

Project Universal Preschool Vision Screening: A Demonstration Project

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The authors have indicated they have no financial relationships relevant to this article to disclose.

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.

www.pediatrics.org/cgi/doi/10.1542/peds.2004-2809

doi:10.1542/peds.2004-2809

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Key Words

vision screening, vision, amblyopia, preschool, well-child

Abbreviations

AAO—American Academy of Ophthalmology
AAP—American Academy of Pediatrics
AAPOS—American Association for Pediatric Ophthalmology and Strabismus
AOA—American Optometric Association
MCHB—Maternal and Child Health Bureau
HRSA—Health Resources and Services Administration
NEI—National Eye Institute
NIH—National Institutes of Health
PUPVS—Project Universal Preschool Vision Screening
logMAR—log minimum angle of resolution

Accepted for publication Jul 25, 2005

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VISION-THREATENING EYE PROBLEMS, which include amblyopia, strabismus, and significant refractive error, are estimated to occur in 2% to 5% of preschool children.¹⁻⁴ Numerous professional organizations endorse timely assessment of vision for the early detection and treatment of eye and vision problems, including the American Academy of Ophthalmology (AAO), American Academy of Pediatrics (AAP), American Association for Pediatric Ophthalmology and Strabismus (AAPOS), and the American Optometric Association (AOA).⁵ In a joint policy statement with the AAO, the AAPOS, and the American Association of Certified Orthoptists, the AAP recommended that physical inspection of eye functioning and overall eye health begin at birth and that “objective evaluation” of acuity be initiated by 3 years of age.⁶ As many as 34 states have endorsed programs for vision screening to improve the rates of preschool vision screening.^{7,8} However, there is state-to-state variability regarding whether the programs are mandated, as well as how they are implemented. In addition, studies in primary care settings indicate that few preschool-aged children are screened for vision problems.⁹⁻¹¹

In 1998, the Maternal and Child Health Bureau (MCHB), Health Resources and Services Administration (HRSA), collaborated with the National Eye Institute (NEI), National Institutes of Health (NIH), and various national and state agencies to review research and policies related to vision screening in preschool-aged children. The specific mission was to determine “useful screens to efficiently detect amblyopia risk factors and other significant problems” and “to provide and evaluate the practicality and effectiveness of ocular screening services for young children, including photoscreening technology.” An expert panel, the MCHB/NEI Preschool Vision Screening Task Force, was convened in September 1998.^{5,12} One major outcome of this task force discussion was a set of interim vision screening recommendations for preschool children. The recommendations were designed to detect amblyopia and amblyopiogenic factors using assessments of visual acuity and stereopsis. The recommendations were notably more explicit with regard to the specific tests and methods than previous recommendations.⁵

The purpose of the current study was to implement the recommendations proposed by the MCHB/NEI Task Force. Project Universal Preschool Vision Screening (PUPVS) was a cooperative agreement between MCHB and AAP that was designed to study the feasibility of implementing these recommendations in primary care practice and community-based settings. The broad, long-term goals of PUPVS were to develop a plan that would, over time, ensure that

1. All children in the United States receive vision screening at the earliest age that is practical but beginning no later than age 3.

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”¹³).
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,

TABLE 1 Time Course of Collaborative Project

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

RFP indicates request for proposal.

TABLE 2 Project Procedures for Vision Screening in Community-Based Setting⁵

Function to be Evaluated	Type of Test	Specific Test	Minimum Testing Procedures	Passing Criterion
Monocular Distance Acuity	Chart tests Isolated optotypes with crowding	HOTV Chart LEA Chart HOTV cards with bars	Test distance = 10 ft (3 m) 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. 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. Critical line: 20/40 at 36–47 mo 20/30 ^a at 48–59 mo	Child must identify or match 4 of 5 optotypes on the critical line with each eye tested monocularly.
Stereopsis	Random dot stereogram	Random Dot E	Test Distance = 40 cm (630 arcsec) All testing, including pretesting, should be done binocularly with the polarized glasses on. 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). 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.	Child must locate stereo E on 4 of 5 presentations. ^b

^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%.

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.^{6,14,15} 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

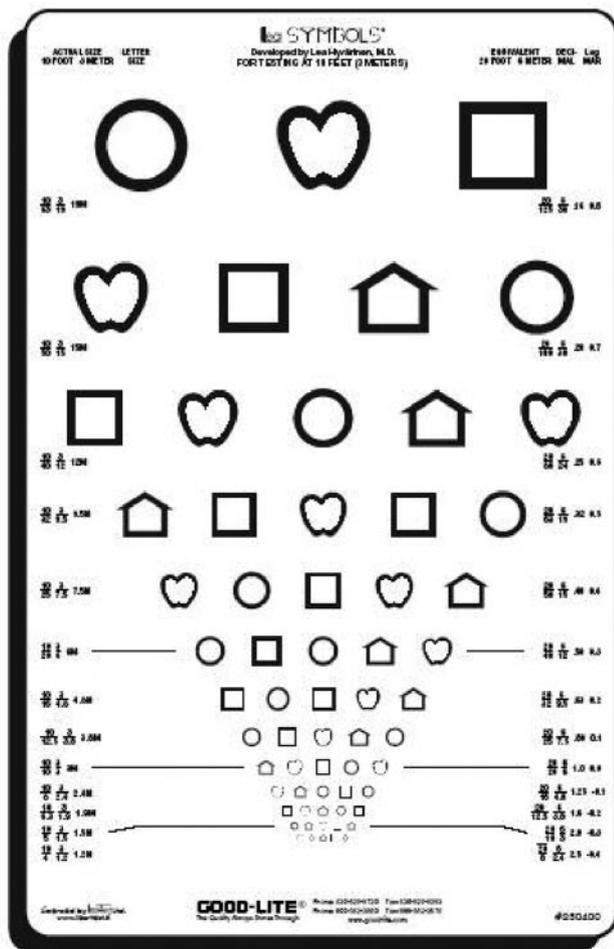


FIGURE 1
Lea Symbols Chart. Courtesy of Good-Lite Company, Elgin, IL.

disease and observation but failed either visual acuity or stereopsis testing could be identified as needing rescreening 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 unreachable 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.

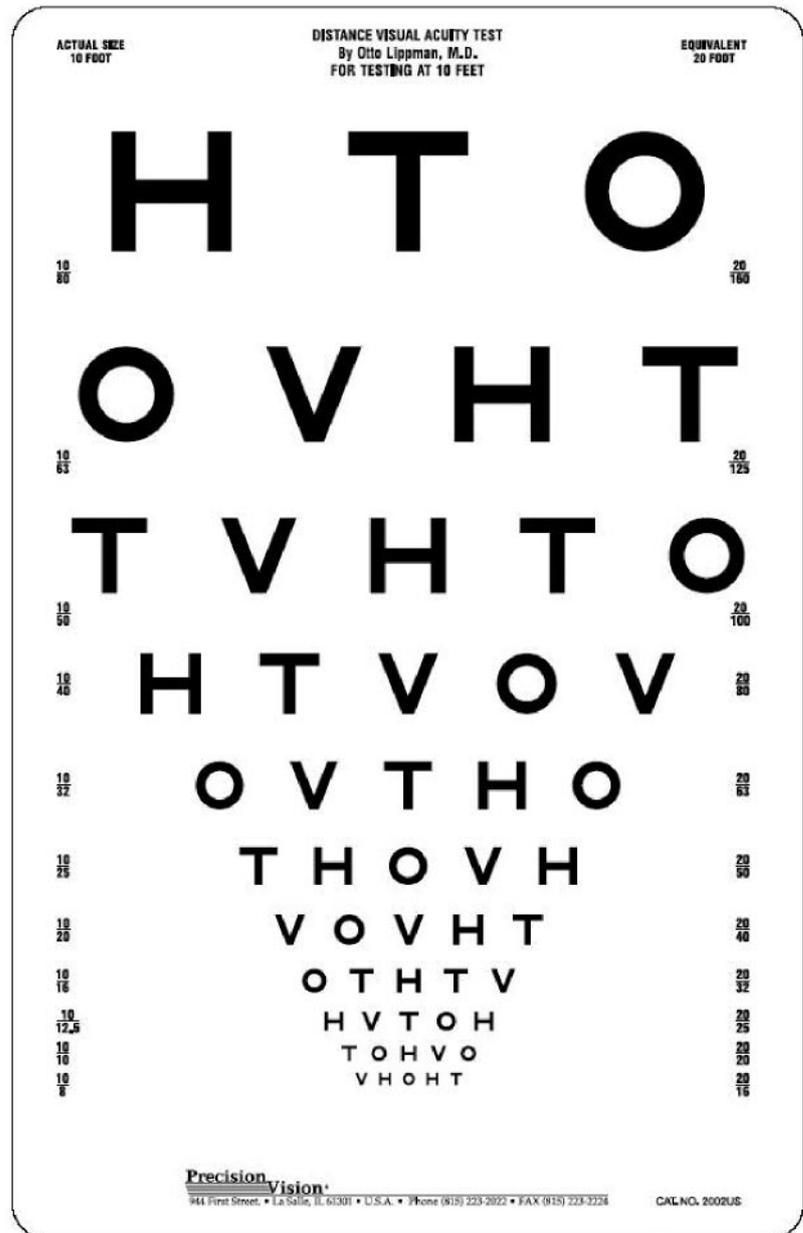
All statistics were conducted as a test of differences between proportions using Statistica.

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.¹⁶ 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

FIGURE 2
HOTV Chart. Courtesy of Precision Vision, La Salle, IL.



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}



FIGURE 3
Random Dot E Test. Courtesy of Stereo Optical, Chicago, IL.

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 chil-

dren 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).¹⁷ 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).

TABLE 3 Project Procedures for Vision Screening in Primary Care Settings⁶

Function to be Evaluated	Test	Recommended Testing Procedures	Referral Criterion	Passing Criterion
Visual acuity	Same as community tests	Same as community recommendations	<20/40 at ages 36–47 mo <20/30 at ages 48–59 mo	Passes 20/40 level at ages 36–47 mo Passes 20/30 ^a level at ages 48–59 mo
Stereopsis	Same as community tests	Same as community recommendations	Same as community recommendations Positive family history (congenital cataracts, retinoblastoma)	Same as community recommendations
Vision history	Review of medical history and parents' concerns	Review and update pediatric history for risk factors Ask whether parent is concerned about eyes or vision	Positive systemic factors (premature birth, congenital infection, metabolic, genetic diseases, etc)	No vision history factors No systemic factors No parental concern
External inspection of eyes	External examination	Examination of eye and surrounding structures, evaluating for both symmetry and function Penlight evaluation of conjunctiva, sclera, cornea, and iris	Any observable structural abnormality	No observed structural abnormality
Ophthalmoscopic examination	Red reflex check	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.	Dark spots in red reflex, blunted red reflex on 1 side, lack of a red reflex, or presence of a white reflex	Symmetric red reflex
Tests for ocular muscle motility and eye muscle imbalances ^b	Corneal light reflex	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).	Asymmetric corneal light reflections	Equal and symmetric corneal light reflections
	Fixation/tracking	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.	Inability to fix and follow with each eye equally in all directions	Able to fix and follow equally with each eye in all directions. Absence of fixational movement.
	Unilateral cover test	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.	Presence of re-fixational movement	

^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.

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 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 test 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.

Tables 6 and 7. Statistical comparisons were calculated only for the final point: proportion of children treated. Statistically significant differences for the proportion of children treated were observed for the following comparisons (Table 8): (1) fewer 3-year-old children who were screened in primary care settings received treatment compared with (a) 4-year-old children who were screened in primary care settings ($P < .0045$), (b) 3-year-old children who were screened in community-based settings ($P < .0002$), and (c) 4-year-old children who were screened in community-based settings ($P < .0001$); and (2) fewer 4-year-old children who were screened in primary care settings received treatment compared with (a) 3-year-old children who were screened in community-based settings ($P < .0551$) and 4-year-old children who were screened in community-based settings ($P < .0065$).

There was no statistically significant difference in the proportion of children who received treatment between 3-year-old and 4-year-old children who were screened in community-based settings ($P < .3464$). All statistics were conducted as a test of differences between proportions using Statistica.

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).^{1,20} Of these children ~0.03% of children have media opacities that interfere with vision,² 2% have strabismus,³ and 5% have high refractive errors.⁴ 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.^{5,12}

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.²¹

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

TABLE 5 Characteristics of Pilot Sites

Pilot Site and Location	Training Programs	Pre-existing Programs	Acuity Symbol	Reported Visual Acuity Referral Criteria	Other Deviations to Protocol
California community Neighborhood House Association Head Start Centers (N = 9)	One-on-one training	Community Ophthalmology UCSD	Lea Symbols Chart	3-year-olds: 20/40 4-year-olds: 20/30	Used different screening protocol for first 6 mo of data collection; tested absolute acuity, but reported criterion for referral.
Ohio 85% primary care public health clinics (n = 2); pediatric practices (n = 3); family practice practices (n = 17)	4-h training conducted by Prevent Blindness Ohio; certification after written assignment; equipment received after certification completed	All private practices claimed to be screening preschool children; variety of tests; no stereopsis	Lea Symbols Chart	3-year-olds: 20/40 4-year-olds: 20/30	None reported
Tennessee primary care pediatric practices (n = 5); university- based pediatric practice (n = 1)	1.5-credit CME course for physicians; in-office training with specific tests	sailboat chart	HOTV Chart	3-year-olds: 20/40 4-year-olds: 20/30	Each practice used monocular acuity and stereopsis test for 6 mo; alternated with 6 mo of photoscreening ¹⁶
West Virginia 87% community early care and education sites; 33% of state	1 h for medical personnel; 4 h for early care and education personnel; recertify every 2 y	Head Start programs using Allen or single Lea symbols; others starting from scratch	Lea Symbols (flip chart)	3-year-olds: 20/40 4-year-olds: 20/30	None reported

CME indicates continuing medical education.

TABLE 6 Data From 3-Year-Old Children by Site

Site	No. Screened	No. Testable	No. Untestable	Referred	No. With Follow-up	Normal	No. Treated
Community based	631	537 (85%)	94 (15%)	158 (29%)	64 (41%)	44 (69%)	20 (31%)
California	210	147 (70%)	63 (30%)	61 (41%)	36 (59%)	28 (78%)	8 (22%)
West Virginia	421	390 (93%)	31 (7%)	97 (25%)	28 (29%)	16 (57%)	12 (43%)
Primary care based	627	473 (75%)	154 (25%)	18 (4%)	8 (44%)	6 (75%)	2 (25%)
Ohio	401	280 (70%)	121 (30%)	3 (1%)	3 (100%)	2 (67%)	1 (33%)
Tennessee	226	193 (85%)	33 (15%)	15 (8%)	5 (33%)	4 (80%)	1 (20%)
Total	1258						

TABLE 7 Data From 4-Year-Old Children by Site

Site	No. Screened	No. Testable	No. Untestable	Referred	No. With Follow-up	Normal	No. Treated
Community based	914	865 (95%)	49 (5%)	245 (28%)	109 (44%)	73 (67%)	36 (33%)
California	303	268 (88%)	35 (12%)	106 (40%)	52 (49%)	40 (77%)	12 (23%)
West Virginia	611	597 (98%)	14 (2%)	139 (23%)	57 (41%)	33 (58%)	24 (42%)
Primary care based	699	651 (93%)	48 (7%)	42 (6%)	25 (60%)	14 (56%)	11 (44%)
Ohio	478	444 (93%)	34 (7%)	37 (8%)	20 (54%)	9 (45%)	11 (55%)
Tennessee	221	207 (94%)	14 (6%)	5 (2%)	5 (100%)	5 (100%)	0 (0%)
Total	1613						

to evaluate directly the effect of different referral criterion on the referral rates between community-based and primary care-based pilot sites. It is possible that health care 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 chil-

dren 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-

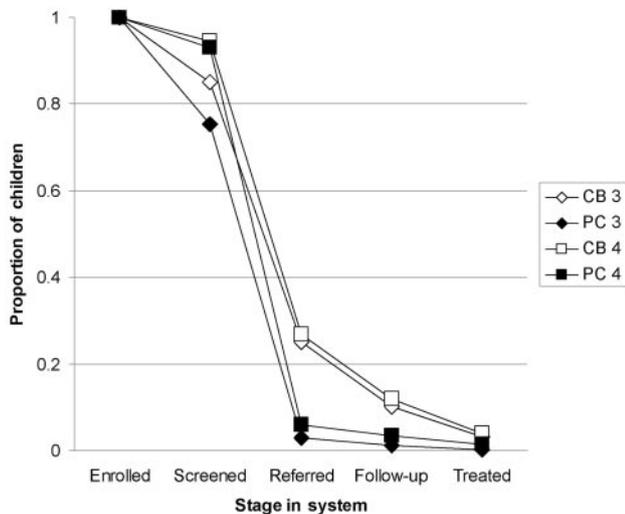


FIGURE 4
Summary of proportion of children who passed through the “vision screening” system. CB3, 3-year-old children who were tested in community-based programs; PC3, 3-year-old children who were tested in primary care–based programs; CB4, 4-year-old children who were tested in community-based programs; PC4, 4-year-old children who were tested in primary care–based programs

TABLE 8 Summary Statistics: Outcome Measure.

Setting	Child's Age	Proportion Treated	Setting		
			Primary Care	Community-Based	
			4	3	4
Primary care	3	0.003	0.0045	0.0002	0.0001
Primary care	4	0.016	X	0.0551	0.0065
Community based	3	0.032	X	X	0.3464
Community based	4	0.039	X	X	X

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

Financial support for this project was obtained from the MCHB of the HRSA and the Lions Club International Foundation.

The PUPVS Panel and pilot sites acknowledge the following community partners for efforts in completing this project: Abraham Ratner Children's Eye Center and Division of Community Ophthalmology, Department of Ophthalmology, University of California San Diego, San Diego, California; Cumberland Pediatric Foundation, Nashville, Tennessee; PrimeCare of Southeastern Ohio, Zanesville, Ohio; and West Virginia University Eye Institute, Morgantown, West Virginia.

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Cumberland Pediatric Foundation; Barbara Brody, MPH, Division of Community Ophthalmology; Department of Ophthalmology, University of California, San Diego; Gil A. Buchanan, MD, Medical Home Project Advisory Committee, American Academy of Pediatrics; Richard T. Bunner, MA, Ohio Department of Health; Sean Donahue, MD, PhD, Tennessee Lions Eye Center, Vanderbilt University; Katrina Entzminger, Prevent Blindness Virginia (formerly); David Granet, MD, UCSD/Ratner Children's Eye Center, University of California, San Diego; Timothy L. Gresham, Prevent Blindness Virginia; E. Eugenie Hartmann, PhD, Nova Southeastern University (formerly), University of Alabama at Birmingham; Maxine Hayes, MD, MPH, Washington State Department of Health; Lynn Hellerstein, OD, American Optometric Association; Glinda Hill, MEd, US Department of Education; Susie Hindel Bunner, MS, RN, CPNP, Prime Care Pediatrics, Inc; Charlene Hsu-Winges, MD, American Association of Health Plans; Lara Hustana, OD, Division of Community Ophthalmology, Department of Ophthalmology, University of California, San Diego; Phil Itkin, MD, Section on Administration and Practice Management, American Academy of Pediatrics; Tammy Johnson, MPH, Tennessee Lions Eye Center, Vanderbilt University Medical Center (formerly), Lions Clubs International Foundation; Alex R. Kemper, MD, MPH, Child Health Evaluation and Research Unit, University of Michigan; Sunnah Kim, MS, RN, CPNP, Staff, American Academy of Pediatrics; Harold P. Koller, MD, Section on Ophthalmology, American Academy of Pediatrics; Michael D. Oberdorfer, MD, National Eye Institute, National Institutes of Health; Michele A. Lloyd-Puryear, MD, PhD, Genetics Services Branch, US Maternal and Child Health Bureau; Wendy Marsh-Tootle, OD, MS, MCHB/NEI Preschool Vision Task Force, University of Alabama, Birmingham; P. Kay Nottingham Chaplin, MA, West Virginia University Eye Institute; Michael R. Redmond, MD, American Academy of Ophthalmology; James B. Ruben, MD, American Association of Health Plans; Mark Ruttum, MD, MCHB/NEI Preschool Vision Task Force; John A. Shoemaker, Prevent Blindness America; Thomas P. Stratford, MD, Prevent Blindness Virginia; Jack Swanson, MD, American Academy of Pediatrics; Thomas F. Tonniges, MD, Department of Community Pediatrics, American Academy of Pediatrics; Maynard B. Wheeler, MD, American Association for Pediatric Ophthalmology and Strabismus; and Barbara P. Yawn, MD, American Academy of Family Physicians.

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Pediatrics 2006;117:e226
DOI: 10.1542/peds.2004-2809

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