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Development of a vision screening exam for pediatricians

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Development of a vision screening exam for pediatricians

Abstract
The purpose of this project was two fold. First an assessment of the eye examination methods of western state Pediatricians and Pediatric residencies was examined via a letter survey. Second a quick but comprehensive routine for the examination of the visual function of the pediatric patient was generated. This routine was the result of current Optometric and Ophthalmological literature, insight gained from the survey and professional knowledge acquired as Optometry students. The letter survey revealed that Pediatricians were aware of the need for a good exam routine. It also revealed that their current procedures were quite inadequate by Optometric standards. The end result of this project was a good screening exam of the visual function of the pediatric patient -that could be performed by the Pediatrician or a qualified assistant. This leading to an earlier diagnosis and/or referral of eye problems resulting in improved care for the pediatric patient.

Degree Type
Thesis

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DEVELOPMENT OF A VISION SCREENING EXAM FOR PEDIATRICIANS

A Thesis
Presented to
the Faculty of the College of Optometry
Pacific University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Optometry

by
William J. Bogus
Wesley W. Charlton

February 1980
DEVELOPMENT OF A VISION SCREENING EXAM FOR PEDIATRICIANS

by

William J. Bogus

Wesley W. Charlton

Norman S. Stern

GRADE

February 1980
ACKNOWLEDGEMENTS

We would like to thank Dr. Norman Stern for his expert advise making this project run smoothly. Thanks also to the Oregon Optometric Association for research funds needed for the letter survey expenses. A very special thank you goes to Cris Bogus whose countless hours of hard work and invaluable assistance enabled us to complete this thesis.
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ABSTRACT

The purpose of this project was two fold. First an assessment of the eye examination methods of western state Pediatricians and Pediatric residencies was examined via a letter survey. Second a quick but comprehensive routine for the examination of the visual function of the pediatric patient was generated. This routine was the result of current Optometric and Ophthalmological literature, insight gained from the survey and professional knowledge acquired as Optometry students.

The letter survey revealed that Pediatricians were aware of the need for a good exam routine. It also revealed that their current procedures were quite inadequate by Optometric standards. The end result of this project was a good screening exam of the visual function of the pediatric patient that could be performed by the Pediatrician or a qualified assistant. This leading to an earlier diagnosis and/or referral of eye problems resulting in improved care for the pediatric patient.
INTRODUCTION

The importance of pediatric vision testing is being recognized as an important part of the total health care system. In 1977 and again in 1979 the Journal of the American Optometric Association devoted entire issues to Pediatric Optometry. In April of 1979 Optometric Monthly initiated a new column on Pediatric Optometry. The feeling within the profession of Optometry is that care of the pediatric patient has been overlooked too long.

Optometry is now considered a primary health care provider but at this time it is seldom that the Optometrist has the opportunity to examine a patient before he or she enters school. The main health care provider for the child is the Pediatrician. The fact that the Pediatrician may be the only doctor a child sees before school age is the reason behind this research project. The Pediatrician needs a quick but comprehensive examination routine for testing the visual performance of the pediatric patient. He is the primary screener for health problems and as such should be provided with the proper tools to effectively detect early vision anomalies.

This project sampled current vision testing procedures by western state Pediatricians and Pediatric Residencies. Using this
data along with current Optometric and Ophthalmological literature and professional knowledge gained while Optometry students, a vision examination procedure for use by Pediatricians was developed.

The early diagnosis of ocular problems is desirable according to separate studies by Fabian,1 Nawratzki,2 and Ingram.3 Unfortunately, however, the literature is scant on actual examination routines to be used by Pediatricians. There are several volumes on Pediatric Ophthalmology but these are mainly concerned with acuity and structure and very seldom address binocularity, refractive error or muscle imbalances.

The literature on vision screenings once the child has entered school is quite abundant. The literature on examination techniques to be used by Optometrists and Ophthalmologists is also quite abundant. This is however, of somewhat limited value if the eye care specialist rarely has the opportunity to examine a pediatric patient or if he or she examines the patient after a vision problem has imbedded itself.

The lack of literature in this area speaks to the need for this research thesis. Since early diagnosis is deemed desirable a method for early diagnosis by the primary health care provider, the Pediatrician is not only desirable but important to the well being of the pediatric patient.
METHODS, MATERIALS AND SUBJECTS

Pediatricians and Pediatric residencies were used as the subjects. A Pediatrican was defined as an M.D. who lists him or herself primarily as a Pediatrician or child care specialist. Pediatric residency was a program of study offered through a College of Medicine.

Ninety (90) Pediatrician and ten (10) Pediatric residency programs were selected as the sample population, making a total of one hundred (100) subjects. The states from which the subjects were sampled were California, Washington, Oregon, Utah, Montana and Idaho. A value for the total population in each state was assigned as follows:

<table>
<thead>
<tr>
<th>State</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>1</td>
</tr>
<tr>
<td>Washington</td>
<td>2</td>
</tr>
<tr>
<td>Utah</td>
<td>3</td>
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<tr>
<td>Oregon</td>
<td>3</td>
</tr>
<tr>
<td>Montana</td>
<td>4</td>
</tr>
<tr>
<td>Idaho</td>
<td>4</td>
</tr>
</tbody>
</table>

The highest value was one (1) and the lowest was four (4). These values were used to determine the number of Pediatricians sampled from each state.
Using the relative state values assigned, the actual number of Pediatricians sampled from each state were as follows:

<table>
<thead>
<tr>
<th>State</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>25</td>
</tr>
<tr>
<td>Washington</td>
<td>21</td>
</tr>
<tr>
<td>Utah</td>
<td>16</td>
</tr>
<tr>
<td>Oregon</td>
<td>15</td>
</tr>
<tr>
<td>Montana</td>
<td>7</td>
</tr>
<tr>
<td>Idaho</td>
<td>6</td>
</tr>
</tbody>
</table>

The names and addresses of the Pediatricians were obtained from the "Pink Book" and current telephone books available from the states. The Pediatricians were randomly chosen as were the cities in which they practiced.

The ten (10) residency programs were chosen with respect to the actual number available in each state:

<table>
<thead>
<tr>
<th>State</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>5</td>
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<tr>
<td>Washington</td>
<td>2</td>
</tr>
<tr>
<td>Utah</td>
<td>2</td>
</tr>
<tr>
<td>Oregon</td>
<td>1</td>
</tr>
<tr>
<td>Montana</td>
<td>0</td>
</tr>
<tr>
<td>Idaho</td>
<td>0</td>
</tr>
</tbody>
</table>

The names and addresses of the residency programs were obtained from the "Pink Book".
The subjects were used to assess what tests are currently being utilized by Pediatricians in the examination of the eye of the pediatric patient.

A letter survey was sent out to the one hundred subjects. A cover letter of introduction explaining the purpose of the study and introducing the experimenters to the subject was attached to each survey. The survey was so constructed as to sample all areas of visual function deemed important by current Optometric standards, specifically externals, acuities, innervation, muscle imbalance and motility, fields, refractive error, fundoscopy color vision and binocularity.

The survey was constructed with ease of completion in mind. This it was hoped would promote a high return of questionnaires. Space was provided for comments from the subjects. In addition the subject's age, sex, years in practice and population of area served was sampled.

A self addressed, stamped envelope was also included in the survey packet. Pacific University, College of Optometry was used as the return address. The surveys were sent out on August 15, 1979 and a cut off date of October 31, 1979 was set. After the October date any responses return were not used in the study.
The letter survey (see appendix B) was the only experimental equipment utilized in this study.
RESULTS

The methods of statistical analysis used were a simple frequency distribution and a calculation of mean and range. The calculation of mean was used only for the age, years in practice and population of area served portions of the survey. The formula used for calculation of the mean was \[ M = \frac{EX}{N} \].

The remainder of the survey was analyzed by means of a simple frequency distribution. This was deemed adequate as this was an information gathering medium only.

Of the doctors responding 94% said they always performed an external exam, with the remaining 6% performing an exam 41 - 80% of the time. (See Table III.)

Concerning acuities 46% said they always performed a far acuity while 24% performed near acuities all the time. Fifty-two percent never performed pinhole acuities with 36% not responding to this question. The remaining doctors were quite evenly spread on far and near acuities except that 28% said they never performed near acuities. (See Table III.)
Sixty six percent of the doctors performed a pupillary reflex all of the time. Twenty percent performed them 21 - 80% of the time with 14% not responding. (See Table III.)

Ten percent of the Pediatricians did a corneal light reflex all of the time. Whereas 38% performed one, less than 40% of the time, with 42% not responding. (See Table III.)

Of the Pediatricians sampled 18% performed a cover test all the time. Twenty-four percent did a cover test less than 40% of the time. Fifty percent failed to respond. (See Table III.)

Fourteen percent did Ophthalmoscopy all the time. Ten percent did it less an 40% of the time and 70% did not respond to this question. (See Table III.)

Concerning an N.P.C., 14% did one all the time, while 26% and 32% performed one never and seldom respectively with 12% not responding. (See Table III.)

Sixty percent of the doctors always did eye motility tests. Thirty percent did this less than 80% of the time and 10% did not respond. (See Table III.)

There were 2% of the pediatricians that did visual fields always and 40% that did not respond. Fifty-four percent did it less than 40% of the time. (See Table III.)
Eighteen percent did retinoscopy always with 40% never doing it. Twelve percent did not respond to the question. (See Table III.)

There were 22% of the doctors doing color vision more than 41% of the time and 76% doing it less than 40% of the time. (See Table III.)

Two percent of the doctors performed IOP measurements all the time and 74% never doing IOP. Sixteen percent seldom performed IOP and 6% did not respond. (See Table III.)

None of the doctors sampled did a test for binocularity all the time. There were 72% reporting they never tested binocularity and 26% not responding. (See Table III.)

Four percent of the codtors did a +1.75 lens test always and 84% said they never did this test. Eight percent failed to respond to this question. (See Table III.)

There were 8% who used a cision screener always with 68% saying they never used one. Twenty-two percent did not respond to this question. (See Table III.)

The average and range of the doctors age, years in practice, population served and percent of male and female responders is summarized in Table I.
The responses to open ended questions are summarized in Appendix C.
TABLE I
BREAKDOWN OF AVERAGE AGE, YEARS IN PRACTICE, POPULATION SERVED AND PERCENT OF MALE AND FEMALE RESPONDERS

<table>
<thead>
<tr>
<th>Description</th>
<th>Formula</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age of Doctor responding</td>
<td>$M = \frac{\sum X}{N}$</td>
<td>$\frac{2053}{50} = 41.06$</td>
</tr>
<tr>
<td>Range of age</td>
<td></td>
<td>29 - 63</td>
</tr>
<tr>
<td>Average years in practice</td>
<td>$M = \frac{\sum X}{N}$</td>
<td>$\frac{584}{50} = 11.68$</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>1 - 31</td>
</tr>
<tr>
<td>Average population of area served</td>
<td>$M = \frac{\sum X}{N}$</td>
<td>$\frac{17,733,000}{43} = 412,395$</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>15,000 - 3,500,000</td>
</tr>
<tr>
<td>Percentage of Male Responders</td>
<td>$N = 48$</td>
<td>96%</td>
</tr>
<tr>
<td>Percentage of Female Responders</td>
<td>$N = 2$</td>
<td>4%</td>
</tr>
</tbody>
</table>
### TABLE II

**BREAKDOWN OF SURVEYS SENT OUT AND RETURNED**

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>% TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys sent out</td>
<td>100</td>
</tr>
<tr>
<td>Surveys sent to Pediatricians</td>
<td>90</td>
</tr>
<tr>
<td>Surveys sent to Residency Programs</td>
<td>10</td>
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<tr>
<td>Surveys sent to California Pediatricians</td>
<td>25</td>
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<tr>
<td>Surveys sent to Washington Pediatricians</td>
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<tr>
<td>Surveys sent to Montana Pediatricians</td>
<td>7</td>
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<tr>
<td>Surveys sent to Idaho Pediatricians</td>
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</tr>
<tr>
<td>Surveys sent to California Residencies</td>
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<tr>
<td>Surveys sent to Utah Residencies</td>
<td>2</td>
</tr>
<tr>
<td>Surveys sent to Oregon Residencies</td>
<td>1</td>
</tr>
<tr>
<td>Surveys returned</td>
<td>50</td>
</tr>
<tr>
<td>Surveys returned by Pediatricians</td>
<td>50</td>
</tr>
<tr>
<td>Surveys returned by Residencies</td>
<td>0</td>
</tr>
</tbody>
</table>

The number of surveys returned was then used as the point of reference for the remainder of the study:

<table>
<thead>
<tr>
<th>Total number of surveys</th>
<th>% TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys from Pediatricians</td>
<td>50</td>
</tr>
<tr>
<td>Surveys from Residencies</td>
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</tr>
<tr>
<td>QUESTION #</td>
<td>NEVER 0%</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>0 0</td>
</tr>
<tr>
<td>2</td>
<td>2 4</td>
</tr>
<tr>
<td>2a</td>
<td>14 28</td>
</tr>
<tr>
<td>2b</td>
<td>4 8</td>
</tr>
<tr>
<td>2c</td>
<td>26 52</td>
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<tr>
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<tr>
<td>4</td>
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<td>5b</td>
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<td>37 74</td>
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<td>13c</td>
<td>24 48</td>
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<td>13d</td>
<td>23 46</td>
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<tr>
<td>13e</td>
<td>20 40</td>
</tr>
<tr>
<td>14</td>
<td>42 84</td>
</tr>
<tr>
<td>15</td>
<td>34 68</td>
</tr>
<tr>
<td>15a</td>
<td>26 52</td>
</tr>
<tr>
<td>15b</td>
<td>16 32</td>
</tr>
</tbody>
</table>
DISCUSSION

It would be far too consuming to discuss the results of the survey in detail question by question, however some generalizations and highpoints can be extracted. The first point is that a large majority of Pediatricians (94%) always employ an external examination of the eyes.

The next most frequent exam procedure was pupillary reflex evaluation which was always performed by 66% of those polled. The third most frequent procedure performed was eye motility. This was done all the time by 60% of those sampled. From there, the procedures performed fall off quite rapidly with none being performed all the time by 50 or more percent of the Pediatricians.

A striking result of the survey is that only 34% and 30% of Pediatricians perform a near or far cover test respectively, all of the time. In addition, none of those sampled perform a test for binocularity all of the time. In fact, 72% said they never perform a test for binocularity.

The remainder of the procedures sampled were very much similar in response. That is the majority of responses fell in, or below the
seldom category. There were in addition a substantial number of "no response" responses. This could either mean that they simply failed to answer the questions as an oversight or that they did not know what the procedure was. The investigators believe it is more likely that the doctors were not familiar with either the test procedure or the name of the test used in the survey.

From the results of this survey a typical exam routine utilized by those Pediatricians polled was constructed. It consists first of an external exam of the eyes using no instrumentation. Next the pupillary reflexes would be checked by most doctors followed by an eye motility examination. It is safe to assume from the survey that any further routine is seldom used with the possible exception of ophthalmoscopy, which was done by 50% of Pediatricians at least 41% of the time, and far acuities, which was done 50% of Pediatricians at least 41% of the time.

The results speak to the very purpose of this study. A comprehensive and quick exam routine of the eyes of the Pediatric patient is needed by Pediatricians.
GRAPHS OF LETTER SURVEY ANSWERS
QUESTION #2

Percent doctor's performing external exam

A = 0% (NEVER)
B = 1 - 20% (Seldom)
C = 21 - 40% (Sometimes)
D = 41 - 80% (Usually)
E = 81% + (Always)
F = No Response

QUESTION #2a

Percent doctor's performing near visual acuities
QUESTION #2b

A
B
C
D
E
F

Percent doctor's performing far visual acuities

0% 20% 40% 60% 80% 100%

A = 0% (NEVER)  D = 41 - 80% (USUALLY)
B = 1 - 20% (Seldom)  E = 81% + (ALWAYS)
C = 21 - 40% (SOMETIMES)  F = NO RESPONSE

QUESTION #2c

A
B
C
D
E
F

Percent doctor's performing pinhole far acuities

A
B
C
D
E
F

QUESTION #3

A
B
C
D
E
F

Percent doctor's performing pupillary reflexes
<table>
<thead>
<tr>
<th></th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
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<td>D</td>
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<tr>
<td>F</td>
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</tr>
</tbody>
</table>

**QUESTION #4**

Percent doctor's performing corneal reflexes

A = 0% (NEVER)  D = 41 - 80% (USUALLY)
B = 1 - 20% (SELDOM)  E = 81% + (ALWAYS)
C = 21 - 40% (SOMETIMES)  F = NO RESPONSE

**QUESTION #4a**

Percent doctor's performing monocular light fixation

**QUESTION #4b**

Performing doctor's performing Hirschberg
QUESTION #5b

Percent doctors performing far cover test

A = 0% (NEVER) D = 41 - 80% (USUALLY)
B = 1 - 20% (Seldom) E = 81% + (ALWAYS)
C = 21 - 40% (SOMETIMES) F = NO RESPONSE
% doctors performing ophthalmoscopy

A = 0% (NEVER)
B = 1 - 20% (SELDOM)
C = 21 - 40% (SOMETIMES)
D = 41 - 80% (USUALLY)
E = 81%+ (ALWAYS)
F = NO RESPONSE

% doctors performing mydriatic ophthalmoscopy

% doctors performing nonmydriatic ophthalmoscopy
QUESTION #7

Percent doctors performing near point of convergence

- A = 0% (NEVER)
- B = 1 - 20% (SELDOM)
- C = 21 - 40% (SOMETIMES)
- D = 41 - 80% (USUALLY)
- E = 81% + (ALWAYS)
- F = NO RESPONSE

QUESTION #8

Percent doctors performing eye motility

- A = 0% (NEVER)
- B = 1 - 20% (SELDOM)
- C = 21 - 40% (SOMETIMES)
- D = 41 - 80% (USUALLY)
- E = 81% + (ALWAYS)
- F = NO RESPONSE

QUESTION #9

Percent doctors performing visual fields
### QUESTION #9a

<table>
<thead>
<tr>
<th>Percent doctors performing confrontation fields</th>
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<tbody>
<tr>
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<tr>
<td>D</td>
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<tr>
<td>E</td>
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<td>F</td>
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</table>

### QUESTION #9b

<table>
<thead>
<tr>
<th>Percent doctors performing other fields</th>
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<tr>
<td></td>
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<tr>
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</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
</tbody>
</table>

### QUESTION #10

<table>
<thead>
<tr>
<th>Percent doctors performing retinoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
</tbody>
</table>

- **A** = 0% (NEVER)
- **B** = 1 - 20% (Seldom)
- **C** = 21 - 40% (Sometimes)
- **D** = 41 - 80% (Usually)
- **E** = 81%+ (Always)
- **F** = No Response
QUESTION #11

Percent doctors performing color vision

A = 0% (NEVER)
B = 1 - 20% (SELDOM)
C = 21 - 40% (SOMETIMES)
D = 41 - 80% (USUALLY)
E = 81% + (ALWAYS)
F = NO RESPONSE

QUESTION #12

Percent doctors performing intraocular pressure

A = 0% (NEVER)
B = 1 - 20% (SELDOM)
C = 21 - 40% (SOMETIMES)
D = 41 - 80% (USUALLY)
E = 81% + (ALWAYS)
F = NO RESPONSE

QUESTION #13

Percent doctors performing binocularity

A = 0% (NEVER)
B = 1 - 20% (SELDOM)
C = 21 - 40% (SOMETIMES)
D = 41 - 80% (USUALLY)
E = 81% + (ALWAYS)
F = NO RESPONSE
QUESTION #13a

0% 20% 40% 60% 80% 100%

A B C D E F

Percent doctors performing random dot stereogram

A = 0% (NEVER)
B = 1 - 20% (Seldom)
C = 21 - 40% (Sometimes)
D = 41 - 80% (Usually)
E = 81% + (Always)
F = No Response

QUESTION #13b

A B C D E F

Percent doctors performing stereo fly

QUESTION #13c

A B C D E F

Percent doctors performing worth 4 dot
QUESTION #13d

Percent doctors performing 4^ test

A = 0% (NEVER)   D = 41 - 80% (USUALLY)
B = 1 - 20% (SELDOM)   E = 81% + (ALWAYS)
C = 21 - 40% (SOMETIMES)   F = NO RESPONSE

QUESTION #13e

Percent doctors performing other binocularity tests

A = 0% (NEVER)   D = 41 - 80% (USUALLY)
B = 1 - 20% (SELDOM)   E = 81% + (ALWAYS)
C = 21 - 40% (SOMETIMES)   F = NO RESPONSE

QUESTION #14

Percent doctors performing +1.75 lens test
QUESTION #15

A = 0% (NEVER)
B = 1 - 20% (SELDOM)
C = 21 - 40% (SOMETIMES)
D = 41 - 80% (USUALLY)
E = 81% + (ALWAYS)
F = NO RESPONSE
APPENDIX A

EXAMINATION ROUTINE
Note: It should be remembered that this section of the thesis is written with the Pediatrician in mind. The tests, testing methods and failure criterion are directed at his or her area of specialty.

EXAMINATION ROUTINE

It was mentioned earlier that there is virtually not set examination routine for the Pediatrician. As such this section is a combination of various sources and tests. A base for the areas to be examined is drawn from Dr. Mondindra's examination record for the pediatric patient. In addition to the actual routine to be followed it was felt that there should be a division of test to be performed. That is, the younger child cannot be evaluated in the same manner as the older child. Doctor Mondindra and Dr. Catania, et.al., both make a similar division concerning the age of the pediatric patient. Dr. Catania, et.al., divides the population into two groups, from newborn to age three years, and then again from age three to fourteen. Dr. Mohindra makes four divisions, birth to one year, one year to two and a half, two and a half to five or six, and from five or six to nineteen.

The investigators believe that a single division concerning age is best. Since this study deals with pre-school children the top age to be dealt with is six. The two groups are from birth to age two and a half or three, and from two and a half or three to six. This division of age is, or
course, not absolute and the Pediatrician can decide for him/herself what tests can be employed depending upon individual developmental stage.

Additionally a division of duties that could be performed by a nurse and that the Pediatrician should perform was deemed necessary. Since the attention span of the patient is limited and the Doctors time is valuable we believe that this enhances the usefulness of the examination routine.

Starting with the birth to two and a half or three year age group a list of tests considered a minimum is presented below.

1. External exam
2. Pupillary reflexes
3. Light fixation test
4. Acuities, near and far
5. Ocular tracking and/or motility
6. Cover test
7. Ophthalmoscopy

1. The external exam should include an appraisal of the sclera, cornea, iris, conjunctiva and lids. The Pediatrician is extremely well versed in the anatomical and/or pathological anomalies
associated with the eyes, therefore no attempt at the vast range of diseases or anatomical abnormalities will be included.

This examination should be performed by the Doctor and can be done by either the naked eye, the use of an ophthalmoscope, a high plus lens (+20) and penlight, or a hand held slit lamp. The best method is with a slit lamp but a very thorough exam can be done with an ophthalmoscope and/or a high plus lens and penlight.

2. Pupillary reflexes are a must to evaluate the afferent and efferent nerve pathways. Direct and indirect measurement of reflexes is advocated. Again, the Doctor is very well educated in pupillary reflexes and no explanation of methods or results will be done here. This procedure can be performed by either a doctor or his nurse.

3. Some form of light fixation should be attempted. The preferred method is a binocular or Hirschberg test. The penlight is held midway between the two eyes and the corneal light reflex noted. The reflexes should be equal and in the same direction for both eyes. That is, using the center of the pupil as a reference the light reflexes should be both nasally displaced, temporally displaced or centered and of the same quantity.

A large deviation from this pattern should be considered an
abnormal binocular response and further evaluation undertaken. This test can be performed by the nurse.

4. The measurement of acuities of the child is often a difficult task. If the child can talk any illiterate chart is sufficient, but evaluation of the child that cannot yet speak is hard. The use of optokinetic nystagmus is recommended by Holt but this method is often times difficult. The actual acuities at different age levels is still uncertain but most researchers agree that 20/20 should be attained by age five.

Therefore the measurement of acuity before the child can talk is not recommended for the Pediatrician. Any acuity that is one-two lines below normal for both eyes or a one-two line difference between the eyes should be investigated further and a near acuity measurement is essential. This can be done by a nurse.

5. Ocular tracking and motility can be done with either a penlight or large toy. The eye movements are jerky and somewhat dysjunctive at first but should be fairly smooth and accurate by age one. The eyes should be taken to the extremes of their range in several meridians. Any lagging of one eye should be evaluated.

A near point of convergence should also be evaluated at this same time. The eyes should be able to converge to two inches or so from the nose.
These tests can be performed by the nurse.

6. A cover test is an essential part of any eye exam. The hand can be used, a card, the thumb or an occluder to perform this test. The child is given a good target to fixate on and one eye is covered. The uncovered or fixating eye should not move. The cover is then removed and the procedure performed on the other eye. Any movement of the uncovered eye must be further evaluated.

The next step is to alternately cover the right and left eyes while the child is fixating an object. The examiner must look to the eye just when the cover is removed. Some ocular movement is normal, however a large movement in or out (1.5mm or more) requires further evaluation. This test should be done by the Doctor.

7. The importance of ophthalmoscopy is well known in medicine and no attempt at describing it will be done here. The earlier a good view of the fundus is performed the better. Several new small pupil binocular indirects are now on the market and we feel they would be a definite advantage.

The Doctor should perform this test.
(Note: The reason that the light fixation test and cover test were explained in some detail was that Optometry places a high value on these tests. Also from the letter survey it was apparent that few Pediatricians perform these tests. 80% - 74% respectively either failed to respond or performed the test less than 40% of the time.)

In the second age group, two and a half or three to six years, more testing can be performed simply because of the maturation of the patient. All of the tests recommended for the first group should be performed with some added measurements. The list for this age group is given below.

1. External Exam
2. Pupillary reflexes
3. Light fixation test
4. Acuities, near and far
5. Ocular tracking and/or motility
6. Cover test
7. Ophthalmoscopy
8. Color vision
9. Confrontation visual fields
10. Test for binocularity

1. The external exam is the same as for the first group.

2. Pupillary reflexes are the same as the first group.
3. The binocular light fixation test is the same as the first group. In addition a monocular light fixation test should be performed. One eye is covered while the other views a penlight, the procedure is performed on both eyes. The corneal reflex should be equal between right and left eyes (see previous explanation) and steady. Any "searching" pattern of the fixating eye requires further evaluation.

4. Acuity measurement is a must for this age group and should include a near and far measurement.

5. Ocular tracking and/or motility is performed in the same manner as previously described.

6. Cover test is again essential as with group one.

7. There should be a fairly extensive evaluation of the fundus at this time.

8. Some evaluation of color vision is desirable at this time. Pseudoisochromatic plates are acceptable. The child who does not yet know their numbers can simply trace over the figure seen with a blunt instrument. Care should be taken to provide the proper type of illumination during the test. The nurse can perform this test.
9. A gross measurement of visual fields should be done. A penlight brought in from the periphery is adequate. Any depression of the periphery must be investigated further. This test can be performed by a nurse and ideally should be done in several meridians.

10. An essential part of the exam at this time is a test for binocularity. This is not simply both eyes pointing in the same direction but rather it is fusion of some object. The investigators prefer the random dot stereogram. Rosner\textsuperscript{9} stated that the random dot E test was as effective at determining visual function as visual acuity, near point of convergence, cover test and retinoscopy combined. The procedure for administering the test comes supplied with the test itself and as such will be included here. The random dot stereogram can be purchased for use in a stereoscopy or hand held, both will work adequately.

Other tests for binocularity are the stereo fly and Worth 4 dot test. The fly is a very good test for pre-schoolers but the Worth 4 dot is not recommended because subtle suppressions are often times missed.

The investigators suggest the purchase of a stereoscopy and a set of pre-schoolers stereograms. Several tests can be performed with this instrument by the nurse and it is probably the single most effective instrument for screening children. The investigators believe however, that a random dot stereogram is an important part of the instrumentation in the Pediatrician's office.
and should be included with the stereoscope. Failure criterion is provided with the instruments.

The tests just presented may appear to be too time consuming for the busy office but with practice the tests can be performed in a matter of minutes. With a penlight the pupillary reflexes, light fixation test, tracking visual fields and some external examination can be done quite rapidly. A cover test, ophthalmoscopy and test for binocularity do require more time but the information obtained is well worth it.

The addition of two tests can expand the scope of the exam but also extends the length of the exam. A retinoscope for the determination of refractive error can add to the exam substantially. The retinoscope head alone is relatively inexpensive and your ophthalmoscope handle provides the power. A method of retinoscopy can be learned from any test on refraction. Also a +1.75 lens test can give valuable information. If the child can clear the acuity chart to his normal level with the +1.75 lens in place this is failure and should be investigated further.

A list of tests, failure criterion, and examiner is provided for convenience (see Tables IV and V). The investigators believe that with practice this routine gives a quick but comprehensive examination of the visual function of the pediatric patient. The investigators also believe that it is a valuable addition to the Pediatrician's routine.
<table>
<thead>
<tr>
<th>TEST</th>
<th>FAILURE</th>
<th>EXAMINER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. External Exam</td>
<td>Left to individual Dr.</td>
<td>Doctor</td>
</tr>
<tr>
<td>2. Pupillary Reflexes</td>
<td>Left to individual Dr.</td>
<td>Nurse</td>
</tr>
<tr>
<td>3. Light Fixation Test</td>
<td>Searching, unequal reflexes</td>
<td>Nurse</td>
</tr>
<tr>
<td>4. Acuities, near &amp; far</td>
<td>Established norms for age</td>
<td>Nurse</td>
</tr>
<tr>
<td>5. Ocular tracking, motility, nearpoint of convergence NPC</td>
<td>Excessive jerky movements, limitations of gaze, NPC &gt; 4&quot; - 5&quot;</td>
<td>Nurse</td>
</tr>
<tr>
<td>6. Cover Test</td>
<td>Any movement on unilateral, &gt; 1.5mm on alternating</td>
<td>Nurse or Doctor</td>
</tr>
<tr>
<td>7. Ophthalmoscopy</td>
<td>Left to individual Dr.</td>
<td>Doctor</td>
</tr>
<tr>
<td>TEST</td>
<td>FAILURE</td>
<td>EXAMINER</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>1. External Exam</td>
<td>Left to individual Dr.</td>
<td>Doctor</td>
</tr>
<tr>
<td>2. Pupillary Reflexes</td>
<td>Left to individual Dr.</td>
<td>Nurse</td>
</tr>
<tr>
<td>3. Light Fixation Test</td>
<td>Searching, unequal reflexes</td>
<td>Nurse</td>
</tr>
<tr>
<td>4. Acuities, near &amp; far</td>
<td>Established norms for age</td>
<td>Nurse</td>
</tr>
<tr>
<td>5. Ocular tracking, motility, nearpoint of convergence NPC</td>
<td>Excessive jerky movements, limitation of gaze, NPC &gt; 4&quot; - 5&quot;</td>
<td>Nurse</td>
</tr>
<tr>
<td>6. Cover test</td>
<td>Any movement on unilateral</td>
<td>Nurse or Doctor</td>
</tr>
<tr>
<td></td>
<td>&gt;1.5mm on alternating</td>
<td></td>
</tr>
<tr>
<td>7. Ophthalmoscopy</td>
<td>Left to individual Dr.</td>
<td>Doctor</td>
</tr>
<tr>
<td>8. Color Vision</td>
<td>Established Norms</td>
<td>Nurse</td>
</tr>
<tr>
<td>9. Confrontation Visual Fields</td>
<td>Established Norms</td>
<td>Nurse</td>
</tr>
<tr>
<td>10. Binocularity Test</td>
<td>Established Test Norms</td>
<td>Nurse</td>
</tr>
</tbody>
</table>
APPENDIX B

LETTER SURVEY
Dear Doctor:

You have been selected to participate in a letter survey as part of a research project. We are sampling Pediatricians and Pediatric residency programs in Oregon, Washington, Idaho, Montana, Utah and California concerning visual examination procedures of the infant and young child. The ultimate goal of the project is to develope a routine for the examination of visual functions of pediatric patients.

It is hoped that this routine could be used by health care practitioners for the early diagnosis of visual impairments. Your response is vital to this project as you are the primary health care provider for the child. The results of this survey will be used in conjunction with literature on the subject and current Optometric and Ophthalmological techniques to construct a quick but thorough visual exam. The results of this letter survey will be kept completely confidential.

We are both fourth year Optometry students at Pacific University and Dr. Stern is our advisor. We sincerely hope you will take the time to fill out the questionnaire and used the self-addressed, stamped envelope to return it to us. Your help is greatly appreciated.

Thank you,

Bill Bogus

Wesley W. Charlton

Norman S. Stern O.D., Ph.D.

Enclosure
When a pediatric patient presents him or herself to you for a routine physical exam what eye examination procedures do you or your staff employ?

<table>
<thead>
<tr>
<th>PLEASE CHECK ONE</th>
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<tbody>
<tr>
<td>NEVER</td>
</tr>
<tr>
<td>0%</td>
</tr>
</tbody>
</table>

1. External exam.
2. Visual acuities
   a. Near
   b. Far
   c. Pinhole Far Acuities
3. Pupillary reflexes
4. Corneal reflex
   a. Monocular Light Fixation
   b. Hirschberg
5. Cover test
   a. Near -- Unilateral, alternating
   b. Far -- Unilateral, alternating
6. Ophthalmoscopy
   a. Mydriatic
   b. Non mydriatic
7. Near Point of Convergence
8. Eye motility
9. Visual fields
   a. Confrontation
   b. Other
10. Retinoscopy
11. Color Vision
12. Intraocular pressure
13. Binocularity
   a. Random Dot Stereogram
   b. Stereo Fly
   c. Worth 4 Dot
   d. A test
   e. Other
14. +1.75 lens test (no decline in far acuity with +1.75 in place)
15. Vision Screener
   a. Orthorater
   b. Telebinocular
16. Other tests you employ:

(over)
17. Comments: _____________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

18. Would you be interested in a copy of our results? YES __________ NO __________

If yes, please indicate name and address where results can be sent:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Please return this questionnaire in the enclosed, stamped, self-addressed envelope.

Thank you.
Space was provided at the end of each survey for remarks or comments. Following are some of the comments made by those Pediatricians completing the surveys:

"Obvisouly depend on age of child...do some of these once (e.g. color vision) if response is normal. Some tests are not done at all by Pediatrician residents because of immediate availability of ophthalmologist (same clinic share facilities)."

"We do screening eye check only."

"I'd be interested in a breakdown of tests performed by specialists within medicine and between disciplines."

"Good luck."

"Eye exam portion of routine exam will very depending on patient's age -- your responses may be difficult to interpret because of this -- i.e. I do fundoscopy on 100% of 10 year olds and 0% of 10 month olds during routine exams."

"Thanks for asking."

"My husband is an Ophthalmologists. No further screening necessary for me."
"I do more allergy than general pediatrics so the above exam may be oriented toward asthma etc. We do complete exams on all these patients on a regular basis."

"What I do depends on patient's age, reason for visit. Newborn - check red reflex if child fixes follows. 1 year - cover, uncover. Older - acuity test. If child comes for check-up exam I don't check eyes."

"My simple screening procedures have proven adequate, in that I have never missed a visual problem, to my knowledge."

"I would be interested in knowing if simple screening procedures are truly adequate."

"I have some difficulty in the questionnaire because difference in age. After 3 years, we always do visual acuity (or try using Snellen chart). Before it we do no test of acuity."

"If screening exam shows problem...refer to an ophthalmologist."

"I just moved to Louisiana to practice -- I was never taught how to check the eyes of pediatric patients and have just gotten by the best I could."

"Patients evaluated are mentally retarded. Many are referred for further eye evaluation."
OTHER TESTS EMPLOYED

Space was provided at the end of the questionnaire for the Pediatrician to list other tests employed during eye examination. Some of those tests listed are as follows:

"Hold pinpoint light source 18" from patient. Patch eye alternately -- when releasing patch, see if eye still "on the beam". E chart vision test -- one eye at a time for any one three eyars. Eight months or over -- at least attempt same."

"Snellen "E" -- but have never been happy with it."

"Snellen."

"Titmus vision tester."
BIBLIOGRAPHY


