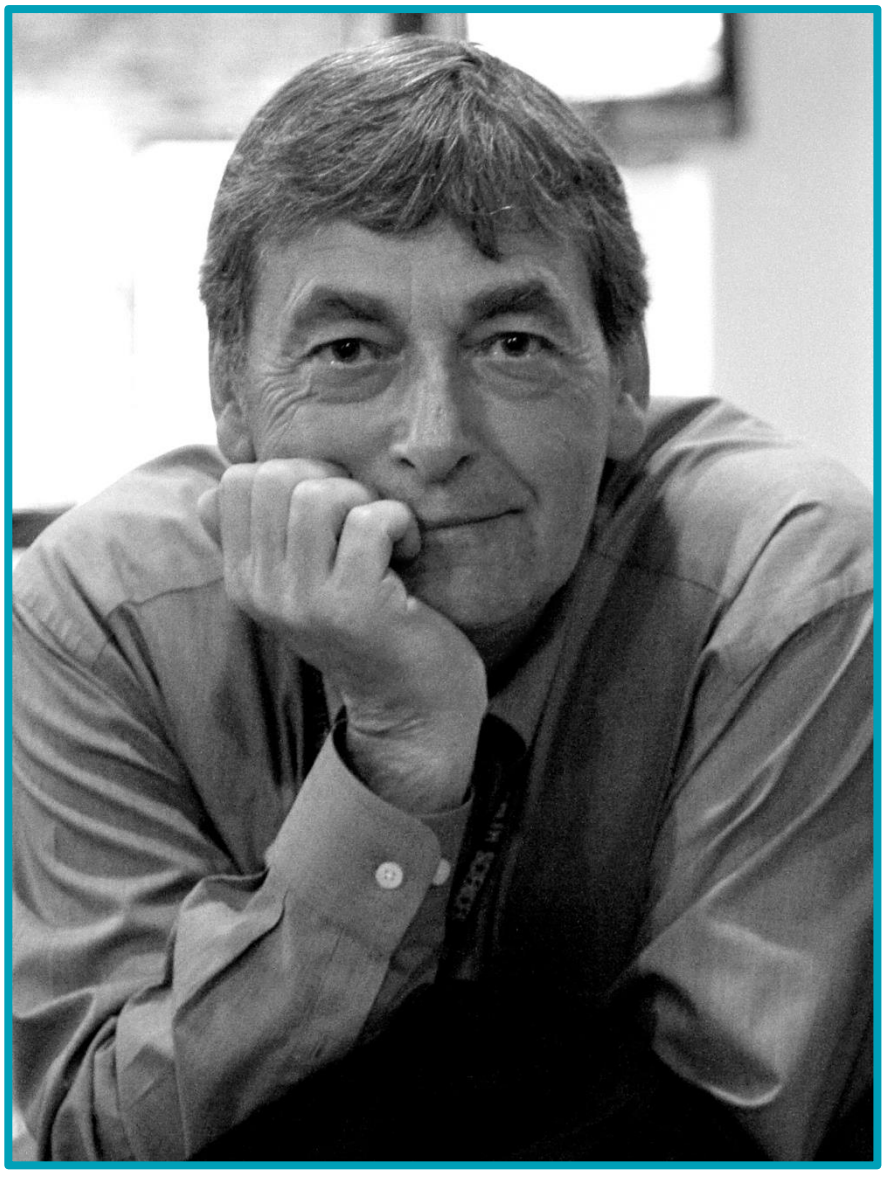
# EYE-MAC
# Annual Report
2018-2019

# Contents

## DEDICATION

This annual report is dedicated to the memory of Dr. Del Harnish, who was one of the greatest supporters of the EYE-MAC project.

He will be deeply missed.



## SECTION 1: VISION SCREENING

### Importance of Vision Screening

In 2010, the World Health Organization (WHO) reported that approximately 19 million children are visually impaired around the world, with 1.4 million being blind.[1] The WHO also reported that 80% of all vision impairment globally is considered to be avoidable or preventable.[2] Periodic vision screening is critical in the detection of visual impairment and is imperative to preventative paediatric health care.[3,4] Poor vision has numerous consequences on the educational and social development of children. 88% of adults with visual impairments claimed to have their educational attainment and career choices directly impacted by their sight.[5] Presence of astigmatism has been associated with reduced academic readiness among preschool children.[6]

Among children, the most common visual disorders include amblyopia (lazy eye), strabismus (cross-eyes), and refractive errors.[7] It is estimated that approximately 2% of children have amblyopia.[8] Amblyopia is a visual disorder that results due to insufficient visual stimulation within the brain during child development leading to reduced monocular or binocular visual acuity in a structurally normal eye.[8] Strabismus occurs when the eyes are misaligned and if left untreated can lead to amblyopia. Refractive errors are visual disorders in which the shape of the eye prevents proper focusing and include conditions such as myopia (near-sightedness) and hyperopia (far-sightedness). Treatment is typically inexpensive and with timely screening these visual disorders can be easily treated or corrected.[7]

Guidelines from both pediatric and ophthalmologic societies agree that screening can begin as early as children aged 3-5 years old.[9] After initial assessment, children should continue to have their vision examined annually throughout adolescence.[3] Children with amblyopia are often asymptomatic and the severity of vision impairment increases with the length of time it remains undiagnosed.[9] Treatment success of amblyopia can be dependent on the time of initiation which further stresses the importance for early detection and screening.[9]

### Gaps in Current Vision Care

Although many provinces in Canada, including Ontario, offer minors free annual comprehensive eye examinations conducted by optometrists, it is estimated that only 14 % of children under the age of 6 years old receive professional eye care in Canada.[10] Rather than universal screening Ontario currently utilizes opportunistic screening, in which parents or teachers must request for an eye examination if they identify a child complaining or showing symptoms of visual deficits.[7] However, this method is flawed as a study demonstrated that many children are unaware of their visual problems.[11] As of July 1, 2018, children enrolled in junior kindergarten in Ontario could participate in the Eye See…Eye Learn program and receive one complementary pair of glasses.[12]

Unfortunately, although Eye See…Eye Learn provides a valuable service the program still relies on parents to recognize the importance of routine eye examinations.

One of the reasons given for the lack of vision screening is that primary physicians are expected to perform some routine vision screenings.[3] A recent study found that only 66% of pediatricians conduct eye examinations on children over the age of three.[13]

Insufficient vision screening within routine medical examinations may be accredited to factors including:[13]

1. Time restrictions
2. Inadequate reimbursement
3. Lack of Training

Effective August, 2018 the Ministry of Health and Long-Term Care established vision screening protocol to provide in-school vision screening services.[14] As of completion of this report, the protocol has yet to be implemented in Hamilton public schools.

## SECTION 2: THE EYE-MAC PROGRAM

### Background of EYE-MAC

The EYE-MAC project aims to implement a vision screening program in schools performed by non-eye care professionals who have received technical training through a multi-step educational program. Vision screening will assess fundamental indicators of eye health, including distance visual acuity (measured using Snellen and Lea charts) and stereoacuity (using the Randot stereotest). The data collected is used to identify children with potential visual impairments and connect them with eye-care professionals to ensure timely intervention and prevent further deterioration of vision. Additionally, screening results are used to evaluate the necessity of vision screening programs in general and the training regimen used through cross-comparisons with optometrist results. The long-term goal of EYE-MAC is widespread implementation of screening programs that would increase utilization of eye-care services where needed, leading to substantial benefits for children's overall health and performance in daily life.

### Overview of the Screening Process

In a typical screening day, two vision screeners will arrive at the beginning of the school day to the front office/reception area. This allows the vision screeners to sign themselves in as visitors, gather class attendance lists, and go to the screening room. Each school was asked to provide a well-lit, quiet, and distraction-free environment. Next, vision screeners set up all equipment, and following all relevant protocol. This procedure includes setting up the M&S system at a distance of 10 ft from the screening chair.

Once setup is complete, one screener acts as the "runner" and escorts children to and from the classroom according to a corresponding attendance list. Any child whose

parents have opted them out of the vision screening process through is crossed off of this list.

The other screener then conducts the visual and stereoacuity tests on each child. Distance visual acuity is measured using Snellen crowded letters or LEA symbols depending on the child's age and literacy ability. One eye is tested at a time while the other is covered with an occluder. The best line in which more than half of the letters or symbols are correctly identified is recorded, along with the number of letters or symbols read correctly on the line afterward. Near stereoacuity is assessed using the Randot Stereotest Booklet. All tests are conducted with the child's existing visual correction (e.g. glasses or contact lenses).

At the end of the school day, the vision screeners pack up the equipment, return the room to original condition, and sign out of the visitors logs. All equipment and data sheets are returned to the McPERG office at the McMaster University Children's Hospital.

The criteria for failing screening are as follows:

1. Visual Acuity:
    a. children aged 4 years old who measure ≥LogMAR 0.3 (20/40) in either eye
    b. children aged ≥5 years old who measure ≥LogMAR 0.2 (20/32) in either eye
    c. children who measure more than one line difference between their visual acuity scores on both eyes
2. Stereoacuity:
    a. children who measure ≥70 seconds of arc

All children who participated in screening received a letter to take home to their parents informing them of the results of their screening. All children, regardless of whether they passed or failed were advised of the importance of regular eye exams by an optometrist. Children who failed were advised to visit their optometrist within the next three months. Chilren whose visual acuity was LogMAR 0.4 (20/50) or worse in either eye were advised to visit an optometrist within one month. In some cases the vision screeners were unable to screen a child. These children's parents were informed that their child had not been screened and were advised to visit an optometrist for a routine exam.

All children received a form for an optometrist to fill out upon examining the child which they could fax to the McPERG office. These results are used to assess the accuracy of the initial vision screening, as well as to get a rough idea of whether children are accessing follow-up through their optometrists.

## SECTION 3: 2018-2019 SCHOOL YEAR RESULTS

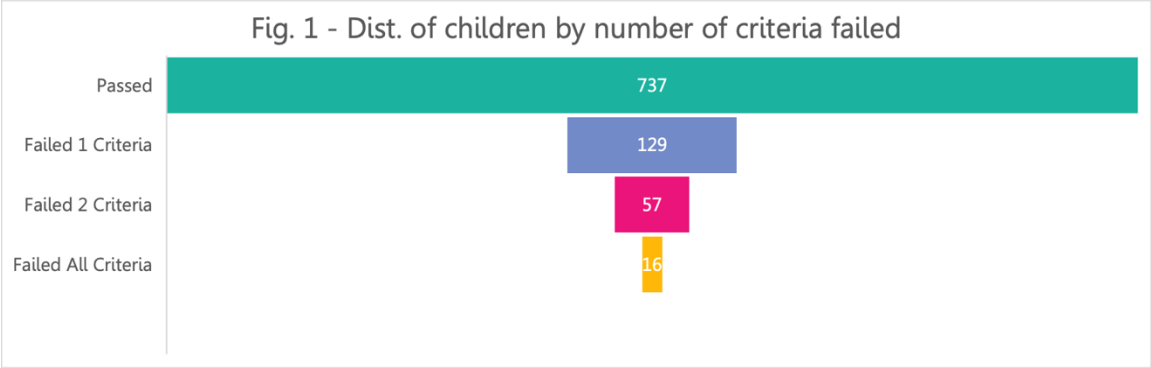
### General Statistics

This year, the EYE-MAC program visited five schools in Hamilton:

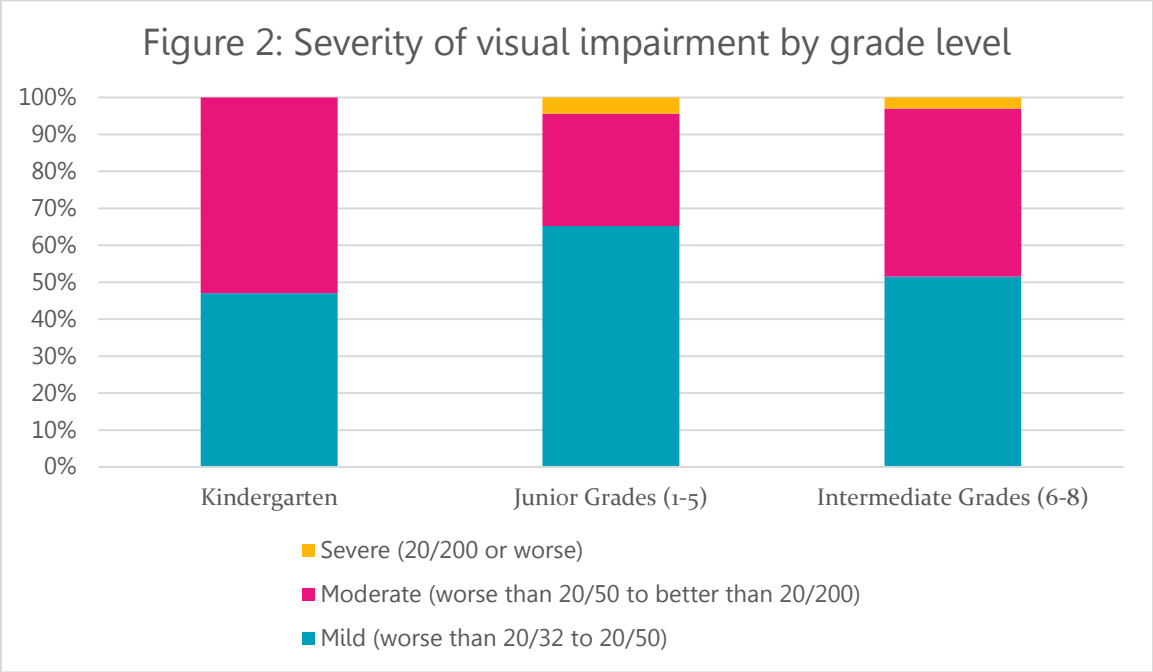
- Canadian Martyrs

- Our Lady of Lourdes
- Immaculate Heart of Mary
- St. Ann (Hamilton)
- St. Michael

In total, 939 children were screened. Of those, 202 (22%) children failed screening: 73 failed the stereoacuity criteria, 107 failed based on visual acuity and 111 failed based on line difference. Since children could fail based on more than one criteria, these numbers add up to more than the total number of children who failed (202). Figure 1 shows the distribution of children by number of criteria failed.




While the average fail rate was 22%, this was not common to all grades. In general, children in Kindergarten tended to fail at a higher rate than other grades. This is partially because younger children have a harder time completing the vision screening process without losing focus, but also could reflect the statistic that 14% of children have had a full eye exam before entering grade 1. While children tended not to pass screening in higher numbers in Kindergarten, JK in particular, grade level did not correlate with the severity of vision problems identified. The distribution of visual impairment identified is shown in Figure 2, which shows the proportion of children (among children who failed based on VA) in each grade group that showed various levels of vision loss.




Visual acuity was measured monocularly, which means that each eye's function was assessed separately from the other. The following table (table 1) shows the distribution of visual acuity in each eye among children who had 20/32 or worse vision in at least one eye. The percentages given in each category reflect the percentage of all students screened.

Table 1: distribution of visual acuity by eye

| Degree of vision loss in better eye | Degree of vision loss in worse eye | | |
|---|---|---|---|
| | Mild (worse than 20/32 to 20/50) | Moderate (worse than 20/50 to better than 20/200) | Severe (20/200 or worse) |
| None (20/32 or better) | 51 (5.4%) | 12 (1.3%) | 2 (0.2%) |
| Mild (worse than 20/32 to 20/50) | 43 (4.6%) | 10 (1.1%) | |
| Moderate (worse than 20/50 to better than 20/200) | | 13 (1.4%) | |
| Severe (worse than 20/200) | | | |

## Feedback from Optometrists

All students who are screened receive, as part of their results letter, a separate form to take to their next optometrist visit. This letter outlines the EYE-MAC program to the optometrist and asks them to fax the results of the child's exam to the program. This data is used to get a general idea of the accuracy, specificity and sensitivity of the screeners on an ongoing basis.

This process has some limitations. Because this phase of the program relies on the voluntary participation of both parents and optometrists, it has a low response rate. Further, responses come in on a scattered timeline, meaning some parents take their children to the optometrist over one year after the vision screening. Finally, there has not yet been a standardized form developed to ask optometrists for specific information, and occasionally the exam summary returned doesn't include relevant information for comparison to a screening. For these reasons, table 2 shows the results received from optometrists since the beginning of the current EYE-MAC program, aggregated into one data set. The responses are fairly evenly distributed over the 2-year span given the number of children screened each year.

Table 2 – Comparison with optometrist exam results for visual acuity only

| | Screener Passed | Screener Failed |
|---|---|---|
| Optometrist Passed | Correct<br>46 | False Positive<br>11 |
| Optometrist Failed | False Negative<br>3 | Correct<br>8 |
| Accuracy Values | • Sensitivity = 94%<br>• Specificity = 42%<br>• Accuracy = 79% | |

It is important to note that we compared the results found by the optometrist exam to those found by the screener on the screening criteria. This doesn't mean that an optometrist necessarily recommended corrective devices to all children who failed screening.

## Cost Analysis

The total cost for school vision screening was $10,340 (all costs listed in CAD). The direct costs include $10,000 for two M&S systems, $40 for two occluders, and $300 for two Randot stereo acuity booklets and $0 for vision screeners. These items were all purchased in previous years and will be reused in future years. With over 5,600 students screened to date, this currently accounts for a per-child cost of less than $2.

The primary ongoing cost is transportation. Over the past screening year, approximately $600 was attributed to transportation in the form of Uber fares, incurred when students needed to attend screening where no bus or private car was readily available. The average cost of each trip was approximately $30 CAD.

Considering there is no cost associated with the volunteer vision screeners, the EYE-MAC program has demonstrated the cost effectiveness of using non-eye care professionals to conduct vision screenings.

### Challenges

While the screeners were taught strategies to promote compliance in children during vision screening, the attention span required to complete the screening tests were found to be difficult for many children, particularly in Kindergarten. Children with developmental delays can also present challenges during screening. Some children were able to use cards to allow them to point to symbols instead of verbally identifying letters. Occasionally an Educational Assistant accompanied the child, which proved useful as they repeated the instructions and helped retain the child's attention. Children who were unable to be screened were noted as needing further examination and given an 'unable to screen' letter. Finally, malingering from students was another potential impediment to the accuracy of the vision test as children may be motivated to downplay their testing performance in order to receive glasses like their fellow peers, or get attention.

In terms of screening environment, the screening room that was provided by the schools not meet the requirements in some instances. Schools have very limited availability of rooms that were available for a full day of screening over many days that met the requirements. Improper lighting and background distractions in these rooms have the potential to impact the screening quality as well as the attention span of the child being screened. This year, there were times when the room provided was too distracting and screening was slowed significantly as a result. Additionally, given the increase in number of screening dates, many snow days and religious holidays conflicted with planned screening dates. While snow days are an unpredictable fact of life in this area, better coordination between McPERG and the schools could potentially alleviate the other challenges listed above.

## SECTION 4: FUTURE OF EYE-MAC

The EYE-MAC project has demonstrated the potential benefits of using non-eyecare professionals to conduct community paediatric vision screening. Namely, that this method of screening could and does detect children with visual abnormalities and bring awareness to parents of the importance of vision screening. Vision screeners have demonstrated accuracy with vision screening and can serve as a cost-effective option for in-school vision screening compared to using paid professionals such as ophthalmologists, optometrists, nurses and/or public health staff.

Furthermore, the findings of this year's vision screenings demonstrate the need for universal vision screening. No matter what the demographics of the school visited by EYE-MAC, the failure rate was between 20-25%. This year, EYE-MAC identified 94 children who had moderate vision loss in at least one eye, and 37 children who had moderate to severe vision loss in at least one eye. Vision screening can ensure that timely care is given to children so that inadequate vision does not impede their potential to learn.

To aid in future vision screening endeavors, and to prevent some of the pitfalls of screening in schools where physical space is already limited, the Eye-Van is currently being outfitted to provide a distraction-free and standardized environment for screening. The use of the Eye-Van would lower the most expensive annual cost of the EYE-MAC program: transportation.

Finally, now that the goal of standardizing the curriculum used to train EYE-MAC volunteers is completed, focus has shifted to making it a for-credit course available at McMaster University. This process is currently underway.

## APPENDICES

### Appendix 1: Visual Acuity Conversion Chart

| Snellen | LogMAR |
|---|---|
| 20/20 | 0.0 |
| 20/25 | 0.1 |
| 20/32 | 0.2 |
| 20/40 | 0.3 |
| 20/50 | 0.4 |
| 20/63 | 0.5 |
| 20/80 | 0.6 |
| 20/100 | 0.7 |
| 20/125 | 0.8 |
| 20/160 | 0.9 |
| 20/200 | 1.0 |
| 20/400 | 1.3 |

### Appendix 2: 2018/2019 Participating Schools

- Canadian Martyrs C.E.S
- Our Lady of Lourdes C.E.S
- Immaculate Heart of Mary C.E.S
- St. Ann (Hamilton) C.E.S
- St.  Michael C.E.S

## ACKNOWLEDGEMENTS

We would like to thank the following people for their support with the EYE-MAC project:

*Optometrists:*

Dr. Kevin Ahokas
Dr. Charlie Alfano
Dr. Anukool Chadda
Dr. Aman Dhaliwal
Dr. Melanie Fox-Chen
Dr. Camilo Garzon
Dr. Kathleen Hill
Dr. Betty Johnson
Dr. Priya Maharas
Dr. Christine Misener
Dr. Amy Reid
Dr. Todd Ruhl
Dr. Daina Sanderson
Dr. Jasjeet Singh
Dr. Vikram Singh
Dr. Robert Stodulka
Dr. Laura Thomas
Dr. Casthoory Viswanathan

*2018-2019 Volunteer Vision Screeners*

Natalia Blaszczyk
Behrad Garmsiri
Ava Harris
Reza Khorvash
Brittany Lau
Asma Maqsood
Andrew Nguyen
Emilyanne Stocks
Raymond Su
Monica Takahashi
Emily Yang

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Natalie Fleming (McPERG Clinical Research Assistant)

*HWDCSB Staff*

Dr. Clinton Davis (Chair, Research Advisory Committee, HWDCSB)

*McMaster University Staff*

Dr. Stacey Ritz (Assistant Dean, BHSc Program)
Dr. Ilana Bayer (Director of The Learning Technologies)

*Hospital Staff*

Dr. David Higgins (President, St. Joseph's Healthcare Hamilton)
Eithna Ganguli (Orthoptist)
Alanna Reekie (Ophthalmology Technician)
Michele Ceranic (Child Life Specialist)
Kate Sutherland (Child Life Specialist)
George Boyes (Bioengineer)

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