Targeting treatable disease—not just risk factors—in pediatric vision screening

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Despite decades of investment in vision screening, hundreds of thousands of children in the United States—and millions around the world—continue to suffer preventable vision loss resulting from the lack of early detection and treatment of amblyopia and strabismus. As a result, amblyopia is now the leading cause of monocular visual loss in children.1,2 This failure to detect amblyopia while it is amenable to treatment is a serious public health problem.

We know that early detection and treatment of amblyopia can prevent vision loss. Eibschitz-Tsimhoni and colleagues3 performed a prospective trial of 1,600 children in two towns in Israel: one town provided expert (ophthalmologist/orthoptist) screening of all children at age 2, whereas the other did not. When all children were reexamined at age 8, those who had not been screened had a 2.6-fold-higher prevalence of in amblyopia. In Scandinavian countries, expert examinations are performed in all children at a young age, resulting in the near-elimination of severe forms of amblyopia.4 In the United States, such widespread expert screening is not available because of cost constraints, and we rely on pediatricians and pediatric nurses, who have little or no training in ophthalmology, to perform vision-screening examinations. This is not easy to do in a busy pediatric clinic, and only 40% of children ages 2-6 receive any form of vision screening in the United States.5 Thus some pediatric practices invest hours performing ineffective screenings, whereas others have simply given up. As a result, many children suffer a lifetime of preventable vision loss while many more are referred for unnecessary specialist examinations.

In an effort to improve the accuracy of pediatric office-based vision screening, a variety of automated devices have been developed, and the journal Pediatrics has just published a policy statement supporting the efficacy of instrument-based vision screening for preschool children.6 Today’s commercially available vision-screening instruments estimate the refractive state of the eyes. Although they cannot detect amblyopia or strabismus directly, they can be used to identify children who are at the greatest risk of developing amblyopia or strabismus, that is, those with “amblyopia risk factors,” who can then be referred accordingly. However, many children with risk factors for amblyopia never develop amblyopia: Arnold has estimated that only about 1 of 8 children with amblyopia risk factors may have amblyopia (Arnold RW. The high prevalence of AAPOS amblyopia risk factors. JAAPOS 2011;15:e2 [Abstract 007]). This means that screening programs that are based on risk factors alone will refer many children who are not in need of treatment. In a series of studies using a photoscreener, the authors found only half of the children with significant refractive error had strabismus or amblyopia, and 37 of 59 children without significant refractive error were referred.7,8 Despite these limitations, the available screening devices are an advance over “manual” screening, and the joint endorsement of instrument-based screening is a tremendous step forward.

In this issue of the Journal of AAPOS, the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) Vision Screening Committee has updated their recommendations for how clinical trials of preschool vision screening devices or protocols should be reported to account for advances in our understanding of amblyopia risk.9 The new AAPOS vision screening guidelines have been adjusted to refine the consensus-based thresholds for refractive error to account for age at screening and risk of undetected amblyopia. Although the goal of the revision is to use more stringent refractive criteria at certain ages to reduce the number of false referrals, Silbert and colleagues10 recently reported that application of the earlier and less-stringent AAPOS risk factor referral criteria resulted in underreporting of amblyopia. Furthermore, in combined analyses of the Multi-Ethnic Pediatric Eye Study (MEPEDS) and the Baltimore Pediatric Eye Study (BPEDS), only 60% of children aged 2.5-6 years with ≥2.00 D anisometropia had amblyopia,11 whereas 72% of children with strabismus had refractive errors within the normal range.12 More stringent referral criteria will thus miss more of these patients, yet there will still be many false referrals. In the end, amblyopia risk factors are arbitrary, consensus-based thresholds of risk, and as such they will lead to false and missed referrals even if a device that identifies risk factors alone can provide perfect accuracy.

The revised guidelines also recognize recent advances in technology that can detect amblyopia when it develops,
rather than risk factors, allowing for the possibility that we may someday be able to improve the accuracy of instrument-based screening and refer only those children who would benefit from treatment. My colleagues and I have spent the last 20 years developing the Pediatric Vision Scanner (PVS), a binocular retinal scanner that analyzes reflected birefringence patterns to detect foveal fixation. We and other investigators have independently found that the PVS identifies children who have developed strabismus and amblyopia with very high sensitivity and does not refer children with refractive error alone (Yanni SE, Jost RM, Beauchamp CL, Stager DR, Birch EE. Objective detection of amblyopia and strabismus . . . not just screening for risk factors. J AAPOS 2012;16:e9 [Abstract 033]; Kane J, Omran SS, Donahue SP. Detecting amblyopia and strabismus in children with the Pediatric Vision Scanner. J AAPOS 2012;16:e20 [Abstract 075]). This high accuracy is most likely the result of the device’s ability to detect microstrabismus (or reduced fixation stability), which is likely present in all amblyopic eyes. The PVS refers children after reduced binocular vision has developed as a result of manifest strabismus or amblyopia. The revised guidelines recognize this new ability to identify amblyopia by proposing that sensitivity and specificity for detecting amblyopia or strabismus—not risk factors—should be reported when testing screening devices.

The revised AAPOS guidelines for defining amblyopia risk factors in preschool vision screening studies are helpful, but they divert attention from the goal of screening, which is not to detect risk factors but to detect amblyopia and strabismus. Testing the ability of an autorefractor to detect refractive error involves a form of circular reasoning that does not get to the core question of who needs treatment. In other fields, screening tests are judged on their ability to detect disease. For example, screening tests for cancer should be evaluated on the basis of their ability to detect cancer. Similarly, screening tests for amblyopia should be evaluated on the basis of their ability to detect amblyopia or reduced binocular vision, not amblyopia risk factors.

The ability to detect amblyopia when it develops creates a new dilemma when it comes to monitoring children with risk factors. In our published clinical trial, we reported that the PVS had 96% sensitivity and 96% specificity for the detection of amblyopia or strabismus. But some children who were considered “normal” for the purpose of the study (no amblyopia or strabismus) had amblyopia risk factors and were not referred. To account for these children, annual screening should be performed when using approaches that detect amblyopia and strabismus so that patients with (undetected) risk factors can be monitored and referred if they develop treatable disease.

In conclusion, the new consensus guidelines are an important advance that will promulgate the use of instrument-based vision screening. As technology advances, it may soon be within our power to eliminate preventable vision loss from amblyopia through early, automated detection in the medical home. To properly evaluate the utility of preschool screening devices or protocols, all future studies must report how accurately amblyopia and strabismus (not just risk factors) are detected. Such study designs will provide vital data that can empower investigators to assess the overall cost of screening and demonstrate the benefits for individual patients—and for society.

References