



## Eye Exams for Children: Their Impact and Cost Effectiveness

Prepared by Abt Associates for the Vision Council of America

# Executive Summary

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This panel included Alex Kemper M.D., M.P.H., M.S.; William Reynolds O.D.; James Tielsch Ph.D., M.H.S.; and Joel Zaba, M.A., O.D.

The panel provided general guidance on the structure of the model, suggestions about relevant articles to include in our literature review, gave input as to the values of model inputs, and reviewed the Final Report.

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# Executive Summary

Comprehensive eye exams and vision screenings are two methods used to detect amblyopia and other visual disorders in children. Eye exams are performed by an ophthalmologist or optometrist and are used to diagnose vision problems. Vision screenings are conducted by non-medical volunteers, nurses and pediatricians and used to identify people at risk for vision problems.

The goal of the study was to estimate the impact and cost effectiveness of providing comprehensive eye exams to all preschool-age children. We compared the universal provision of eye exams to two interventions: (1) a system in which all preschool-age children receive a vision screening and (2) the eye care that would be provided to children even without the presence of a formal vision screening or eye exam program.

## Results

**(1) Eye exams would detect, treat and cure significantly more cases of amblyopia in children than a universal vision screening program or the “usual patterns of care” that would exist without a formal vision screening program in place.**

It is estimated that nearly 100,000 four-year-olds in America have amblyopia. Even without a formal vision screening system in place, many of these children would have their vision problems identified and treated as part of the usual health care they receive.

However, replacing a system that relies on “usual care” with one that provides universal eye exams would result in 51 percent more children receiving successful treatment for amblyopia by age 10. The following table compares the effectiveness of universal eye exams to “usual care”:

Percent of amblyopia cases...	Universal Eye Exams	Usual Care	Percent Gain
Receiving treatment by age 10	98%	77%	27%
Receiving successful treatment by age 10	68%	45%	51%

Universal eye exams would also outperform a program of universal vision screenings and successfully treat 33,000 (144 percent) more children with amblyopia. The table below compares the effectiveness of universal eye exam and universal vision screening programs:

Cases of amblyopia...	Universal Eye Exams	Universal Screenings	Difference	Percent Gain
Detected in initial visit	94,171	64,433	29,738	46%
Receiving treatment	75,337	30,928	44,409	143%
Successfully treated/cured	56,503	23,196	33,307	144%

**(2) A universal comprehensive eye exam program would be highly cost effective and produce a greater return on investment than many other health care interventions.**

Our measure of cost effectiveness is based on a comparison of the costs of these interventions against the improvement in outcomes (quality/length of life) they generate. Cost effectiveness is measured in QALYs (quality-adjusted life-years), a unit that expresses the additional costs required to generate one year of perfect health (1 QALY).

There are no universally accepted standards, but if an intervention costs less than \$50,000 per QALY it is generally considered cost effective; if it costs less than \$20,000 per QALY, it is generally considered highly cost effective. Assigning a QALY value to different interventions allows policymakers and providers to prioritize and focus on interventions that give the greatest return at the lowest cost.

Replacing a system of “usual care” with universal preschool-age eye exams was highly cost effective at a cost of \$12,985 per QALY. Universal eye exams were also highly cost effective when compared to universal vision screenings at cost of \$18,390 per QALY. The table at right provides QALY values of other common medical interventions (ophthalmic interventions in **bold**.)

## Background

Amblyopia affects up to five percent of the population and is the leading cause of unilateral vision loss among those aged 20 to 70. The consequences of untreated amblyopia may include blindness, problems with school performance and effects on quality of life. A number of previous studies have found that early detection of amblyopia provides the best opportunity for effective treatment.

Comprehensive eye exams are considered by all eye care professionals to be the “gold standard” for detecting amblyopia and other vision problems in children. Several studies also suggest that eye exams are more effective than vision screenings in terms of ensuring appropriate treatment for amblyopia. However, they are more costly to perform than vision screenings.

A recent study suggests that vision screening, even when performed by pediatric eye specialists, identifies only about three-fourths of children with amblyopia.

QALY values for selected medical procedures	
Intervention	Cost/QALY <sup>†</sup>
Liver transplantation	\$350,000
<b>Central retinal artery occlusion (paracentesis)</b>	<b>\$345,000</b>
<b>Annual retinopathy screening for 45-y.o. diabetes patient</b>	<b>\$231,000</b>
<b>Photodynamic AMD therapy (20/200 vision)</b>	<b>\$174,000</b>
Elective repeat cesarean birth	\$120,000
Lung transplantation	\$120,000
<b>Photodynamic AMD therapy (20/40 vision)</b>	<b>\$87,000</b>
<b>PVR eye surgery</b>	<b>\$80,000</b>
Dual-side air bags	\$76,000
Diabetes screening (all individuals 25+ y.o.)	\$67,000
ESRD treatment, including dialysis and transplants	\$67,000
Hepatitis A vaccination (vs. no vaccination)	\$54,000
Heart transplantation (vs. optimal treatment).	\$51,000
<b>Annual retinopathy screening for 45-y.o. diabetes patient</b>	<b>\$44,000</b>
Chemotherapy (for 60 y.o. woman with breast cancer)	\$41,000
One-time screening for depression (for 40 y.o.)	\$35,000
Driver-side air bags	\$30,000
Typical school-based tobacco prevention program.	\$22,000
Breast cancer screening vs. no screening for 70-75 y.o. women	\$21,000
Cochlear implant for deaf individual	\$20,000
Hypertension screening (for asymptomatic 60 y.o. woman)	\$19,000
<b>Universal eye exams for children vs. universal screening</b>	<b>\$18,930</b>
<b>Universal eye exams for children vs. “usual care”</b>	<b>\$12,985</b>
Bone marrow transplantation	\$11,000
Universal cancer screening program (vs. no screening)	\$5,200
<b>Cataract surgery</b>	<b>\$4,500</b>

<sup>†</sup>In 2002 dollars. The source for many values is the Harvard Center for Risk Analyses, Harvard School of Public Health, Comprehensive Table of Cost Utility Ratios, 1976-2001, [www.hsph.harvard.edu/cearegistry](http://www.hsph.harvard.edu/cearegistry)

It is almost certain that vision screening tests given by non-eye care professionals are less effective. In addition, several studies suggest that many children who fail a vision screening do not receive the appropriate follow-up evaluation and care.

As a result of the performance differences between exams and screenings, some children who receive comprehensive eye exams are likely to have amblyopia identified and treated earlier than if they had received a vision screening.

## **Methodology**

Our goal was to determine if the benefits resulting from exams' higher rates of detection and treatment offset their higher costs. By understanding the costs and likely benefits, one can better evaluate the level of resources society should devote towards promoting eye exams for all preschool children.

We assessed the cost effectiveness by using cost-utility analysis. This is a method of economic evaluation that analyzes the cost effectiveness of interventions by comparing the benefits of a medical intervention (in this case, eye exams) to the costs of providing that intervention (in this case, both examination and treatment expenses).

Our cost-utility analysis is measured in QALYs (quality-adjusted life-year), a unit that expresses the additional costs required to generate a year of perfect health. A QALY takes into account both quantity and the quality of life generated by intervention being studied and provides a common unit of measurement by which a wide range of medical interventions can be compared.

Because comparisons of cost-effectiveness can be made among interventions, cost-utility analysis means that priorities can be established based on those interventions that are inexpensive (low cost per QALY) and those that are expensive (high cost per QALY). An intervention is generally considered cost effective if it costs less than \$50,000 per QALY and generally considered highly cost effective if costs less than \$20,000 per QALY.

The economic model we developed to compare these interventions focuses on amblyopia. This is the only vision disorder typically identified during comprehensive exams/vision screenings for which there was sufficient information in the medical literature. Given an initial prevalence of amblyopia in the study population, the model takes into account the following:

- (1) The relative performance of comprehensive exams and vision screenings;
- (2) The probability that treatment is successful;
- (3) The costs of exams, screenings, and treatment;
- (4) The utility values associated with healthy vision, amblyopia, and amblyopia-caused bilateral impairment;
- (5) Patterns of treatment under usual eye care.

To estimate model parameters, we conducted an extensive literature review and also consulted with the panel of experts who advised us on the study. While there is an extensive literature on amblyopia and other visual disorders, there are significant gaps that affect our ability to precisely measure

several key model parameters and differences across relevant studies in their estimates of model parameters.

For example, little data has been published on the relative performance of comprehensive exams and vision screenings, the costs and outcomes associated with treating amblyopia, or the impact of untreated amblyopia on quality of life. We developed a set of base values that represent our best estimates, but these are subject to uncertainty given the range of values found in the literature.

Sensitivity analyses were used to examine how results change using different values of model parameters. We found that changes in the values of most model parameters had marginal impact on the basic conclusions of the report. However, results were particularly sensitive to assumptions made about the quality of life associated with untreated amblyopia, prevalence, and the probability of successful treatment.

## **Conclusion**

The study's conclusions are largely driven by the fact that treatment of amblyopia is extremely cost effective. While data are limited, we estimate that treating amblyopia (not including detection) costs about \$1,800 per QALY. As a result, spending additional dollars on interventions that detect and treat large numbers of children with amblyopia are also highly cost effective.

That a vision screening costs less to perform than an eye exam is not the only relevant factor in assessing cost effectiveness. What is relevant is a comparison of the costs and the benefits associated with each procedure. Based on our evaluation, the higher costs associated with eye exams are more than offset by the gains that result from the additional children who are successfully treated as a result of receiving an eye exam.

In conclusion, it was beyond the scope of this study to address issues related to the feasibility of requiring comprehensive eye exams for preschool children. However, the study suggests that policymakers should give consideration to programs that would increase the number and proportion of preschool children who receive a comprehensive eye exam from an eye care professional.

These gaps in our knowledge illustrate the clear need for further research on amblyopia and other visual disorders in order to refine estimates of model parameters, allowing for more precise estimates of the costs and benefits of comprehensive exams.