

# THE EPIDEMIOLOGY OF SCHOOL VISION SCREENINGS

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## Abstract

*Epidemiology is defined as the study of the distribution of health and disease in groups of people. Recent legislative events in several states and public health initiatives have sparked renewed interest in school-based optometric consulting. This article presents the epidemiological principles underlying vision screening in the interest of the development of the most effective screenings from the standpoints of validity, public acceptance and cost. A review of the Orinda Study and the New York State Optometric Association screening battery is presented to illustrate the epidemiological principles.*

## Key Words

*compliance, epidemiology, predictive value, optometric school consulting, process indicators, sensitivity, specificity, vision screening*

## Introduction

**E**pidemiology is defined as “the study of the distribution of health and disease in groups of people and the study of the factors that influence this distribution.”<sup>1</sup> Modern epidemiological studies also evaluate diagnostic and therapeutic modalities as well as the delivery of health care services. Discussions between the American Optometric Association (AOA) and the American Public Health Association (APHA) have identified children’s vision as an area worthy of collaborative efforts to advance the nation’s public health.<sup>2</sup> New opportunities to focus on the epidemiology of vision screening programs have resulted from recent legislative events in several states<sup>3</sup> that have sparked renewed interest in optometrists serving as school consultants. All school consulting programs, which range in scope from basic vision screenings to delivery of vision therapy services in the school setting, must begin at the beginning: the identification of school-aged children with vision problems. Since it appears that optometrists are becoming involved in the design and administration of vision screening programs, the purpose of this review is to provide a firm understanding of the epidemiological theories that underlie vision screening. This background will aid optometrists in developing optimal programs that are best suited to the populations they serve. In addition, such programs are more likely to yield outcomes that contribute to the evaluation of

the diagnosis and treatment of vision disorders in school-aged children.

## Definition of a screening program

A screening is defined as “the presumptive identification of unrecognized disease or defects by the application of tests, examinations or procedures which can be applied rapidly.”<sup>4</sup> This definition includes the word “presumptive” because the screening test is not diagnostic. Individuals with a positive test must be referred for a diagnostic evaluation to confirm the presence or absence of disease.

Schmidt<sup>5</sup> defines a school vision screening by its principal objective: “to detect children who have vision problems or potential vision problems that affect physiological or perceptual processes of vision, and to find those who have vision problems that interfere with performance in school.” She elaborates by pointing out that the reasons for conducting a vision screening program may vary with the purpose of the sponsoring organization. For example, in addition to providing a public health service, colleges of optometry sponsor screening programs to provide clinical education to their students, while private practitioners may strive to enhance professional visibility in their communities. Despite these differences, all vision screening programs should conform to 10 basic guidelines to ensure their effectiveness:<sup>6</sup>

1. The condition sought should be an important health problem.
2. There should be an accepted treatment for patients with recognized disease.

3. Facilities for diagnosis and treatment should be available.
4. There should be a recognizable latent or early symptomatic stage.
5. There should be a suitable test or examination.
6. The test should be acceptable to the population.
7. The natural history of the condition, including development from latent to declared disease, should be adequately understood.
8. There should be an agreed policy on whom to treat as patients.
9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditures on medical care as a whole.
10. Case finding should be a continuing process and not a "once and for all" project.

### Important considerations

When considering these guidelines in relation to a vision screening, it is more important to view them from the point of view of the community rather than that of the optometrist. No one would argue with the need to provide eyeglasses for children to see adequately in the classroom. But at least some parents and school personnel may be less willing to accept the impact of a convergence insufficiency on academic performance. Obviously, education of the parents and school personnel must become a component of an effective vision screening.<sup>7</sup> Not only will education promote acceptance of a more comprehensive view of learning-related vision problems, but compliance with follow-up of screening failures is likely to be enhanced.

Efforts to implement effective screening programs can also be undermined if treatment services are not available. This has become a reality in Kansas where a \$250,000 grant from the state legislature is funding the Vision Therapy and Reading Performance Research Project.<sup>8</sup> To date, more than 850 children have been screened in various school districts across the state. More than 80 optometrists have participated in a continuing education program in vision therapy, in order to meet the demand for services.<sup>9</sup>

Finally, the cost-benefit ratio for treatment of learning-related vision problems

is more nefarious than that associated with diseases with defined mortality rates. The costs of the vision screening as well as treatment programs must be measured against improvements in quality of life.<sup>10</sup> Ultimately, it is this type of outcomes data that will demonstrate the impact of optometric intervention on school performance.

### Vision screening tests

A screening test should be *simple, rapid, inexpensive, safe and acceptable*.<sup>4</sup> Simplicity is a major consideration for school vision screening programs. Some screening batteries are designed to be administered by parents and school personnel with minimal optometric supervision. Others require an optometrist to perform certain clinical procedures such as retinoscopy.<sup>5</sup> More recently, photorefractometry is being evaluated as a screening tool, especially for preschoolers.<sup>11</sup> Simplicity often has an indirect relationship to expense. The simplest tests usually cost the least to administer. Greater complexity may require more expensive equipment and/or a greater time commitment from the supervising optometrist. Often these parameters must be balanced with the needs of the community and limitations of available resources.

Rapidity is the essence of any screening program. The amount of time required is directly related to perceived value.<sup>4</sup> A screening procedure that requires only five minutes is more likely to be perceived as worthwhile than one that requires one hour to complete. Immediate feedback about screening results is also more effective than having participants wait days or weeks for results. Because most vision screenings are composed of multiple tests, larger amounts of information must be collected and analyzed. Typically these analyses are performed off-site in order not to increase the time required to complete the clinical procedures. A time lag is also created by the requirement to provide feedback to parents who are usually not present at the screening. Although immediate feedback is usually not feasible at school-based vision screenings, optometrists should minimize the time lag in order to maintain parental involvement and enhance compliance with follow-up care.

### Vision screening vs. vision examinations

In an ideal world, every child would receive periodic comprehensive vision examinations.<sup>12</sup> In reality, our health care system does not have the resources to provide this level of care, particularly to low-income families.<sup>13</sup> From the public health perspective, vision screening provides an alternative model for the delivery of vision care services by identifying the children with the greatest need. However, the provision of vision screenings becomes a double-edged sword. "The fact that screening procedures are nondiagnostic and therefore in no way indicate if treatment will be required is an illusory concept at best for the general public."<sup>5</sup> Too many parents assume that because their child passed a vision screening, there is no vision problem. How many children are NOT receiving appropriate care because they participated in a vision screening? Again, the importance of educational programs for parents and school personnel cannot be overstated. The limitations of vision screening programs must be clearly identified and emphasized.

### Measures of validity: sensitivity, specificity, and predictive value

The goal of a vision screening program is to identify children requiring further vision care. Ideally, all the children would fall into one of two categories: those who fail the screening and do indeed have a vision problem when given a diagnostic examination, and those who pass the screening and do not have a vision problem when given a diagnostic exam. These are termed true positives and true negatives, respectively. However, because of limitations in screening procedures, there are two additional categories. Those who fail the screening but do not have any vision problems when they undergo a diagnostic examination are called false positives. Those who pass the vision screening but would have a vision problem if they were to receive a diagnostic examination are termed false negatives.<sup>14</sup> These categories represent overreferrals and underreferrals. An effective vision screening maximizes the number of true results (correct referrals and correct nonreferrals) and minimizes the number of false results (overreferrals and underreferrals).<sup>5</sup>

When evaluating screening programs, the emphasis is usually placed on the positive results. Typically, these are the chil-

dren who receive comprehensive exams and can then be classified as either true positives or false positives. The children who pass the screening rarely receive the comprehensive examinations which are required to separate the true negatives from the false negatives. If all children received diagnostic exams, then it would be possible to evaluate the screening's validity by quantifying the program's sensitivity and specificity (Simply stated, validity is the degree to which the screening achieves its purposes.).

The validity of the screening may be represented by using a 2 x 2 table (See Figure 1.). The rows of the table represent the results of the screening test (where failing the screening is noted as a positive). The columns represent the results of the diagnostic examination.

*Sensitivity* is the percentage of children with vision problems (that are identified by a diagnostic examination) and who fail the screening (a positive screening result). *Specificity* is the percentage of children without vision problems (as confirmed by a diagnostic examination) who pass the screening (a negative screening result). The sensitivity and specificity may be represented mathematically by the formulas in Figure 1 which refer to the 2x2 table (Figure 1).

In other words, sensitivity is a measure of how correctly the screening identifies those with vision problems. Specificity is a measure of how correctly the screening identifies those without vision problems.<sup>14</sup>

Sensitivity and specificity are a function of the referral criteria used in the screening program. For example, if the referral criterion for visual acuity is set at 20/25, then the sensitivity of the screening would be very high. Virtually all children with refractive anomalies would be referred because the cutoff was set so low. However, many children without refractive anomalies would also be referred because the 20/25 cutoff has cast a wide net. The specificity of the screening would be low because of the large number of false positives. If the criterion is raised to 20/50, very few children without refractive anomalies would be referred for further care. The number of false positives would be reduced and the specificity would increase. However, many children with refractive anomalies would be missed, raising the number of false negatives and reducing the sensitivity.

These concepts are illustrated in Figure 2. For purposes of this analysis, children with refractive anomalies are represented under the curve so labeled and children without refractive anomalies are represented under the curve so labeled. Cutoff A is 20/25 and cutoff B is 20/50. Notice that there is some overlap in the measurement of visual acuity between children with and without refractive anomalies. In other words, there is no visual acuity measurement that cleanly distinguishes between children with and without refractive anomalies. If 20/25 is chosen as the cutoff, then all children to the right of this cutoff point in both distributions will fail the vision screening. However, because of the overlapping distributions, a child who fails the screening may be from the population of children without refractive anomalies. These false positives are represented by the area which is both to the right of cutoff A and under the "no refractive anomalies" curve. Similarly, the false negatives are represented by the area which is both to the left of cutoff A and under the "refractive anomalies" curve.

Moving the cutoff to 20/50 (cut-off B) reduces the area to the right, which has the effect of reducing the number of false positives. However, the area to the left of cutoff B is increased which increases the number of false negatives. Using 20/25 as the pass-fail criterion greatly enhances the screening's ability to identify the children with refractive anomalies. In other words, the sensitivity is maximized. If the pass-fail criterion is changed to 20/50, the ability to correctly identify the children without refractive anomalies is enhanced. In this case, specificity is maximized.<sup>1</sup>

The criteria used in a vision screening program should attempt to balance sensitivity and specificity in order to decrease the number of false results (underreferrals and overreferrals). Overreferrals (which are the byproduct of high sensitivity) are viewed negatively by the community, because they cost parents time and money for comprehensive evaluations which they may ultimately consider unwarranted. Large numbers of overreferrals may cause parents to pressure the school to discontinue the screening program be-

		Diagnosis of Vision Problem	
		+	-
Vision Screening Results	+	a True positives	b False positives (overreferrals)
	-	c False negatives (underreferrals)	d True negatives

Figure 1. 2 x 2 table to evaluate the validity of a screening program

$$\text{Sensitivity} = a / a + c$$

$$\text{Specificity} = d / b + d$$

$$\text{PPV} = a / a + b$$

$$\text{NPV} = d / c + d$$

$$\text{Prevalence} = a + c / a + b + c + d$$

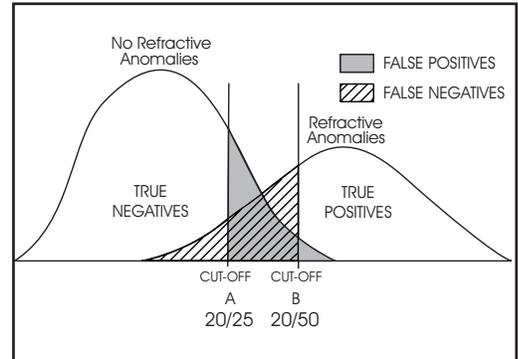


Figure 2.

CUT-OFF A: Greater sensitivity; lower specificity; more false positives.

CUT-OFF B: Lower sensitivity; higher specificity; more false negatives

Adapted from Wassertheil-Smoller S. *Biostatistics and Epidemiology, A Primer for Health Professionals, 2nd Edition.* New York:Springer-Verlag, 1990:127.

cause they view the optometrist's participation as self-serving. Underreferrals (which are the byproduct of high specificity) are a more serious problem from the public health perspective because they represent undiagnosed vision problems. The "incalculable hidden cost of underreferrals in screening programs"<sup>5</sup> is not only the loss of visual function, but the negative impact on the academic performance and quality of life of these children.

Two other measurements of screening validity are positive and negative predictive value. Positive predictive value (PPV) is the proportion of individuals who screened positive by the screening test that actually have the condition. Similarly, negative predictive value (NPV) is the proportion of individuals screened negative by the screening test that do not have the disease.<sup>4</sup> These measurements can also be represented mathematically using the formulas indicated in Figure 1.

Unlike sensitivity and specificity, predictive values are affected by the prevalence rate of the condition being screened. As prevalence increases, the number of

Testing Procedure	Characteristic Measured	Criteria of referral
Snellen Distance Visual Acuity	Visual Acuity	20/40 or less, either eye
Retinoscopy with lens rack neutralization	Refractive error Hyperopia Myopia Astigmatism Anisometropia	+1.50 DS or more -0.50 DS or more +/-1.00 DC or more +/-1.00 D or more
Distance Cover Test	Coordination at distance Tropia Esophoria Exophoria Hyperphoria	Any 5 <sup>Δ</sup> or more 5 <sup>Δ</sup> or more 2 <sup>Δ</sup> or more
Nearpoint Cover Test	Coordination at near Tropia Esophoria Exophoria Hyperphoria	Any 6 <sup>Δ</sup> or more 10 <sup>Δ</sup> or more 2 <sup>Δ</sup> or more
Observation and Direct Ophthalmoscopy	Organic	Any verified pathology or medical anomaly of the eye and/or adnexa

Source: Adapted from H Blum, HB Peters, JW Betterman. *Vision Screening For Elementary Schools: The Orinda Study*. Berkeley CA: University of California Press, 1959.

true positives, or correct referrals, also increases, but so does the number of false negatives, or underreferrals. This has the effect of increasing the PPV and decreasing the NPV. In clinical practice, the increase in the PPV can be used to justify additional expenditures for diagnostic evaluations, because individuals who fail the screening have a high probability of having the condition. Thus, when screening populations known to have a higher prevalence of visual deficits, (i.e., learning-disabled children,<sup>15</sup> juvenile delinquents,<sup>16</sup> children with special needs,<sup>17</sup>) expect a high number of positive results, but feel confident that the majority of them are correct referrals (true positives).

### The Orinda Study

No discussion of the epidemiology of school vision screening programs would be complete without consideration of the Orinda Study, which was conducted between 1954 and 1956 in the Orinda Union School District of Orinda, California. Although this study profiled the visual characteristics of a large population of school-aged children, that was not the primary objective. The goal of the Orinda Vision Study was “to design the least expensive, least technical and most effective screening program for finding essentially all elementary-school children with vision problems.”<sup>18</sup> The study had two clinical components – the administration of six vision screening programs and comprehensive examinations of the children who

failed any of the screening tests as well as a control group. The Orinda Study essentially worked backwards, by first analyzing the comprehensive examinations in order to identify those children who needed professional attention, regardless of the diagnosis. All of the examination data was then distilled to a minimal set of visual characteristics which was capable of distinguishing those children who required intervention from those who did not. Finally the data from the vision screenings were considered to identify the screening program and criteria which was most effective at identifying the children requiring further intervention. Of the six screening programs, the Modified Clinical Technique (MCT) was the most effective at identifying the children who had been “tagged” with diagnosed vision problems during the comprehensive examination. The MCT and the clinical criteria are listed in Table 1.

The Orinda Study established the MCT as the standard for school vision screening programs, and with good reason. The data for the 3,889 administrations of the MCT are included in Figure 3 including the calculation of the sensitivity and specificity.

The MCT correctly identified 96% of all children who required visual intervention, and 98% of the children who did not. The over and underreferrals were minimal. None of the other screening programs came close to these measurements of validity. In fact, Snellen testing alone

		Requires Visual Attention	
		+	-
MCT Vision Screening Results	+	a 668	b 78 (overreferrals)
	-	c 31 (underreferrals)	d 3112

Figure 3. 2 x 2 table describing the results of the Orinda Study

$$\text{Sensitivity} = 668 / (668 + 31) \times 100 = 96\%$$

$$\text{Specificity} = 3112 / (3112 + 78) \times 100 = 98\%$$

was successful at identifying less than half of the children with identifiable vision problems. The clinical criteria defined for the MCT by the Orinda Study (see Table 1) remain the foundation of vision screening programs today.

The authors of the Orinda Study also noted the inherent flexibility of the MCT, which enables variation of these criteria to fit the needs of a particular community or population.

The Orinda Study is exceptional for several other reasons. First, it was implemented by an interdisciplinary team of optometrists, ophthalmologists, biostatisticians, school psychologists, parents and teachers.<sup>19</sup> Public health initiatives today would certainly benefit from this type of partnership. Second, the Orinda Study evaluated the effects of previous care on the results of the vision screening. More than 50% of the children who had previous care still failed the vision screening, but almost all of them were easily managed after re-examination. The Orinda Study also found that for 6-14 year olds, the incidence of vision problems increases with age at a rate of 1.6% per year. Taken together, these facts support vision screening and vision education as worthy of continuous implementation and financial support. Third, the Orinda Study considered the cost of vision screening programs. Direct costs included salaries for the participating optometrists and other personnel and expenses for training any volunteers. In 1954 – 1956, the direct costs of the MCT were \$0.45 per student screened. The least expensive screening battery was the Massachusetts Vision Kit (MVK), with direct costs of \$0.37 per student screened. Indirect costs, or “costs to the community” were calculated as fees generated for comprehensive examinations of overreferrals. Cost of equipment was not included in the analysis. When the total costs of the various vision screen-

ing programs were compared, the MCT was the most economical. Although the salaries of the optometrists increased the direct costs, the costs to the community were greatly reduced by the efficiency of the MCT and the limited number of over-referrals. The cost analysis also included an accounting of the amount of time required per child to complete the various screening programs. The MCT was the fastest screening program, with time per child calculated as just under five minutes.

Despite being characterized by the Orinda Study as the most effective, most economical and least time consuming school vision screening program, the MCT has never garnered the widespread implementation that it seems to deserve. The primary reason is its dependence upon the services of an optometrist to perform and interpret clinical procedures such as the cover test and retinoscopy. Perhaps school districts are not swayed by the analyses of lower indirect costs to the community. They are concerned only with the implementation costs. Many colleges of optometry have utilized a student workforce to perform the MCT in school-based screening programs, with moderate success. When compared to the Orinda study, Bailey found a lower positive predictive value when 2<sup>nd</sup> year optometry students conducted the MCT and 4<sup>th</sup> year students performed the diagnostic examinations, but the cause of the reduced efficiency is not clear.<sup>12</sup> The possibilities include differences in the demographics of the study populations, changes to the clinical procedures used in both the diagnostic examinations and the screening, or the skills of the optometry students. Still, the use of optometry students to administer the MCT is more effective than the administration of only a distance visual acuity test by school personnel. Peters argued that the Orinda Study clearly indicates the need for optometrists to accept responsibility for the visual welfare of their communities and become involved in the delivery of school vision screening services.<sup>19</sup>

### The NYSOA vision screening program

The Orinda Study has been criticized for its limited evaluation of visual skills related to school performance.<sup>20</sup> But, as I earlier stated, the Orinda Study began with the identification of children requiring

Test	Condition Screened	Criteria for Referral
Snellen Chart- 20 ft.	Myopia, high astigmatism, amblyopia, high hyperopia	20/40 or worse in either eye or more than 2 line difference between the eyes.
Reduced Snellen Chart- 13"	High refractive error, focus dysfunction	Same as above
+1.50 sphere VA test- 20 ft.	Mild hyperopia	Less than 2 line blur of the best distance acuity
+/-2.00 flippers- 13"	Accommodative facility, focus ability	Less than 3 cycles in 30 seconds
Bell push up	Convergence ability	4" or greater
Keystone Skills a) vertical imbalance b) 4 ball fusion – distance c) 4 ball fusion – near	Suppression, fusion ability, muscle balance	Line through any figure other than ball 2 or 4 balls 2 or 4 balls
Titmus stereo tests	Stereopsis perception, binocularity	7 or less
NYSOA K-D	Eye track skills	Greater than 1 standard deviation above age norms in the NYSOA manual
Winterhaven copy forms	Eye-hand coordination, visual motor coordination, visual organization, form reproduction	Less than age norms in the NYSOA manual
Keystone color card	Color deficiency	Failure to read numbers

*From Cohen AH, Lieberman S, Stolzberg M, et al. The NYSOA vision screening battery: a total approach. J Am Optom Assoc 1983;54:981. Copyright © 1983 by the American Optometric Association. Reprinted with permission.*

professional eye care based on the results of a comprehensive examination. Analysis of the vision screening data revealed that the MCT was able to identify the vast majority of those children, regardless of the diagnosis. For example, a child with an accommodative dysfunction is likely to fail at least one of the clinical criteria of the MCT, despite the exclusion of accommodative testing from the screening battery. Still, if one compares the referral rate from the Orinda study to the prevalence of visual efficiency deficits, especially among the reading disabled,<sup>15,21</sup> then the need for a more comprehensive screening battery can be justified. The most well-known of these targeted screening batteries is the one developed by the New York State Optometric Association (NYSOA) in 1980. In addition to being aimed at the identification of learning-related vision problems, this screening battery is designed to be administered by parent volunteers after they participate in a 2-3 hour training session. The NYSOA screening program and the clinical criteria are listed in Table 2.<sup>20</sup>

A validation study of the NYSOA screening program found the sensitivity to be 72% and the specificity to be 65%.<sup>22</sup> Each subtest of the NYSOA battery has a

low sensitivity (ranging from 5.7% to 30.2%) and a high specificity (ranging from 70% to 100%). If used in isolation, each subtest would result in too many underreferrals but virtually no overreferrals. Using the entire battery balances these validity measures. As the authors point out, it is more important to increase the sensitivity and reduce the underreferrals in order to detect children with potential learning-related vision problems. This is especially true for high risk populations with a higher prevalence rate.<sup>23</sup> The NYSOA battery has a high overall referral rate, 53%, especially when compared to the MCT, which referred 19% of the children in the Orinda Study.

Krumholtz developed a "blended" vision screening which incorporated components of both the NYSOA battery and the MCT.<sup>24</sup> The overall referral rate was 25-30%. Thirty to 35% of the referrals failed acuity measures and 65-70% of the referrals failed functional measures.

Because these screening batteries use different clinical procedures and were applied to different populations, it is difficult to compare referral rates for various visual conditions.<sup>12</sup> However, the NYSOA battery includes testing of many visual skills which are not directly screened by the

MCT: near visual acuity, accommodation, eye movements, stereopsis, convergence, fusion, and visual-motor integration. It is logical to assume that the higher referral rates are the result of failures on these additional screening tests. Optometrists are cautioned to refer to #3 of the basic guidelines presented earlier in this paper. The optometric community must be prepared to provide the diagnostic and therapeutic services associated with these higher referral rates. School personnel and parents must also be educated concerning learning related vision problems, their impact on visual performance, and outcomes associated with treatment. The value of a screening program is twice enhanced when the children receive the appropriate therapeutic services. First, the children are being given the visual tools they require to maximize their performance in school (and other environments). Second, the profession benefits from documentation of the outcomes associated with optometric intervention and validation of the relationship between vision and learning.

### Evaluation of vision screening programs

The current fiscal environment in health care is forcing greater attention on the outcomes associated with modes of health care delivery. Vision screening programs are no exception. School districts are more likely to purchase or continue to fund vision screening services that can document referral rates, costs, compliance with follow-up care, and treatment outcomes. These variables used to evaluate a vision screening program are termed process indicators.<sup>25</sup> Consideration of process indicators prior to conducting the vision screening program is essential to an accurate and meaningful appraisal. Improvements in design and administrations of the vision screening as well as the process indicators are likely to accrue with the appropriate investment in program evaluation.

Casser<sup>26</sup> completed an analysis of a community vision screening program administered to 490 patients over three years. Although it was not a school-based program, the evaluation included several process indicators such as patient demographics and referral rates, which can and should be applied to a school-based vision screening program.

Much of the literature on school vision screenings report the referral rates for each clinical criterion, but few include measures of compliance with follow-up care of the referrals. Clinical settings that are able to deliver comprehensive examinations as well as the screenings have a "captive audience" and are able to provide more extensive data. In one study, compliance with diagnostic evaluations improved from 8% to 40% when comprehensive examinations were provided in the schools.<sup>24</sup> Mechanisms to improve compliance with diagnostic as well as various therapeutic modalities is an area sorely in need of research.<sup>27</sup> If compliance can be enhanced and documented, then a yield can be calculated. Yield is the "number of previously undiagnosed cases which are diagnosed and treated as the result of the screening program."<sup>25</sup>

Process indicators may include measurements of practice enhancement and student education. Casser noted that 11-20% of the patient's participating in the screening returned for comprehensive vision care services. This effect could be further enhanced by entering names and addresses of screening participants into a mailing list in order to send them office newsletters and patient education materials.<sup>26</sup> Vision screenings also serve as an essential component of clinical education at the schools and colleges of optometry.<sup>28</sup> In addition to providing them with a diversity of patient care experiences, the students are also given the opportunity to experience the value of community service projects.<sup>22,29</sup>

### Conclusions

The right to vision is a human right.<sup>30</sup> Nevertheless, optimal high quality vision care is being denied to many children in the United States. Certainly family income and health insurance status are related to the ability to obtain health care services in general. However, making these services available does not necessarily make them accessible. Innovative programs must bring health care services directly to the children instead of waiting for parents to seek them out.<sup>13</sup>

School-based programs can provide vision care to all children, including many who have been unable to obtain these services elsewhere. Maples notes that an optometric school-based program can make quality vision care with maximum

continuity accessible to the children of a community at a reasonable cost.<sup>31</sup> Vision screenings lie at the base of a pyramid of school-based optometric services. As such, their effectiveness will have a direct impact on the delivery of vision care services which follow.

The ultimate success of any screening program is judged by the use of diagnostic services and compliance with treatment protocols by patients with a positive screening result.<sup>32</sup> However, if one wishes to begin at the beginning, then attention to the epidemiological principles which underlie a vision screening will ensure "optimal care for the subject while using available resources efficiently."<sup>14</sup>

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