examination. The panel developed numerator and denominator definitions to measure rates of children "who completed a vision screening in a medical or community setting using a recommended method, or received an eye examination by an optometrist or ophthalmologist at least once between the ages of 36 to <72 months." A separate measure for children with neurodevelopmental disorders and measures for eye examination and follow-up were also developed. The panel recommended that these measures be implemented at national, state, and local levels.

**Conclusions.** Standardized performance measures that include all eye services received by a child are needed at state and national levels to measure progress toward improving preschool children's eye health.

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Key Words: children, vision, vision screening, performance measure, data analysis

The Maternal and Child Health Bureau (MCHB) established the National Center for Children's Vision and Eye Health (NCCVEH) to recommend systems to increase rates of vision screening and necessary eye examinations in children aged 36

to younger than 72 months. The NCCVEH facilitated an independent expert panel of professionals in eye care, pediatrics, and related fields to establish guidelines for vision screening (see Cotter et al. in this issue<sup>1</sup>), recommendations for data collection (see Hartmann et al. in this issue<sup>2</sup>), and performance measures to track progress toward national goals related to children's visual health. The rationale and process used to develop the recommendations are fully described in the Appendix (available at <http://links.lww.com/OPX/A188>).

Increasing the proportion of preschool-aged children who receive either a valid vision screening (in a community setting or in the medical home) or an eye examination by an ophthalmologist or optometrist is a national public health priority. Healthy People 2020 specifically included the goal of increasing vision screening rates in children aged 5 years and younger, with a target of 44%.<sup>3</sup> In addition, the United States Preventive Services Task Force endorsed preschool vision screening for children aged 3 to 5 years,<sup>4</sup> and the American Academy of Pediatrics' Bright Futures Guidelines<sup>5</sup> recommended vision screening for preschool children to detect amblyopia or risk factors for the development of amblyopia. Early diagnosis of amblyopia is particularly important as there is evidence that treatment before age 5 years leads to better long-term

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outcomes, whereas delaying treatment until age 7 or older reduces treatment outcomes.<sup>6,7</sup>

Existing data provide widely varying estimates of US preschool vision screening rates ranging from 2 to 64% (Table 1) depending on the definition of screening, the population studied, ages of children included, and the sources of data.<sup>3,8–13</sup> Some studies report only numbers of children screened and not the size of the population from which those children are drawn; hence, the proportion of children screened is unknown. The absence of a standardized approach to the determination of vision screening rates means that the United States lacks reliable data to track national progress toward vision screening goals or to compare rates of vision screening across states and regions.

For our vision care system to improve, it is necessary to measure each step in the continuum of care, including screening, eye examinations, diagnosis of significant conditions, and provision of necessary treatment and follow-up care. One multiclinic study has shown that only 48% of children aged 3 to 5 years who failed vision screening in the medical home were documented to be referred for diagnostic evaluation.<sup>14</sup> To accomplish goals of improved vision care, it is important to monitor the quality of preventive child health services, to

evaluate the performance of the system of vision screening for young children, and to respond to requirements for program accountability (required by the Title V Maternal and Child Health Services Block Grant Program [MCHB],<sup>15,16</sup> the Children's Health Insurance Program Reauthorization Act [CHIPRA],<sup>17</sup> and/or the Patient Protection and Affordable Care Act<sup>18</sup>).

Optometrists and ophthalmologists have long been interested in measuring vision screening performance. Both disciplines have a close working knowledge of the process of screening and follow-up, extensive experience with the eye health care delivery system, and an understanding of measures that would best reflect vision care quality. Development and implementation of performance measures for vision screening of preschool-aged children should include ophthalmologists and optometrists in leadership positions.

## RECOMMENDATION DEVELOPMENT

The NCCVEH expert panel undertook a consensus process incorporating review of the published literature (through February 2014) including research, reviews, and policy statements, as well as consultation with programs that are developing vision screening

**TABLE 1.**

Estimates of preschool vision screening (VS) rates from available sources

Source	Breadth	Performance measure	Strengths	Weaknesses
Office of the Inspector General <sup>6</sup> 2010	9 states	<ul style="list-style-type: none"> <li>• # VS per child/# well-child visits</li> <li>• 40% have VS</li> </ul>	Stratified sampling, chart review	No age-specific rates; no definition of "vision"
National Health Interview Survey <sup>1</sup> 2008	National; parent survey	<ul style="list-style-type: none"> <li>• "Has [name of child] ever had his/her vision tested by a doctor or other health professional"</li> <li>• 44% aged &lt;6 y</li> </ul>	Population-based, conducted annually, disparity indicators	No definition of "vision testing"; not specific to provider types
Medical Expenditure Panel Survey <sup>7</sup> 2011	National; parent survey	<ul style="list-style-type: none"> <li>• Same question as National Health Interview Survey</li> <li>• 64% aged 3 to 6 y</li> </ul>	Population-based, conducted annually, disparity indicators	Same as above
National Ambulatory Medical Care Survey <sup>8</sup> 1993–2002	National; medical home	<ul style="list-style-type: none"> <li>• # VS/# examined within sample week</li> <li>• 11–17% depending on race/ethnicity</li> </ul>	Large sample, high % of selected practices participated	No age-specific rates; limited to children attending preventive care visits
Vermont Quality Improvement Project <sup>9</sup> 2006	Statewide	<ul style="list-style-type: none"> <li>• # VS/records reviewed</li> <li>• 62% of 4-y-olds</li> </ul>	91% (N = 35) of pediatric offices participated	No definition of "vision"; nonrandomized design
Family Practice Project <sup>10</sup> 2000	135 primary care practices in Ohio	<ul style="list-style-type: none"> <li>a. # "vision" observed/# examined</li> <li>b. # "vision" observed or charted/# examined;</li> <li>a. 2% screened aged 3–6 y</li> <li>b. 5% by observation or chart review</li> </ul>	Data collection method (direct observation and chart review); large number of practices participated	Separate reporting of "vision" and "amblyopia (3–5 y)" is confusing
Alabama Medicaid <sup>11</sup> 2008	Statewide, medical home	<ul style="list-style-type: none"> <li># screened/# well-child visits</li> <li>12% (3 y), 23% (4 y), and 47% (5 y)</li> <li># screened/# enrolled</li> <li>6% (3 y), 13% (4 y), and 20% (5 y)</li> </ul>	VS reported as separate procedure in claims data; known denominator for children with or eligible for well-child visit	Limited to billing data; limited to one insurance carrier

infrastructure and with national and state agencies actively involved in performance measure development. The panel considered whether any existing measures could be adopted more widely. The National Quality Forum has endorsed a performance measure (#1412; “Preschool Vision Screening in the Medical Home”) to document the proportion of “children under 5 years old who receive visual acuity or photo-screening” among “all children under 5 years old attending preventive care visits.”<sup>19</sup> Although this measure is useful to evaluate primary care performance, it is not useful as a population-based measure. Excluded from this measure are children who miss well-child visits,<sup>20</sup> receive a vision screening in community-based settings such as Head Start or preschool, or have been examined directly by an optometrist or ophthalmologist.

The expert panel also reviewed the methodology used in existing regional vision screening performance estimates, to determine whether any could be “scaled up” to provide a population-based estimate. However, each of the methods had flaws, including reliance on family’s memory of a screening event, study of a nonrepresentative population sample, or lack of a valid screening assessment.

The expert panel determined that a new approach was needed, one that included all sources of vision screening and eye care using a unique child identifier. The former requirement allowed inclusion of all sites of care, so that rates are not underestimated. The latter requirement allows elimination of duplicate services so that screening rates are not overestimated.

The expert panel recognized that the data collection infrastructure supporting vision screening and follow-up in the United States is underdeveloped. Rather than consider only those measures that could be estimated from the existing highly fragmented system, the panel chose instead to make recommendations for more comprehensive measures, recognizing that accepted, well-designed performance measures can help to drive development of appropriate national, state, and local data systems and inform policy direction.

## **Recommendations from the National Expert Panel to the NCCVEH for Preschool-Aged Child Vision Care Performance Measures**

The expert panel adopted general principles of measure development including the need to define both the numerator and the denominator for each measure (simple tallies of episodes of care would be insufficient), the need to define the age range of children included in the measure, and the recommendation to report performance by birth cohort, that is, the child’s birth year. The panel also determined that more than one measure would be needed to monitor the full continuum of vision care. The panel recognizes that the following recommendations are the first step in a methodical process that is necessary to ensure that valid, standardized measures are obtained across settings.

### **Recommendation 1: Performance Measures for Vision Care**

The expert panel recommends a child-based performance measure for vision care for children aged 36 to younger than 72 months, defined as:

*Numerator:* Number of children from the denominator who completed a valid vision screening in a medical or community

setting or received an eye examination by an optometrist or ophthalmologist at least once between the ages of 36 and younger than 72 months. (For all performance measures, “valid vision screening” is defined as vision screening attempted using a recommended quantitative method [see Cotter et al. in this issue<sup>1</sup>] with an outcome of “pass” OR another outcome [fail or untestable] AND evidence that the child was referred or rescreened as specified in Table 2. Thus, a nonpassing result without evidence of a referral or rescreen is considered an invalid screening and is not counted in the numerator. Acceptable evidence of referral would be the date of the appointment, and name of consulting ophthalmologist or optometrist reported by the screening agency.)

*Denominator:* All children who turn 72 months of age by December 31st of the reporting year in the entire population, or a representative sample.

As the minimum standard of care stipulates at least one vision screening (or eye examination) between the ages of 36 and younger than 72 months, the panel recommends that this measure be reported retrospectively by birth cohort when the youngest child in each birth year has reached the age of 72 months (i.e., on December 31st of that year; those children who turn 72 months of age between January 1 and December 31 of the reporting year). For example, children born in 2010 would have this measure determined at the end of 2016 including screenings from 2013, 2014, 2015, and 2016.

Entities establishing this performance measure are encouraged to identify their baseline performance and to set annual targets increasing toward their specific goal. Provider-based data collected can be used to determine an “achievable benchmark of care” (ABC).<sup>21</sup> For example, using the ABC method, rates of quantitative vision screening by “best” pediatric primary care providers in Alabama were 68.3% of 3-year-olds, 79.4% of 4-year-olds, and 93.2% of 5-year-olds.<sup>22</sup> Entities that require a population-based goal (such as the Healthy People 2020 goal of 44% of children screened by 2020) will need to be equipped to report all community-based and office-based screening. Lower population-based targets may be appropriate owing to children not attending office- or community-based screening, or because reporting is not accurate.

Age-specific reporting, for purposes of identifying settings that successfully test younger children, could be a secondary goal, because identified gaps in care could be corrected before the ideal age to correct vision problems has passed. Reporting age-specific screening rates would require adjustments to the numerator and denominator to reflect the cohort being addressed. For example, the denominator could be restricted to “All children who turn 48 months of age by December 31st of the reporting year in the state, or a representative sample” and the numerator could specify “Number of children from the denominator who completed a valid vision screening in a medical or community setting, or received an eye examination by an ophthalmologist or optometrist at least once between the ages of 36 to <48 months.”

### **Recommendation 2: Performance Measures for Children with Diagnosed Neurodevelopmental Disorders**

The panel recommends a separate performance measure for children diagnosed as having neurodevelopmental disorders (e.g.,

**TABLE 2.**  
Steps in the vision care process\*

System of Vision Screening for Children Aged 36 to 72 Months						
<b>Direct referral</b>						
Quantitative vision screening is not required for specified conditions below						
Indications to refer directly from medical or community setting			Additional indications to refer directly from the medical setting			
Parent suspects eye or vision problem	Child is being monitored or treated by an optometrist or ophthalmologist	Family history reveals increased risk of eye abnormality	Physical examination shows eye abnormality	Diagnosis of neurodevelopmental condition	Diagnosis of systemic condition requiring eye examination	Medication requiring eye examination
<b>Quantitative vision screening</b>						
Recommended for children without any of the specific indications listed above for direct referral						
Medical and community settings must both use a recommended vision screening test of acuity or refractive error (see Cotter et al in this issue)						
(Child) <b>Passes*</b> vision screening			(Child) does not pass screening			
(Child) <b>Fails*</b> first vision screening			(Child) is <b>untestable*</b> but is judged <b>LIKELY</b> to complete screening		Child is <b>untestable*</b> and is judged <b>UNLIKELY</b> to complete a repeat screening	
			Child should be rescreened <b>as soon as possible*</b> but at least within 6 months		Or	
			(Child) <b>Passes*</b> rescreening within 6 months	Child is <b>unable to pass*</b> rescreening within 6 months		Child did not attend a rescreen within 6 months
Recommendation is fulfilled	<b>Refer*</b> ; evidence of referral is needed to complete action	Recommendation is fulfilled	<b>Refer*</b> ; evidence of referral is needed to complete action		<b>Refer*</b> ; evidence of referral is needed to complete action	

\*Highlights indicate outcomes that must be specified in data collection systems to underpin recommended performance measures 1 to 4. Screenings or examinations after the first vision screening pass are considered duplicate services and ignored in performance measure calculations. Data systems in medical and community settings must record the outcomes for each child.

hearing impairment, motor abnormalities such as cerebral palsy, Down syndrome, cognitive impairment, autism spectrum disorders, and speech/language delay) who should be referred directly (Table 2). This measure addresses eye examination rates for these children. Implementation will require integration of vision and developmental diagnostic data.

*Numerator:* Number of children from the denominator who completed an eye examination by an ophthalmologist or optometrist within 6 months of diagnosis of the neurodevelopmental disorder.

*Denominator:* All children who turn 72 months of age by December 31st of the reporting year in the state, or a representative sample, diagnosed as having a neurodevelopmental disorder.

The expert panel further recommends the setting of baselines and target goals for each of these measures, with annual monitoring and progress reports.

**Recommendation 3: Performance Measures for Follow-Up and Treatment**

Children who do not pass quantitative screening or rescreening in primary care or community settings should obtain follow-up care and any required treatment. The panel recommends a performance measure addressing the proportion of children receiving follow-up eye examinations after a screening referral (Table 2), defined as:

*Numerator:* Number of children from the denominator who completed an eye examination by an optometrist or ophthalmologist within 6 months of a referral from quantitative vision screening.

*Denominator:* All children who turn 72 months of age by December 31st of the reporting year in the state, a region, or a representative sample, who were referred after quantitative screening (Table 2) in a medical or community setting between the ages of 36 and younger than 72 months.

In case of multiple services, data should reference the earliest examination by an optometrist or ophthalmologist, which was preceded by a referral from a screening (this performance measure does not include eye examinations not preceded by a referral, or triggered by another reason such as positive family history, neurodevelopmental disorder, or observation of an abnormality). This measure should be calculated 6 months after the end of the reporting year, to account for those children who failed a vision screening between the ages of 67 and younger than 72 months who required time to receive a follow-up eye examination.

The following treatment measure addresses the proportion of children with an eye examination found to have a visually significant eye condition, who receive treatment or additional visits to an ophthalmologist or optometrist.

*Numerator:* Number of children from the denominator who obtained glasses and/or attended at least one follow-up appointment with an optometrist or ophthalmologist within 6 months of an eye examination. (This numerator would be reported by the prescribing ophthalmologist or optometrist.)

*Denominator:* All children who turn 72 months of age by December 31st of the reporting year in the population, or a representative sample, who were prescribed treatment including glasses and/or instructed by an optometrist or ophthalmologist to return within 6 months (e.g., for treatment of amblyopia, strabismus, or amblyogenic refractive error<sup>23</sup>).

This measure would provide surveillance of treatment adherence in children diagnosed as having vision conditions or amblyogenic refractive error. In children with multiple services, the earliest relevant visits would be counted. This measure requires that children with amblyopia, strabismus, or amblyogenic refractive error be seen within 6 months of the initial diagnosis or glasses prescription.

### **Recommendations for Implementation of Preschool Vision Care Performance Measures**

- Each state, region, locality, and program will need to determine how to implement these measures. Organizations already use a variety of systems to report required measures such as immunizations and well-child examinations. Using existing data infrastructure, while working toward a more interchangeable data system that will readily support the implementation and reporting of valid measures, is recommended. The panel further recognizes that states and organizations are in differing stages of developing integrated, or even linked data systems, and of adoption of electronic health records. Despite the fluidity of the data landscape, we urge implementation of performance measures into emerging data systems to assure the necessary infrastructure and data elements to allow reporting of the vision measures.
- The feasibility of implementing these vision performance measures can be enhanced by “lessons learned” during implementation of the 18 national performance measures currently required for pediatric health care.<sup>24</sup> Like past efforts, implementation of the vision performance measures will require technical assistance and integration with other data collection and performance measure initiatives. Implementation may involve development of “Use Cases”<sup>25</sup> in which the process and steps for vision performance measures are developed. A technical manual, developed with input from experts in epidemiology, performance measurement, statistics, information technology, and vision, should be adopted so that basic measures are standardized, and the estimates are valid, reliable, and comparable to other locations. This process should be informed by previous efforts to develop other pediatric performance measures, for example, the core CHIPRA measures.<sup>26</sup> Measures may be applied to the whole population or to a representative sample of children aged 36 to younger than 72 months.
- Linkage of child-based measures with child demographic information will enable monitoring of possible disparities in health care provision,<sup>27,28</sup> for example, racial/ethnic differences

in screening and/or follow-up rates, which are especially important for children.

- Recognizing that most states do not currently have Web-based integrated reporting systems to track vision care, we support the use of national parent survey data, for example, the National Survey of Children’s Health, as an *interim* step to allow states to estimate their performance on our recommended measures. Because survey methods are subject to the potential inaccuracies and recall bias inherent in the use of parent-report data, Web-based data systems should supersede the survey approach as quickly as possible.
- Rather than separate efforts by agencies such as the National Council on Quality Assurance, the National Quality Forum, the American Academy of Pediatrics, the Agency for Healthcare Research and Quality, and the MCHB to develop performance measures, each of these agencies should continue to collaborate so that efforts are streamlined and coordinated.
- Vision care performance measure results should be publicly available. Such data can be used to determine progress toward goals and drive quality improvement efforts. Addition of future performance measures should be driven in part by consumer priorities, for example, measuring and reporting on the quality of life for children diagnosed as having and treated for significant vision disorders including amblyopia.

Improvements in vision screening and eye examination rates can also be enhanced by concurrent public health and health behavior campaigns aimed at parents and providers. The literature addressing efforts to understand and improve providers’ and parents’ behaviors related to vision care is small but has revealed that providers with high levels of knowledge and positive attitudes toward vision screening are more likely to report compliance with preschool vision screening recommendations<sup>29</sup> and that failing to realize that children without signs or symptoms can still have serious eye problems is a barrier to screening and seeking eye examinations.<sup>29,30</sup> Attempts to improve provider behavior, including office-based<sup>11,14,31,32</sup> and Internet-based<sup>33</sup> interventions have shown some success in improving rates of screening and knowledge about amblyopia. More research and effort in this area are urgently needed.

### **CONCLUSIONS**

Increasing requirements for quality and accountability at national, state, local, and provider levels are driving the development of vision care performance measures. Monitoring the vision care system for preschool-aged children requires regular reporting of measures of vision screening, eye examinations, and treatment. These expert panel recommendations represent the first step toward creating a comprehensive data collection and reporting system. Eye care professionals including optometrists and ophthalmologists should be in leadership positions, driving their evolution and implementation.

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## APPENDIX

The Appendix, which describes the process used to develop the National Expert Panel recommendations, is available at <http://links.lww.com/OPX/A188>.

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