Project Universal Preschool Vision Screening: A Demonstration Project

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ABSTRACT

OBJECTIVES. Visual disorders among preschool-aged children are common, yet screening is infrequent. The purpose of this project was to implement the vision screening recommendations proposed by the Maternal and Child Health Bureau and National Eye Institute Vision Screening in the Preschool Child Task Force: monocular visual acuity and stereopsis testing.

METHODS. Four sites fully participated in the implementation of the task force recommendations with 3- and 4-year-old children. Two of the sites worked with primary care practices (testing performed by staff); 2 worked with community-based programs (testing performed by lay volunteers). Each site tracked number of children screened by age, as well as proportion testable, referred, and with documented follow-up evaluation.

RESULTS. Variations in implementation of the recommendations were observed. Successful screening among 3-year-olds ranged from 70% to 93%; referral rates were 1% to 41%, and follow-up rates were 29% to 100%. Successful screening among 4-year-olds ranged from 88% to 98%; referral rates were 2% to 40%, and follow-up rates were 41% to 100%. The proportion of 3-year-olds who were treated was significantly different between the community-based sites (n = 20) and the primary care sites (n = 2). Similarly, the proportion of 4-year-olds who were treated was significantly different between the community-based sites (n = 36) and the primary care sites (n = 11).

CONCLUSIONS. The variability across pilot sites in numbers successfully screened and numbers referred suggests that all aspects of preschool vision screening need thorough review before the goal of universal preschool vision screening can be realized.
2. All children in the United States who fail to pass the vision screening test(s) are referred to and seen by a licensed eye care specialist for appropriate diagnosis, treatment, and follow-up.

3. Vision screening is conducted within the context of a medical home (the medical home is defined by the AAP as care that is “accessible, family-centered, continuous, comprehensive, coordinated, compassionate, and culturally effective”).

4. Children who are identified as needing a referral for eye care are linked to a medical home if they do not already have one.

The ultimate goal was to develop model programs that could be implemented throughout the United States. Our outcome measure was the proportion of children who received “treatment” from an eye care specialist as a result of passing through the vision screening system, which included enrollment, successful screening, referral, and eye care follow-up. Treatment was defined as any intervention from the eye care provider such that the outcome of the comprehensive eye examination was not categorized as “normal.”

METHODS

Advisory Panel/Development of Protocol

Representatives from disciplines that had established vision screening guidelines for preschool-aged children, as well as groups that are involved more directly in the implementation of these guidelines, were solicited to participate in the PUPVS advisory panel. The panel included State Title V Maternal and Child Health program administrators and staff, primary care pediatricians, family physicians, nonphysician clinicians, pediatric ophthalmologists and optometrists, families, vision screening researchers, and individuals from national nonprofit organizations that are involved in vision screening. The advisory panel consisted of 36 individuals who were responsible for providing oversight to all project activities (see Acknowledgments). The time course of events related to this collaborative project are detailed in Table 1.

Project Procedures

The PUPVS advisory panel adopted the vision screening recommendations as proposed by the MCHB/NEI Task Force as the project protocol: monocular distance acuity and stereopsis testing (Table 2). Recommended monocular distance acuity tests were either the HOTV (Precision Vision, La Salle, IL) or Lea Symbols (Good-Lite Co., Chicago, IL) chart tests (Figs 1 and 2). Three-year-olds were required to pass a critical line of 20/40 (4 of 5 symbols identified correctly). Four-year-olds were required to pass a critical line of 20/30 (4 of 5 symbols identified correctly). Stereopsis was evaluated using the Random Dot E Test (Stereo Optical Company, Chicago, IL).
IL) presented at 40 cm (Fig 3). Children were required to locate the stereo target correctly on 4 of 5 trials (Table 2). Additional procedures were incorporated for primary care settings, as specified in the practice guidelines endorsed by the AAO, AAP, and AAPOS. These primary care guidelines included review of vision history, external inspection of the eyes, ophthalmoscopic examination, and testing for ocular muscle motility and eye muscle imbalance (Table 3).

The protocol for making a referral on the basis of the vision screening assessments is detailed in Table 4. Children who were screened in community-based settings were referred on the basis of the monocular acuity and stereopsis tests only. Children who were screened in primary care settings received the additional assessments described in Table 3, and referral was indicated whenever abnormalities were detected. In addition, children in primary care settings who passed risk factors for eye

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**TABLE 1** Time Course of Collaborative Project

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 11, 1998</td>
<td>MCHB/NEI Vision Screening in the Preschool Child Task Force</td>
</tr>
<tr>
<td>September 1, 1999</td>
<td>MCHB award of collaborative funding to AAP for Project Universal Preschool Vision Screening (PUPVS)</td>
</tr>
<tr>
<td>January 2000</td>
<td>Appointment of PUPVS Panel Members</td>
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<tr>
<td>May 5, 2000</td>
<td>First Panel Meeting</td>
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<tr>
<td>October 13, 2000</td>
<td>Second Panel Meeting</td>
</tr>
<tr>
<td>November 2000</td>
<td>Announcement of RFP</td>
</tr>
<tr>
<td>December 2000</td>
<td>Deadline for Letter of Intent</td>
</tr>
<tr>
<td>February 20, 2001</td>
<td>Deadline for Proposal Submission</td>
</tr>
<tr>
<td>May 2001</td>
<td>Selection of Pilot Sites</td>
</tr>
<tr>
<td>April 19, 2002</td>
<td>Third Panel Meeting</td>
</tr>
<tr>
<td>September 2002</td>
<td>Completion of Data Collection</td>
</tr>
</tbody>
</table>

**RFP** indicates request for proposal.

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**TABLE 2** Project Procedures for Vision Screening in Community-Based Setting

<table>
<thead>
<tr>
<th>Function to be Evaluated</th>
<th>Type of Test</th>
<th>Specific Test</th>
<th>Minimum Testing Procedures</th>
<th>Passing Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monocular Distance Acuity</td>
<td>Chart tests</td>
<td>HOTV Chart</td>
<td>Test distance = 10 ft (3 m)</td>
<td>Child must identify or match 4 of 5 optotypes on the critical line with each eye tested monocularly.</td>
</tr>
<tr>
<td></td>
<td>Isolated optotypes with crowding</td>
<td>LEA Chart</td>
<td>Pretest (performed binocularly): Test child’s ability to perform test by having child identify or match each of the 4 targets (20/100 or greater size). Child must identify successfully each of the 4 targets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HOTV cards with bars</td>
<td>Test procedure (performed monocularly): Patch 1 eye. Constantly monitor for peeking. To proceed, child must identify or match each 20/100 target. Present 1 or 2 smaller targets up to critical line or size. Present 5 targets at critical line or size. Repeat test procedure with the other eye.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Critical line: 20/40 at 36–47 mo 20/30 at 48–59 mo</td>
<td></td>
</tr>
<tr>
<td>Stereopsis</td>
<td>Random dot stereogram</td>
<td>Random Dot E</td>
<td>Test Distance = 40 cm (630 arcsec)</td>
<td>Child must locate stereo E on 4 of 5 presentations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All testing, including pretesting, should be done binocularly with the polarized glasses on.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pretest: Test child’s ability to perform test by having child identify the location of the 3-dimensional E correctly on 4 of 5 trials (E on left or right, above or below).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Test procedure: Test child’s ability to identify the location of the stereo E. Tester should use 5 presentations, varying location in a nonsystematic manner.</td>
<td></td>
</tr>
</tbody>
</table>

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*a* Equivalent to 20/32 on recommended (logMAR) tests.

*b* From a statistical perspective, it would be ideal to require that a child pass 5 of 5 trials, because the probability of achieving this criterion by simply guessing is <5%. In reality, many children will have difficulty attending consistently for 5 trials. Therefore, the 4 of 5 correct passing criterion is considered acceptable, even though the probability of passing by chance is 16.5%.
disease and observation but failed either visual acuity or stereopsis testing could be identified as needing re-screening at a later date (Table 4).

Selection of Pilot Sites
Pilot sites were selected to implement the PUPVS project procedures through a competitive request-for-proposal process. Diverse groups were encouraged to apply, including state health or education departments, multistate collaborations, community organizations, nonprofit organizations, and medical universities. Selection criteria specified that the application must include vision screening activities only. Applicants were required to describe how they would screen all children between 36 and 59 months in a catchment area with a minimum population of 100,000. They were encouraged to provide plans for screening underserved or previously unreached children, as well as children with special needs. They were asked to describe the number and types of health care professionals in the area related to vision screening efforts (pediatricians, family physicians, ophthalmologists, and optometrists), as well as other community resources. Applicants were expected to demonstrate existing partnerships with community organizations, how they would develop additional partnerships, and how existing and new partnerships would be sustained. Applicants were asked to define and justify their selection of screening locations, as well as explain who would be conducting the vision screening and how these individuals would be trained. Applicants were also asked to provide information about their proposed methods for ensuring appropriate follow-up for children who were identified as needing referral.

A total of 23 letters of intent were submitted in December 2000. Of that number, 15 applications were completed by February 2001. Advisory panel members served as proposal reviewers. Proposals were distributed across 4 groups with 6 panel members evaluating each proposal. The final selection of funded pilot sites was based on the combined scores of the reviewers. A total of 4 sites were awarded $20,000 each and obtained Institutional Review Board approval for participation in this study. The sites included (1) Abraham Ratner Children’s Eye Center and Division of Community Ophthalmology, Department of Ophthalmology, University of California San Diego, San Diego, California; (2) Cumberland Pediatric Foundation, Nashville, Tennessee; (3) PrimeCare of Southeastern Ohio, Zanesville, Ohio; and (4) West Virginia University Eye Institute, Morgantown, West Virginia.

All statistics were conducted as a test of differences between proportions using Statistica.

RESULTS
Characteristics of Pilot Sites
Characteristics of the 4 participating sites are summarized in Table 5. Most (85%) screenings in Ohio and all screenings in Tennessee were conducted in primary care settings. In Tennessee, each practice used the MTI Photoscreener for 6 months and the PUPVS screening guidelines for 6 months, with half of the practices using the photoscreening technique first and half using the PUPVS screening guidelines first. Data from the Tennessee site are reported only for the children who were tested following the PUPVS screening guidelines, not the data from their photoscreenings. The results from the photoscreenings at these sites are presented elsewhere. Most (87%) screenings in West Virginia and all screenings in California were conducted in early care and education settings, including Head Start programs. Data summaries presented do not include the 15% (n = 161) community-based screenings conducted in Ohio or the 13% (n = 160) primary care–based screenings in West Virginia, because these numbers were small and did not contribute significantly to the overall results. Screening locations were typically restricted to particular cities and not conducted on a statewide level at any site. Individuals
who conducted the screenings in community-based settings were lay volunteers. Individuals who conducted the screenings in primary care settings were predominantly nursing staff but may have included other office staff.

Pilot sites offered training to all individuals who conducted the screening before the initiation of the data collection. Some sites conducted formal group training sessions, whereas others provided background reading materials and one-on-one training (Table 5). The overall content of these training sessions included information on implementing the specified testing procedures. Additional training for obtaining follow-up information was also provided (see Methods to Report and Encourage Follow-up).

A variety of preexisting programs were reported. Before this project, many community programs were mandated to conduct vision screening but were not provided guidance in identifying the better screening methods or training. In these community-based programs, the children typically were tested for visual acuity only. Preexisting visual acuity screening in primary care settings began at age 5, according to office staff, and consisted of various tests, including the pediatric “sailboat” chart (Kindergarten Eye Chart, Krasity’s Medical and Surgical Supply, Inc, Dearborn, MI) or the Titmus Vision Screener (Titmus Optical, Inc, Petersburg, VA), neither of which is an approved test for this age.5,6,14,15

![HOTV Chart](image-url)
Tests and Deviations From Protocol

Most of the sites used recommended acuity targets in chart format (Table 5). Two sites used charts that were designed according to log minimum angle of resolution principles (logMAR).* One site (Tennessee) used a non-logMAR HOTV chart. A fourth site (West Virginia) modified the Lea Symbols chart to present each line of targets on a separate card.18,19 All sites used the Random Dot E stereo test as recommended by the MCHB/NEI Task Force.

Referral Criteria

All 4 sites reported using the referral criteria for the acuity and stereopsis testing as specified in the project procedures adopted from the MCHB/NEI recommendations (Table 2).

Methods to Encourage and Report Follow-up

Most sites used a form to be completed by the eye care specialist after the comprehensive eye examination on a child who was referred for follow-up. This form was given to the parents to deliver to the eye care specialist at the time of the child’s follow-up appointment. The form was returned to the pilot site for recording purposes. Staff reported spending considerable time tracking this follow-up information in terms of assisting parents both in obtaining appointments with licensed eye care specialists and with obtaining results of the eye examinations from these providers.

Linkage to the Medical Home

All sites reported that the majority of children who were screened had an established medical home. Many children were, in fact, screened within their established medical home. Community-based settings concentrated their screening among children who were enrolled in Head Start programs. These programs require entrance physicals and coordinate later health care visits. As expected, high percentages of children who were enrolled in these programs were already linked to a medical home.

Screening Success, Referral, and Follow-up Rates

Three-Year-Old Children

The proportion of 3-year-old children who were untestable varied from 7% to 30%. The proportion of testable 3-year-old children who were referred ranged from 1% to 41%. Referral rates in the community-based settings were 25% and 41%, compared with 1% and 8% in primary care settings. On average, 41% (64 of 158) of children who were referred from community settings were examined compared with 44% of children who were referred from primary care settings (8 of 18). Of the children with completed follow-up examinations, 69% (44 of 64) of children who were referred from community settings were normal, compared with 75% (6 of 8) of children who were referred from primary care settings. As a result of the screening effort, 20 children from a total of 537 children who were screened in community settings were treated compared with 2 of 473 children who were screened in primary care settings (\(P < .002\)).

A total of 1.7% (22 of 1258) of screened 3-year-old children were identified with potential visual problems and treated. A total of 3.9% (50 of 1258) of screened 3-year-old children were examined and found to be normal (Table 6).

Four-Year-Old Children

The proportion of 4-year-old children who were untestable varied from 2% to 12%. The number of testable 4-year-old children who were referred ranged from 2% to 40%. When examined on the basis of the screening location, the referral rates in the community-based settings were 23% and 40%, compared with 2% and 8% in primary care settings. On average, 44% (109 of 245) of children who were referred from community settings were examined, compared with 60% (25 of 42) of children who were referred from primary care settings. Of the children with completed follow-up examinations, 67% (73 of 109) of children who were referred from community settings were normal, compared with 56% (14 of 25) of children who were referred from primary care settings. As a result of the screening effort, 36 children from a total of 865 children who were screened in community settings were treated compared with 11 of 651 children who were screened in primary care settings (\(P < .0065\)). A total of 2.9% (47 of 1613) of screened 4-year-olds were identified with potential vision prob-

* The logMAR visual acuity charts are composed of lines of letter symbols that decrease in size in a logarithmic progression of the minimum angle of resolution. The first such chart was developed by the NEI in the Early Treatment of Diabetic Retinopathy Study (ETDRS). Several important features of these charts are that each line has the same number of letters (or symbols), all letters (or symbols) of the same size have equal height and width, and spaces are equal between letters (or symbols).
lems and treated. A total of 5.4% (87 of 1613) of 4-year-old children were examined and found to be normal (Table 7).

Summary Analyses: An Outcome Measure
An overview of the data is provided in Fig 4. This graph illustrates a progression through the “vision screening” system, disregarding the nuances observed across each individual site. The numbers are grouped separately for 3-year-old and 4-year-old children and by community-based versus primary care settings. The stages along the pathway proceed as follows: enrollment, successful screening, referral, follow-up, and treatment. The proportions plotted are taken from the summary totals of

<table>
<thead>
<tr>
<th>Function to be Evaluated</th>
<th>Test</th>
<th>Recommended Testing Procedures</th>
<th>Referral Criterion</th>
<th>Passing Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual acuity</td>
<td>Same as community tests</td>
<td>Same as community recommendations</td>
<td>&lt;20/40 at ages 36–47 mo</td>
<td>Passes 20/40 level at ages 36–47 mo</td>
</tr>
<tr>
<td>Stereopsis</td>
<td>Same as community tests</td>
<td>Same as community recommendations</td>
<td>Positive family history (congenital cataracts, retinoblastoma)</td>
<td>Same as community recommendations</td>
</tr>
<tr>
<td>Vision history</td>
<td>Review of medical history and parents’ concerns</td>
<td>Review and update pediatric history for risk factors Ask whether parent is concerned about eyes or vision</td>
<td>Positive systemic factors (premature birth, congenital infection, metabolic, genetic diseases, etc)</td>
<td>No vision history factors No systemic factors No parental concern</td>
</tr>
<tr>
<td>External inspection of eyes</td>
<td>External examination</td>
<td>Examination of eye and surrounding structures, evaluating for both symmetry and function Penlight evaluation of conjunctiva, sclera, cornea, and iris</td>
<td>Any observable structural abnormality</td>
<td>No observed structural abnormality</td>
</tr>
<tr>
<td>Ophthalmoscopic examination</td>
<td>Red reflex check</td>
<td>With the room lights off and the ophthalmoscope held 12–18 in away and with the lens dioptic power setting on “0,” shine the light through the pupils. Compare the brightness of the red reflexes in the 2 eyes.</td>
<td>Dark spots in red reflex, blunted red reflex on 1 side, lack of a red reflex, or presence of a white reflex</td>
<td>Symmetric red reflex</td>
</tr>
<tr>
<td>Tests for ocular muscle motility and eye muscle imbalancesb</td>
<td>Corneal light reflex</td>
<td>Have the patient fixate on a small target you hold adjacent to the penlight at arm’s length. Shine the penlight at the bridge of the child’s nose and compare the positions of the reflection of the penlight in the cornea (corneal light reflex).</td>
<td>Asymmetric corneal light reflections</td>
<td>Equal and symmetric corneal light reflections</td>
</tr>
<tr>
<td>Fixation/tracking</td>
<td>Observe the patient first with both eyes open, then with 1 eye occluded at a time to determine whether the patient stares at a stationary target and pursues a moving target at arm’s length.</td>
<td>Inability to fix and follow with each eye equally in all directions</td>
<td>Able to fix and follow equally with each eye in all directions. Absence of fixational movement.</td>
<td></td>
</tr>
<tr>
<td>Unilateral cover test</td>
<td>Have the patient fixate a single letter or picture at arm’s length. Cover the patient’s right eye swiftly with your hand or an occluder and observe the left eye for re-fixational movement. Uncover the right eye, then cover the left eye, and observe the right eye for a re-fixational movement.</td>
<td>Presence of re-fixational movement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a Test all children aged 36 to 59 months using visual acuity and stereopsis. See referral guidelines for incomplete results or repeating the acuity and/or stereopsis screen.
b Fixation, following, and eye alignment should be increasingly frequent between ages 2 and 4 months and should appear adult-like by 6 months of age.
**TABLE 4  PUPVS Referral Criteria**

A child may be referred whenever the child does not attain the passing criterion. In the community-based screening, all children who do not pass acuity or stereopsis testing or who have incomplete results on either mass should be referred to the primary health care professional or eye specialist. The repeat screening by the primary care doctor or the diagnostic examination by the eye specialist should occur as soon as possible but no later than 1 mo after the initial screening.

In the primary care setting, all children who do not pass risk factors for eye disease or observation for evidence of eye disease as determined by the Preferred Practice Patterns (Table 3) should be referred to an eye care specialist.

Children who are between 36 and 47 mo of age and pass risk factors and observation but fail visual acuity or stereopsis may be referred immediately. If responses to acuity or stereopsis testing seem unreliable, then the child should be rescreened within 6 mo using the same tests. If incomplete results are obtained again during the rescreening, then the child should be referred to an eye care specialist.

Children who are between 48 and 59 mo and pass risk factors and observation but do not pass visual acuity or stereopsis must be rescreened within 1 mo or referred. If the child does not pass either rescreen test, or if incomplete results are obtained during the rescreening, then the child should be referred to an eye care specialist immediately.

There was no statistically significant difference in the proportion of children who were treated between age groups (3-year-olds vs 4-year-olds) and setting (community-based vs primary care).

**DISCUSSION**

Early identification of visual abnormalities is intended to lead to earlier treatment and better long-term visual outcome. Approximately 3% to 5% of preschool-aged children have amblyopia (200 000 of 4 million preschool children in the United States). Of these children ~0.03% of children have media opacities that interfere with vision, 2% have strabismus, and 5% have high refractive errors. Evaluation of visual functioning in preschool-aged children has proved to be a challenge to lay community screeners and the practicing clinician, as well as the research community. A set of recommendations was proposed in 1998 by an expert panel: the MCHB/NEI Preschool Vision Screening Task Force. The recommendations were based on an interpretation of current data regarding existing techniques despite the admitted paucity of high-quality empirical evidence.

The purpose of PUPVS, a cooperative agreement between the MCHB and the AAP, was to evaluate the feasibility and the effectiveness of the recommendations as implemented in real-world settings. Preschool vision screening programs were funded and data were reported from 4 sites. Several of the sites had preexisting screening programs; however, none of the preexisting community programs used recommended acuity tests or included stereopsis testing. None of the primary care practices were using stereopsis testing or routinely testing acuity until 5 years of age.

**Major Findings**

Initially, volunteers from community-based programs as well as primary care staff enthusiastically embraced the new screening program and training. However, sustaining a high level of commitment to consistent implementation of the protocol proved difficult. Our major findings included that deviations from the recommended vision screening protocol were common and that results were highly variable, especially comparing community-based with primary care settings. In addition, there were significant differences in the proportion of children who were treated across both age groups (3-year-olds vs 4-year-olds) and setting (community-based vs primary care).

**Variability in Results**

The difference in proportion of children who were treated between age groups is heralded, at least in part, by the difference in numbers of children who were tested successfully. Specifically, the rate of successful screening for the 3-year-old children was 80%, whereas the rate of successful screening for the 4-year-old children was 94%. These success rates need to be considered as revised guidelines for vision screening in the medical home are developed. It is possible that universal preschool vision screening can be achieved by focusing on a quality program with 4-year-old children. In fact, there is no adequate evidence that treatment for amblyopia at 3 years produces significantly better outcome than treatment at 4 years. Furthermore, the evidence from Scandinavia shows that screening at age 4 is effective in reducing the prevalence of amblyopia.

The greatest discrepancy was found between referral rates in community-based (31% in 3-year-olds, 28% in 4-year-olds) versus primary care settings (4% in 3-year-olds, 5% in 4-year-olds). It is unclear why such a difference was seen in this study. The data were not available...
to evaluate directly the effect of different referral criteria on the referral rates between community-based and primary care–based pilot sites. It is possible that healthcare professionals are able to provide a more accurate screen, compared with lay volunteers. Alternatively, it is possible that the screeners in the community-based screening programs were particularly conservative about allowing a child to “pass” the screening. This may have been motivated by a concern for not missing any children with eye problems and would have resulted in more referrals. Finally, it is possible that physicians opted not to make a referral on the basis of the visual acuity and stereopsis testing, particularly in instances in which the child was otherwise normal. Data from other studies suggest that pediatricians do not refer the majority of children who fail visual acuity testing.22,23 We suspect that our data reflect the same tendency. Failure to refer on the basis of visual acuity results alone con-
tributes to observations that children with straight-eyed amblyopia are detected late.24

This discrepancy in referral rates between settings is an interesting finding that warrants additional consideration and research. Additional endeavors to understand these differences might focus on factors such as training and staff turnover, inadequate testing space, time constraints for testing, and referral practices.

Difficulties With Follow-up
Screening is the first step in the larger process of treating children with vision disorders. Once identified through a screening program, these children also require effective follow-up care. A thorough analysis of any screening program demands gold-standard comparisons both for children who are referred and at least a proportion of the children who pass the screening. This type of data is costly and difficult to obtain. Programs rarely collect examination and treatment results from referral eye care specialists. This project was not designed to overcome these particular hurdles. Therefore, the data presented here can in no way provide information concerning the accuracy of the screening protocol. We did not obtain follow-up information on children who passed the screening in either community-based or primary care settings and, therefore, have no information concerning the false-negative results or number of cases that were missed. In addition, when a child was referred on the basis of the screening results, the project relied on the judgment of the eye care specialist to determine whether treatment was needed. As a result, a child may have been considered to have a “normal” eye examination by one eye care specialist yet would have received treatment from another eye care specialist.

Pilot sites attempted to track all children who were referred on the basis of the vision screening results. Overall follow-up rates were relatively low (44%; n = 206) despite the special efforts made as a result of this study. In other words, 56% (n = 257) of children who were referred did not receive a follow-up examination, or the follow-up results were not communicated to the referral source. Even with the extra support and enhanced attention to vision associated with participation in this study, acceptable follow-up rates were not obtained. Identifying and eliminating factors that make follow-up care difficult to obtain should be a priority in future studies. In addition, eye care specialists should be encouraged to communicate eye examination results to the primary health care professional, regardless of the referral source, because these professionals provide the child’s medical home and therefore maintain a central health record for that child.

Recommendations for Future Endeavors
The low referral rates from primary care practices and low follow-up rates observed overall in this project suggest that both primary health care professionals and parents lacked understanding about or confidence in systematic vision screening of young children. One tangible product that resulted from the PUPVS project was a manual that was intended to teach vision screening procedures to primary care–based health care providers.25 The need for broadened and strengthened continuing education programs on preschool vision screening for professionals and lay screeners remains. In addition, public awareness about the importance of preschool vision screening should be improved through a national public health campaign. More specific, the following recommendations are proposed:

1. Develop new and better methods for preschool vision screening. National consensus about the adequacy of current methods has not been reached. Even the Phase I data from the Vision in Preschoolers Study, a multiphase, interdisciplinary, clinical study sponsored by the NEI, demonstrated only moderate sensitivity of 11 preschool vision screening tests under ideal conditions.26
2. Certification and recertification programs for individuals who conduct vision screenings should be developed further to improve accurate and reliable implementation of screening and referral guidelines in both community and primary care settings.

3. Identify and overcome barriers (a) that may discourage the primary health care professional from either making immediate referrals for eye examination or scheduling rescreens within the recommended time frame or (b) that may discourage parents from obtaining eye examinations on the basis of vision screening results.

4. Develop methods to improve communication between eye care specialists and primary health care professionals about an individual child’s eye problem.

CONCLUSIONS

The experience of implementing the preschool vision screening recommendations of the MCHB/NEI Task Force in a wide range of programs across the United States has highlighted the problems with establishing standard vision screening protocols for preschool children at a national level. Vision screening is critical to the welfare of our children and can have an impact not only on eye health but also on social development and productivity in adulthood as a result of visual impairment.23,27–29 These pilot sites provided information that can be used to enhance the successful development and implementation of uniform national standards and provide guidance in understanding the resources that must be allocated for such programs to succeed and be endorsed and embraced in a variety of settings.

ACKNOWLEDGMENTS

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REFERENCES


2. Rahi JS, Dezateaux C; British Congenital Cataract Interest Group. Measuring and interpreting the incidence of congenital ocular anomalies: lessons from a national study of congenital
23. Marsh-Tootle WL, Wall TC, Hardin JM, Evans HH. Do referral practices in pediatric primary care settings depend upon age and/or the technique used to screen vision? *Invest Ophthalmol Vis Sci.* 2003;44:E-Abstract 4849
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