PRE-SCHOOL VISION SCREENING FOLLOW-UP ANALYSIS FOR MONROE COUNTY, MICHIGAN

by

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by

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ABSTRACT

Background: The American Optometric Association estimates that up to 25% of school-age children have a vision problem.[1] In order to catch problems early to initiate early treatment, different vision screening programs have been developed across the nation. Michigan requires screenings on children from pre-school through 9th grade. This pilot study is the first attempt in the history of the 60 year old MDCH screening program to analyze the results of those screenings, including follow up data and diagnoses from the referred examinations. *Methods*: The Michigan College of Optometry collaborated with the Michigan Department of Community Health (MDCH) to obtain permission and access to look at the screening numbers. "Daily Report Sheets" from the sample population of pre-schoolers in Monroe County were analyzed. *Results*: Of 1115 children screened, 6.3% (n=70) screened positive for one or more test, and were referred to an eye care professional. Results were as follows: nearly 33% referred for acuity only, over 27% for a two line difference test, roughly 23% for a cover test, approximately 17% for some combination of tests. Of those examined, 87% had a diagnosis from an eye care professional, and just about 69% of those examined were given some sort of treatment. *Conclusions*: Although the Michigan Department of Community Health does a comprehensive battery of testing, there is some question to the validity of some of the tests in screening for vision problems. Without further information as to exact diagnoses of the eye care professional, it is impossible to evaluate the specificity or sensitivity of the MDCH Screenings.

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BACKGROUND

As most optometrists know, good vision means more than just seeing "20/20"- there are other important areas of vision such as eye teaming, tracking, and visual processing that contribute to a functional visual system. Unfortunately, many people do not visit their optometrist until they have a complaint. For children, who may be unaware of what clear vision is, this can mean missing major disorders until later in life, possibly causing problems in school, developmental delays, and long-term visual and behavioral problems that can be difficult to correct. In fact, the American Optometric Association (AOA) estimates that up to 25% of school-age children have a vision disorder, and by teen-age years, 11.5% of students have a vision problem that has gone undetected.[1] The most common of these problems include amblyopia, strabismus, and significant refractive error. Although it is estimated that 1 in 4 students have a vision problem, this is only an average across the nation. That number varies significantly across populations, and the numbers become increasingly significant with minorities, low income groups, and those without insurance.[2] Clearly, due to the variance between groups, one cannot predict the prevalence of vision problems in a population based on the national average.

In attempt to catch these disorders early, free screening programs have been developed for children in several states across the country. It has been shown that early detection is the best way to prevent problems later in life, and screenings can be an effective way of doing so. The goal is not to diagnose problems, but rather to detect children with possible problems to refer them for a complete eye exam. The Vision in Preschoolers (VIP) study found that "When the best tests were used by highly skilled personnel, approximately two thirds of children with one or more VIP targeted disorders

and 90% of those children with the most important conditions were identified, while referring 10% of normal children for an eye examination (90% specificity)." [3] The study also found that eye care professionals did not have to administer the screening, but trained laypeople such as school nurses achieved equal results when trained for how to perform the screening.[3] This study shows that a good screening program can, in fact, detect early problems for implementation of earlier treatment to prevent problems later in life.

Screenings are by no means uniform, however, and vary from state to state in areas tested, ages screened, tests used, type of administrator, and whether or not the screening is required. Currently, 34 states require some sort of vision screening, but only five of those require a follow-up exam for those children screened positive. This is hugely significant to taxpayers, and without follow-up exams, the screenings become invalid. Kentucky is currently the only state to require a comprehensive vision exam for children before starting kindergarten.

In 1978, the state of Michigan passed Public Health Code Act 368 which states, "A local health department shall conduct hearing and vision testing and screening programs without charge for children residing within its jurisdiction…" The code specifies that lay persons will administer the tests and report their results to the community health department. The eye care professional performing the referral examination is also asked to report their exam findings to the health department. The act also requires screening of vision and hearing in order for a student to be registered for either kindergarten or the first grade. Since1978, Michigan has become one of 33 states that require vision screenings for preschool and grade-school students.[4] Today in

Michigan, following the public health code act, pre-school students along with students in the first grade, third grade, fifth grade, and seventh grade are screened for vision anomalies. In the ninth grade, the students are either screened in school, or the screening is postponed until they are screened at the Secretary of State before earning their state driver's license. The Michigan Department of Community Health (MDCH) performs a different screening battery for pre-school, elementary, and junior high school age patients. It is reported that of approximately three million children residing in the State of Michigan, over one million of them will need eye care by the time they reach their high school graduation. In order to give each child optimal vision to minimize any hindrance on their ability to learn, it is important to catch such ocular anomalies as strabismus, amblyopia, and high refractive error early, as well as monitor the patency of their optical system on a regular basis throughout their academic career.

The standards for the MDCH vision screenings correlate with those from The Orinda Vision Study done in 1954-1956 in the Orinda Union School District in Orinda California. The goal of this study was to design the least technical as well as most economical way to screen children for as many vision problems as possible in the elementary schools. While this study was performed by eye care professionals and therefore such procedures as retinoscopy and ophthalmoscopy could be performed, the referral criteria are still utilized in the current programs performed by the MDCH trained technicians with a modified testing battery. In Orinda, patients were referred for a complete work-up if they had 20/40 or worse visual acuity in either eye, significant refractive error or anisometropia, any tropia or significant phoria at distance or near, or any verified pathology or anomaly of the eye. This particular technique was able to

identify 96% of children who needed some kind of visual intervention, and 98% of children who did not.[5] These successes are what make this the basis of current screening programs.

The battery of testing is conducted by a technician trained for two weeks by the Vision Consultant in the Division of Family and Community at the MDCH. The screenings are performed at no cost to the students or parents on approximately 850,000(cited 2007) pre-school through ninth grade children annually in the State of Michigan, according to the MDCH. Of these children, approximately 50,000 are eventually referred for a complete eye examination, accounting for 6-10% overall referred annually.[6] According to the 2000 Michigan census data, there were 1,492,193 children between the ages of 5 and 14 years old.[7] If 850,000 children are being screened annually, this is approximately 60% of Michigan's children.

For pre-schoolers, the protocol for screening is very specific, but MDCH is sure to point out that "no matter how rigidly standardized or carefully given, it [the screening] never gives positive proof of the existence or absence of a defect."[7] There are five main vision tests performed, and not passing one or more of the tests results in a positive screening, and referral to an eye care professional. The first test set is "visual acuity" combined with the "two-line difference test." This test uses a Tumbling E chart to measure distance acuity with 20/40 and 20/25 acuities. Children must pass with each eye individually at both lines. If both eyes pass the 20/40, but only one eye passes the 20/25, the child is referred due to a visual acuity difference of two lines between the eyes. However, if the child is having difficulty with the testing, the 20/25 line is optional and may not be attempted for preschoolers if they are unable to attend to the task. Symbols

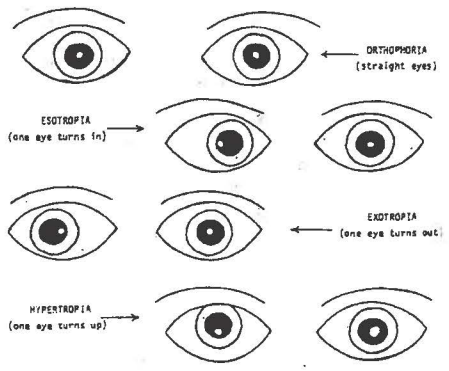


Figure 1.[8] **"Corneal Reflection Test"**

may also be used instead of Tumbling E, and in this case the two-line difference test is also not performed. The second screening test is the "corneal reflection test." The child is asked to look at a penlight 13 inches away. If the reflection is not approximately in the center of the pupil, the child is referred (see **Figure 1**). This test is done to rule out muscle imbalance, but is not performed if the child already wears glasses. The third test, the alternating "Cover-Uncover Test" is to rule out "latent muscle imbalance." This test is performed at both distance and near. The right eye is covered, then the cover paddle is alternated to the left eye, then the left eye is uncovered. This is then repeated in the opposite direction, starting with covering the left eye, and so on. (see **Figure 2**). The MDCH Vision Technician's Manual specifies waiting at least three seconds between movements to allow for disruption of fusion. Any monocular movement results in a referral. This test is not performed if the child wears glasses. The fourth test is a brief eye history, asking if the child has been to an eye doctor,

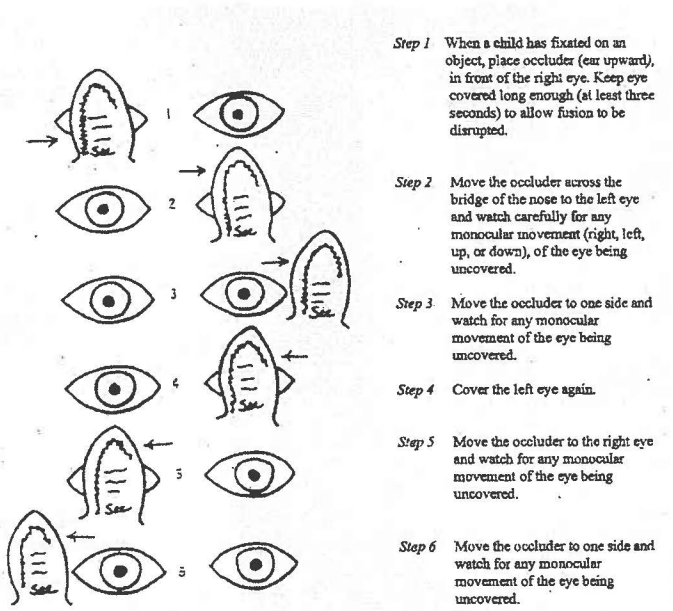
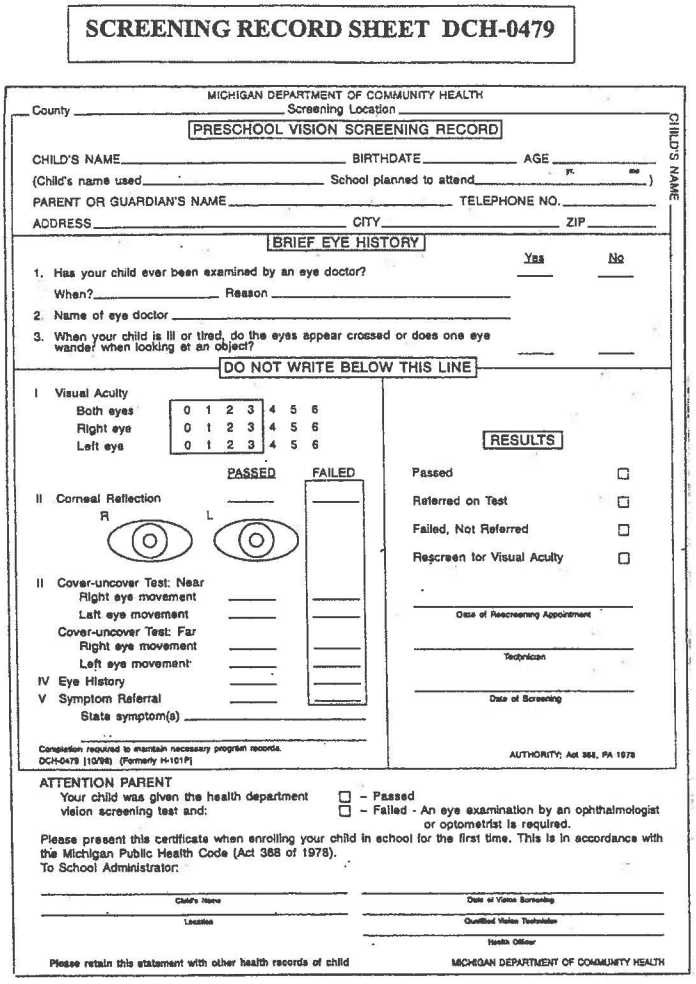


Figure 2.[8] **MDCH "Cover-Uncover Test"**

the name of the doctor, and if the child's eye ever tends to cross or wander when tired. A response of "yes" to any of the questions automatically results in a positive screening and a referral to an eye care professional (see **Figure 3)**. The last test is an observation of the ocular system. Any observation of strabismus (eye turn), ptosis (droopy lid), nystagmus (constantly oscillating eye), or anisocoria (different pupil sizes) by the examiner automatically results in a referral.[8]

The purpose of our pilot study is to provide a summary statement of children with various vision abnormalities in Michigan, by looking at the sample population of preschoolers in Monroe County. Evaluation will attempt to answer the question, "of those children screened positive, what percent followed up with an eye care professional, what portion of those received treatment, and does treatment correlate with the tests screened positive?"



SCREENING RECORD SHEET DCH-0479

MICHIGAN DEPARTMENT OF COMMUNITY HEALTH

County _____ Screening Location _____

PRESCHOOL VISION SCREENING RECORD

CHILD'S NAME _____ BIRTHDATE _____ AGE _____

(Child's name used _____ School planned to attend _____)

PARENT OR GUARDIAN'S NAME _____ TELEPHONE NO. _____

ADDRESS _____ CITY _____ ZIP _____

CHILD'S NAME

BRIEF EYE HISTORY

	Yes	No
1. Has your child ever been examined by an eye doctor? When? _____ Reason _____		
2. Name of eye doctor _____		
3. When your child is ill or tired, do the eyes appear crossed or does one eye wander when looking at an object?		

DO NOT WRITE BELOW THIS LINE

		PASSED	FAILED
I	Visual Acuity: Both eyes 0 1 2 3 4 5 6; Right eye 0 1 2 3 4 5 6; Left eye 0 1 2 3 4 5 6		
II	Corneal Reflection (R / L)		
II	Cover-uncover Test: Near — Right eye movement		
	Left eye movement		
	Cover-uncover Test: Far — Right eye movement		
	Left eye movement		
IV	Eye History		
V	Symptom Referral — State symptom(s) _____		

RESULTS

- ☐ Passed
- ☐ Referred on Test
- ☐ Failed, Not Referred
- ☐ Rescreen for Visual Acuity

Date of Rescreening Appointment _____

Technician _____

Date of Screening _____

Completion required to maintain necessary program records. DCH-0479 (10/98) (Formerly H-101P)

AUTHORITY: Act 368, PA 1978

ATTENTION PARENT

Your child was given the health department vision screening test and:

☐ – Passed

☐ – Failed - An eye examination by an ophthalmologist or optometrist is required.

Please present this certificate when enrolling your child in school for the first time. This is in accordance with the Michigan Public Health Code (Act 368 of 1978).

To School Administrator:

Child's Name _____ Date of Vision Screening _____

Location _____ Qualified Vision Technician _____

Health Officer _____

Please retain this statement with other health records of child

MICHIGAN DEPARTMENT OF COMMUNITY HEALTH

Figure 3.[8] MDCH Symptoms Checklist Form

METHODS

The Michigan College of Optometry signed a Memorandum of Understanding with the Michigan Department of Community Health (MDCH) to obtain aggregate results of pre-school vision screenings (ages 3-6), conducted by the local health department in Monroe County. The MDCH Vision Consultant provided a cumulative data report taken from the "Preschool Vision Screening Daily Report Sheets" of the Monroe County Health Department Vision Screener(s) which outlined the total number of preschoolers who were screened, passed, and referred. Data included age and which test(s) was screened positive. Gender was not included. Separate data points were provided for the children who screened positive for potential vision problems, and were referred for further care. These points included status of follow-up, presence of diagnosis, and treatment plan.

RESULTS

Among a total of 1115 pre-school children screened, 6.3% (n=70) of pre-school children were screened positive for vision problems with the given test battery, and were referred to a doctor of optometry or ophthalmology for a comprehensive examination. There were 28 children who were unable to be screened; the provided data did not give an explanation as to why they were unable. Of those screened positive, 64.3% (n=45) were reported to have received a comprehensive exam. Follow up reports from eye care professionals revealed that 86.7% (n=39) had a diagnosis, and 68.9% (n=31) were given some sort of treatment. Out of those screened positive, 35.7% (n=25) were not examined-one for insurance reasons, with an exam to be scheduled at a later date; the remainder

were unknown.

	Number positive screenings		Number examined		Number given a prescription
Acuity Only		23 (32.9%)		14 (60.9%)	11 (78.6%)
Two Line Difference Only		19 (27.1%)		13 (68.4%)	6 (46.2%)
Cover Test Only	Near	7	Near	4	5 (62.5%) (3 Rx, 1 VT, 1 referral)
	Far	1	Far	0	
	Both	8	Both	4	
	Total	**16 (22.9%)**	**Total**	**8 (50.0%)**	
Combinations		12 (17.1%)		10 (83.3%)	9 (90.0%)
History/ Symptoms		0		0	0
20/50 Only		0		0	0
Corneal Reflection Only		0		0	0
Totals		70 (100%)		45 (64.3%)	31 (68.9%)
Combinations					
CT + CR	Near	1	Near	1	2 (66.7%) (2 VT)
	Far	0	Far	0	
	Both	2	Both	2	
	Total	**3 (4.3%)**	**Total**	**3 (100%)**	
VA + CT	Near	3	Near	2	4 (100%)
	Far	0	Far	0	
	Both	2	Both	2	
	Total	**5 (7.1%)**	**Total**	**4 (80.0%)**	
2 line + CT	Near	4	Near	3	3 (100%) (2 Rx, 1 referral)
	Far	0	Far	0	
	Both	0	Both	0	
	Total	**4 (5.7%)**	**Total**	**3 (75.0%)**	

Figure 4. Results of Monroe County Vision Screenings

The data for children screened positive can be broken down into four separate groups: "Acuity" only, "two-line difference" only, "cover test" only, and some

combination of tests. There were 32.9% (n=23) referred for "acuity" only, 27.1% (n=19) referred for "two-line difference" only, and 22.9% (n=16) referred for "cover test" only. There were 17.1% (n=12) of children who were referred for a combination of tests, all of which included a positive cover test screening. Of the 64.3% examined (n=45), 68.9% (n=31) were given some sort of treatment plan. For further breakdown of referrals, examinations, and combination tests, **see Figure 4**. There were no students referred for 20/50 only, corneal reflection only, brief history, symptoms, or observed abnormal eye posture.

DISCUSSION

For the data itself, there are many numbers and percents for the given data set, however, there is still much that is unclear about the screenings. First of all, no data is provided on whether any of the children screened were corrected with glasses at the time of the screening. This would change the referral rate, and the children who would be sent to have a follow up exam. Since the purpose of a screening is to detect vision deficits that may otherwise go unnoticed, screening children who already have glasses may be unnecessary. For the individual test sets, it is difficult to draw conclusions about diagnosis, and therefore, about sensitivity and specificity of the screenings. It is important to be aware that the tests in the MDCH vision screenings have been developed by the MDCH, and are not necessarily the same protocol that would be used by an eye care professional or paraoptometric professional. Each test set will be discussed in the organization of "visual acuity" with "two-line difference," "cover test," "corneal reflection test," and observational findings.

For the "visual acuity" test, the test itself is similar to that used in an eye care professional's office, and based on the high referral rate, appears to be good for screenings. Unfortunately, although it is noted that those examined from the referrals had a diagnosis and a treatment of a prescription, there is no information about type of prescription. It is not safe to assume that the children referred for acuity only had only a significant refractive error (hyperopia, myopia, astigmatism, or combination), and no other binocular vision problem without knowledge of the resulting diagnosis. The prescription could have been for distance vision only, near vision only, a combination of the two, or to help align the eyes through use of prism. One cannot assume that a referral for an acuity-based problem resulted in treating acuity. For the same reasons, it is not safe to assume that for "two line difference" only, the students screened positive and treated had significant anisometropia between eyes. The test is good in theory to detect difference between eyes or preference of one eye, but again, without diagnosis it is impossible to tell if it was a difference between the eyes that was treated. The other concern with the two-line difference test is that if patients do not cooperate, the test is optional. Children with amblyopia tend to resist occlusion, and being uncooperative may be an indication that the test may screen positive. Those children who do not screen positive because of lack of screening would end up being false negatives, and this would change the screening outcome.

The "cover test" performed by MDCH is much different than the traditional cover test, which is composed of two parts. The unilateral cover test, or "Cover-Uncover Test," involves covering and uncovering one eye at a time to find a tropia, or eye turn. The unilateral cover test is the only way to detect a tropia by disrupting fusion between the

eyes. The second part, the alternating cover test, involves covering each eye in succession to approximate the magnitude of the phoria, or eye posture. In most cases, the resting posture of the eyes is clinically insignificant, even with motion detected. It becomes relevant when there is a large difference of the resting posture between distance and near. As the Orinda Study showed, the traditional cover test was a useful tool in pediatric vision screenings for early diagnosis. The "cover test" as described by the MDCH Vision Technician's Manual is looking for eye movement in a test that combines the traditional unilateral and alternating cover tests. Any eye movement results in a positive screening, which could potentially over-refer normal phorias, and under refer intermittent heterotropias and accommodative esotropias. For those screened positive for cover testing by the MDCH it is difficult to tell whether these patients were strabismic, or simply had a phoria based on the results. For those given a prescription, it is unclear whether prism was included in the prescription, and whether or not the prescription was for full time wear. It is likely that these patients had some sort of binocular vision anomaly, but it is impossible to presume the diagnosis from this data set. Without knowing the diagnosis and treatment plans, it is difficult to judge whether the modified "cover test" is a valid screening test.

The corneal reflection test as performed by MDCH is also slightly different than the traditional test performed by an eye care professional. In the traditional Hirschberg test, a light reflection deviation of approximately .5mm nasal is considered normal. It is very approximate, requires very accurate attention to detail, and diagnoses the same disorders as the traditional cover test. The deviation of the light reflection determines that there is an eye turn present, but is a very rough estimate as to the amount, frequency, and

laterality of the turn. For the MDCH Screenings, the corneal reflection test only had a positive screening along with a cover test, and was never used as the sole basis for referral. Since those children screened positive for a cover test anyway, the corneal reflection test could be removed, and those children would still be referred for an eye exam on the basis of a turning eye(s). For the positive screenings due to a combination of tests, it is likely that these children have more numerous or more significant vision anomalies than those referred for one positive screening only.

There are several tests that do not appear to be useful in detecting vision problems. Theoretically, they could be useful, and may be used more effectively in an eye care professional's office, but are either not showing up in screenings or are not being utilized by those administering the screenings. The history and symptoms portion, although very useful to an eye care professional, may be too time consuming for the screening administrators or the parents, may not be clear to the children in a screening setting, and may not be getting to the parents before the screenings. The observation of anomalies by the screener is another test that has little yield for referrals. Anomalies such as anisocoria, nystagmus, and ptosis are observations that are difficult to detect based on their small magnitude, and may become increasingly difficult to detect for children in distracted testing environments and for examiners not familiar with the measurement procedures or implications of these anomalies. These tests could feasibly be removed.

Obviously, if the children are not following up with the referrals, the screenings become invalid. A pilot study in 2004 found through survey that the biggest reasons for not following up with care were "lack of insurance coverage, inconvenience of follow-up, and lack of knowledge about the benefits of early intervention. Minority children and

those with low family incomes also were less likely to have follow-up.[9]" Even though the screenings are free, costs of comprehensive exams vary from office to office, can have long wait times for exams, and may not be providers of certain insurances- especially those for low income families under the Medicaid program. This could mean that those who need the follow-up care the most are not getting it.

There were several limitations to our pilot study, the most considerable being size of our population. Our sampling was from one age group in one county in the state of Michigan, and it has been shown that eye health and status changes with respect to economic status. In regards to Michigan data, screening results for preschoolers in 2005/2006 showed a range of referrals from as low as 1.6% in Allegan County and 2.3% in Washtenaw county to as high as 20.5% in Delta-Menominee County and 19.6% in Genessee County. Monroe County data from 2005/2006 showed a referral rate of 4.7% for preschoolers, so there is even variance between years. The average for the State of Michigan was 6.3%, so there is much variability between counties.[10] Although some of the treatment numbers from the Monroe County pre-school screenings may seem significant, they may not be representative of the state as a whole. A comprehensive study should include all counties and age groups across the state of Michigan. A second limitation to consider is that we are only able to analyze the information that the eye care professionals have sent back. It is unclear whether some children were referred and had an exam, and MDCH never received follow-up data on the results of that exam, because the doctor did not send the form back, or the family forgot to bring the form to the exam. Another limitation is that we only know whether the children received a prescription, but not the type of prescription or the diagnosis of the vision problem. It is impossible to

assume diagnosis when all the information that is given is whether or not a child received a prescription. Without knowing exact diagnoses, it is impossible to tell the sensitivity of the individual screening tests.

CONCLUSIONS

When analyzing the data from the Monroe County preschool vision screenings, it is evident that the current vision screening program for Michigan may need to implement some changes. We agree with the AOA that "the early detection and treatment of eye and vision problems for children need to be a major health goal." The testing battery, while comprehensive, could be improved to be more useful and easier for the administrator to perform with accurate evaluation. The history form and symptom checklist, 20/50 test, corneal reflection test, and distance cover test could be removed without affecting the results of the screenings, based on Monroe County's data, as these tests were not used alone to refer a patient for further evaluation. Beyond this, a modification to some of the current tests, such as the near cover test, could potentially improve the specificity of the screening battery due to its potential to over-refer for normal phoric postures.

Beyond the screening battery, it would be advantageous to the MDCH and especially to those evaluating the program, to have a more detailed follow-up report requested from the doctor seen after referral. If diagnoses and detailed treatment plans were included in the information returned to MDCH, the actual sensitivity and specificity of the screenings could be more carefully evaluated to see if they are catching the majority of vision problems in the pre-school age group, through comparison to national norms. Until then, few conclusions can be made as to the effectivity of the MDCH

screenings. While it is admirable that the State of Michigan provides vision screenings for preschoolers as an early step in preventative treatment, the program could be improved in order to better the care given to this group.

REFERENCES

1. "The Need for Comprehensive Vision Examination of Preschool and School-age Children." American Optometric Association. 2006. 24 September 2008. <http://www.aoa.org/x5419.xml>

2. Vitale S, Ellwein L, Et al. "Prevalence of Refractive Error in the United States 1999-2004". Arch Ophthalmol. 2008 Aug;126(8):1111-9.

3. "Vision in Preschoolers Study (VIP Study)." National Eye Institute. December 2006. 22 November 2008. <http://www.nationaleyeinstitute.org/neitrials/static/study85.asp>

4. "Public Health Code Act 268 of 1978." Legislative Council, State of Michigan. 18 November 2008. 23 November 2008. <http://www.legislature.mi.gov/(S(hvhzxp554atg4f45iy5bt455))/documents/mcl/pdf/mcl-368-1978-9-93.pdf>

5. Mozlin R. "The Epidemiology of School Vision Screenings." Journal of Behavioral Optometry. 2002. 13(3): 59-64.

6. "Vision Screening." Michigan Department of Community Health. 2001. 24 November 2008. <http://www.michigan.gov/mdch/0,1607,7-132-2942_4911_4912-12634--,00.html>

7. "DP-1. Profile of General Demographic Characteristics: 2000." U.S. Census Bureau. 2000. 27 March 2009. <http://factfinder.census.gov/servlet/QTTable?_bm=n&_lang=en&qr_name=DEC_2000_SF1_U_DP1&ds_name=DEC_2000_SF1_U&geo_id=04000US26>

8. "Vision Technician's Manual." Michigan Department of Community Health, Division of Family and Community Health.

9. Kemper, AA MD MPH MS, Uren, RL MHSA, Clark, SJ MPH. "Barriers to Follow-up Eye care After Preschool Vision Screening in the Primary Care Setting: Findings From a Pilot Study." J AAPOS. 2006 October; 10(5): 476-478

10. Michigan Department of Community Health Vision Screening Statistics for Fiscal year 2005-2006.