Weighing in on Canadian school-based vision screening: A call for action

Katie P. Bennett, BSc(Hons), MPH,¹ Wendy Maloney, MN, RN²

ABSTRACT

Vision-screening programs are designed to detect common causes of visual impairment and increase the likelihood of early diagnosis and treatment. In the health authority Eastern Health – Newfoundland and Labrador, public health leaders raised a concern about the efficiency and effectiveness of the current non-routine, opportunistic vision screening protocol for school-aged children. An environmental scan of screening practices and programs across Canada was conducted, yielding a wide range of inconsistencies with respect to program type, target population, and screening tools. A significant gap in evidence-based research into universal vision-screening programs for the school-aged population (6+) was also noted. In light of these findings (both in practice and research), we recommend that researchers and public health practitioners across the country evaluate their current practice with respect to school-based vision screening and disseminate their findings through publication. We conclude that evaluation and research into current school-based screening programs (both opportunistic and universal) will provide the evidence needed to guide practice.

KEY WORDS: Vision screening; public health surveillance; school health services; strabismus; child health

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Screening is a process used to quickly, efficiently and accurately determine whether a certain health concern may be present before the onset of clinical manifestation.^{1,2} In its simplest form, screening can distinguish or identify those within a population or subgroup who would benefit from further assessment.² The World Health Organization outlines criteria for screening;³ the overall aim of vision screening is to detect common causes of visual impairment.⁴

In developed, higher-income countries, refractive errors (a change in visual acuity) and strabismus (misalignment of the eye, predisposing to difficulties in depth perception) represent the most common causes of visual impairment.³ These two conditions are risk factors for a condition called amblyopia, which manifests itself as decreased visual acuity in the first six years of the child's life and persists throughout life.^{2,5} While refractive errors can be treated with corrective lenses, amblyopia within developed countries is the leading cause of single-eye blindness in people aged 20–70.⁵

Pan Canadian vision screening practices

Vision screening provides a quick and non-invasive means of identifying the characteristics of common childhood vision problems so that further assessment can occur. Ideally, screening increases the likelihood of early diagnosis and treatment for an individual.⁴ Vision screening programs are generally categorized as universal or non-routine (opportunistic). Universal screening takes the approach of equality and equity: children are screened for visual abnormalities regardless of their financial situation, accessibility, or other extrinsic factors.⁴ Opportunistic vision screening is carried out when a need is identified, such as when a child states that he or she cannot see the board clearly. Current recommended practice across Canada is varied: while some

provinces, including Manitoba and Nova Scotia, provide public, universal vision screening, the majority of provinces conduct only opportunistic screening (Table 1). Furthermore, there is a divide between provinces and territories with respect to public screening through the school system, for example, and private screening through programs such as *Eye See Eye Learn* (Table 1).

Benefits and challenges of universal vision screening

An environmental scan of screening practices and programs across Canada was conducted. During this initial investigation period, the benefits and challenges of universal vision screening were tabulated according to the current literature on universal vision screening for school-aged (6+) populations. While this list is not exhaustive, it mirrors the main trends gathered so far on this group.

BENEFITS

One of the more robust benefits of universal screening in school-based populations is the reduction of barriers to follow-up and treatment. The school environment provides a common location at which all children can be screened and followed by the same program, whether that program is public or private. In one case, screening of children for refractive errors, conducted at the

Author Affiliations

1. Faculty of Medicine, Memorial University of Newfoundland, St. John's, NL

2. Eastern Health, Manager of Public Health – Peninsulas, Bonavista, NL

Correspondence: Wendy Maloney, Manager of PH – Peninsulas, P.O. Box 278, Bonavista, NL A0C 1B0, Tel: 709-468-2007, E-mail: Wendy.Maloney@easternhealth.ca

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Vision screening programs in Canadian provinces and territories

territory	Screening program (universal or targeted)	Age screened	Screening tools and/or conditions screened for	Screening p
Alberta	Goal: Universal screening for age 3 Current practice: Universal screening for kindergarten ⁶ and 3-year-olds (pilot studies)	Preschool Kindergarten (age 4–5) on a yearly basis ⁶	1. The SureSight Vision Screener® • Tests refractive error - In combination with - Randot Preschool Stereotest • Assesses stereopsis (amblyopia and strabismus) OR 2. HOTV vision chart - In combination with - Randot Preschool Stereotest ⁶	Public health sta
	Opportunistic screening; primary care, optometry, Eye See ... Eye Learn® (ESEL) program ^{7,8}	Primary care: Well-child visits, aged 1–5 ⁷ ESEL: Kindergarten (aged 4–5) ^{7,8}	Commonly used ⁷ 1. Red reflex 2. Cornea light reflection 3. Fundoscopic examination 4. Vision testing methods - LogMAR LH - HOTV chart - LogMAR Snellen chart - Allen chart	Physicians Optometrists
	Opportunistic screening; “Participe pour voir” (“Join and See”) ⁹	Elementary (10–12 years)	La Fondation des maladies de l’oeil in collaboration with l’Ordre des optométristes choose four screening tools plus any necessary tests ⁹ N/A	Optometrists
	Opportunistic screening; ESEL program ^{8,10} Preschool check-ups; annual vision testing through Alberta Health Services recommended ¹² Universal school-based program ¹²	Kindergarten (ESEL) ¹⁰ Preschool (3–5 years) ¹¹ Kindergarten, grade 1 ¹² Also offered to grade 3 and above ¹²	The Random Dot E Test ¹² - Kindergarten and grade 1 only (K-1) Insta-Line tests (K-1) - Test no. 1 – myopia (visual acuity) Test no. 2 – hyperopia (+2.25 lens) ¹² Insta-Line tests (grade 3+) - Test no. 1 – Hyperopia - Test no. 2 – Myopia Biopter tests (all grades) ¹² - Uses 3 circle target cards - Vertical phoria (at far), lateral phoria (near + far) ¹² Second screening on students who received failure on first screening N/A	Optometrists Trained school volunteers ¹³
British Columbia	Opportunistic screening; ESEL ¹⁴	Pre-kindergarten, kindergarten, grade 1 ¹⁴	N/A	The Saskatchewan Association of C volunteers Public health
	Universal screening for children entering kindergarten ¹⁵	Preschool/kindergarten entry (age 4–5)	Visual acuity, stereopsis ⁵	Public health
Manitoba	Opportunistic screening; Vitalité Health Network ¹⁶ and Healthy Smiles, Clear Vision program ¹⁷	Vitalité Health Network ¹⁶ – 3.5 years of age Healthy Smiles, Clear Vision: 0–18 years of age 3–4 years (PSHC)	Visual inspection of eye Visual acuity, stereopsis ⁵	Public health
Ontario	Comprehensive screening; Preschool Health Check (PSHC), ¹⁸ non-routine screening on kindergarten students who did not receive PSHC ¹⁹	3–4 years (PSHC)	- Sheridan-Gardiner cards - Titmus Vision Screener - Occluder/glasses/patch - Testing for eye alignment, motility and visual acuity ⁵	Public health

Table 1. (Continued)

Province/territory	Screening program (universal or targeted)	Age screened	Screening tools and/or conditions screened for	Screening personnel
Prince Edward Island	Opportunistic/comprehensive screening; pre-school health clinics; ²⁰ Eye See Eye Learn ²¹	3–4 years; ²⁰ 4–5 years ²⁰	<ul style="list-style-type: none"> - Parent questionnaire - External examination of the eye - Light response - Strabismus inspection via alignment - Corneal light reflex - Cover/uncover test - Stereopsis - Distance visual acuity⁵ 	Public health; ²⁰ optometrists
Northwest Territories	Comprehensive school-based screening ²²	Preschool/kindergarten entry (4–5 years) ²²	Visual acuity	Public health
Yukon	School-based screening (rural) ²³	N/A	<ul style="list-style-type: none"> - Eye motility - Visual acuity - Stereopsis³ 	Public health ²³
Nunavut	Opportunistic screening ²⁴	Pre-kindergarten (4–5 years) ²⁴	N/A	Public health ²⁴
N/A = not available.				

community level and integrated into school health programs, helped remove barriers to further follow-up and treatment.²⁵ Recognizing that some barriers, including the socio-economic status and financial capability of caregivers, may still affect timely follow-up,^{25–27} school-based programs could make use of this information when designing, implementing, and evaluating school-based vision-screening programs. Specific ways to mitigate or alleviate the costs associated with follow-up and low socio-economic status could be implemented in the form of government, non-governmental organization or health authority subsidization.

While school-based vision screening can bring to light concerns about timely treatment, other findings have suggested that screening too early can increase the number of false-positive referrals (those that do not have a visual defect but are deemed to have one upon visual screening).² This could have important implications for establishing best practice guidelines for universal vision screening, such that the potential for screening too early (i.e., before school aged) may increase true cases before they are more difficult to treat or prevent, such as amblyopic cases. In addition, it is possible that universal vision-screening programs in school-aged children can improve the detection of visual defects particularly in the high-school population. One peer review article found that 93% of junior high students (grades 7–9) did not recognize they had refractive errors.²⁸ In this case, a universal vision-screening program could increase the likelihood of timely follow-up and effective treatment. Other studies have suggested that screening in school achieves a higher coverage because of the “captive” population (attendance).^{29,30} This in itself could improve detection rates since currently only those over age five who have expressed verbally or behaviourally the signs of potential visual difficulties (i.e., squinting to see the board, blurry vision) or those identified as having learning exceptionalities are screened.

CHALLENGES

Likely the most significant consideration with regard to universal vision screening in school-aged (6+) populations is timely treatment – that is, finding a balance between screening too early and too late. For example, children who enter school with decreased visual acuity at age 4–5 have reduced literary and academic capabilities.³¹ For amblyopia, screening at ages 4, 5, 7, and 10 has indicated that visual pathology was, indeed, detected at age 4, and this detection may have positively contributed in the early treatment of the condition, before progression throughout the child’s life.³² In this case, it is important to consider the harms associated with later screening and the potential irreversible nature of more severe conditions, such as amblyopia, leading to the possibility of reduced academic and learner capabilities. Many visual difficulties, including refractive errors, are often unnoticed by students, and providing an environment in which everyone is screened may increase detection and follow-up rates.²⁸

In addition to timely treatment, psychosocial issues, particularly lower self-reported self-esteem, may arise in children who have been found through school-based universal screening to have a positive screen.¹

A snapshot: Regional issues

Within the landscape of our own health authority, three key issues were identified regarding the current vision-screening practice,

Table 2. Benefits to universal vision screening

Benefits to universal vision screening	Comments/interpretation
<p>Myopia was found to be linked with older age, being female, and having parents with higher education. Corrective lenses were needed for 23% of youth aged 6–14, 11% were unaware they needed glasses. Amblyopia was found in almost 3% of youth.³³ Age-dependent increase in the prevalence of myopia³⁴</p>	<p>Universal screening programs focused on school-aged children are essential for detecting and treating refractive errors or amblyopia. For lower socio-economic settings, universal school-based programs may provide better catchment to everyone.</p>
<p>Vision screening undertaken at an earlier age can have a higher false-referral rate.³⁵ Of students aged 12, 93% were unaware they had refractive errors.²⁸</p>	<p>This finding indicates that universal screening could be beneficial in school-aged children, as myopia increases with age. By implementing universal programs, more individuals can be screened and cases found than in a non-routine referral program. This indicates that over-referral can lead to an excess use of existing resources in the early age groups (5 and under).</p>
<p>Of grades 1, 3, and 5, 8% had abnormal eye screens, 78% had hyperopia and myopia combined.³⁶</p>	<p>This indicates that a large proportion of children may not state that they are having vision problems, which means they or their teachers or parents will not make a referral for screening. Universal screening could solve this issue by screening everyone, not just those who report a difficulty. Screening in this study led to 3 cases for every 100 children screened. By having high-quality school-based vision screening, youth receive adequate detection and treatment of visual defects.</p>
<p>Screening for refractive errors in school health programs, if done with awareness campaigns, could decrease or remove barriers to follow up and/or treatment.¹</p>	<p>If the appropriate health promotion campaigns are produced in conjunction with school-based screening, proper treatment and follow-up for eye conditions may improve.</p>
Challenges of universal vision screening	Comments/interpretation
<p>Decreased visual acuity upon school entry (age 4–5 years) is associated with reduced literacy capabilities.³¹</p>	<p>If universal screening programs were established for school-aged children (6+), this could compromise how long a child may go with decreased literacy secondary to visual defects. This may have future implications for educational health and social outcomes.</p>
<p>In a study examining children aged 3–32, those with amblyopia or recovered amblyopia from childhood were not found to have difficulties in childhood motor development, teenage self-esteem, or low adult socio-economic status.³⁷</p>	<p>While future studies are needed to examine the lifetime risk of visual impairment in both eyes from amblyopia, implementing universal vision screening to detect conditions like amblyopia, according to this study, would not seem to decrease the likelihood of children having functional impairments related to amblyopia. If universal screening were conducted on school-aged children, timely treatment of conditions like amblyopia or poor visual acuity may not provide the best treatment possible, as treatment becomes less successful as age increases.</p>
<p>Timely treatment (before the age of 6) is the greatest benefit to children suffering from more severe forms of amblyopia. This decreases the risk of losing visual function in both eyes later in life.³⁸ While a one-year delay in treatment for amblyopia does not affect children under 5 years, for children over the age of 5, early treatment does indicate better outcomes.³⁸ Compared with peers of the same age, there was reduced self-esteem reported by youth aged 10–12 who had undergone amblyopia treatment detected through screening.³⁸ Uncorrected hyperopia and visual dysfunction in both eyes are associated with a reduced academic capability.³⁹</p>	<p>Universal screening programs targeted at ages 6+ may not be as beneficial as screening programs targeted at 5 and under for amblyopia prevention and treatment. If amblyopia is a component of screening (usually by testing visual acuity), the long-term psychosocial outcomes of the child need to be considered, such as stigma and self-esteem. By conducting screening at a later age (6+), children and youth may experience academic and learning difficulties due to lack of corrected vision the longer the defect goes undetected. The prevalence of RE varies widely, and because of a lack of prevalence data for Newfoundland and Labrador it is hard to estimate at this moment if school-based screening is cost-effective. Available prevalence data for Newfoundland and Labrador are only available for hyperopia: 4.8% in 2008.²⁴ However, these data were collected from a population with an average age of 4.2 years, which may indicate that early screening is beneficial compared with school-aged screening.</p>
<p>In areas where there is a high prevalence of refractive errors (RE), school-based screening programs may be cost-effective⁴⁰</p>	<p>This finding demonstrates that many visual abnormalities are detected early on (5 and under) and that screening during school age does not significantly identify more cases than screening at 5 and under. Screening at a later age does not seem to be significantly associated with increased detection or treatment.</p>
<p>In children who were detected as having visual abnormalities at 5 years of age or younger, few new cases of visual pathology and/or difficulties were detected upon screening in junior high.³² Screening at the age of 4 or younger decreased the prevalence of amblyopia as a result of timely detection and treatment. When comparing screens from infancy, age 4, 5, 7, and 10, visual pathology was generally detected at 4 years or younger.⁴¹</p>	<p>This finding demonstrates that many visual abnormalities are detected early on (5 and under) and that screening during school age does not significantly identify more cases than screening at 5 and under. Screening at a later age does not seem to be significantly associated with increased detection or treatment.</p>

ultimately leading to the examination of whether universal school-based vision screening should be adopted: 1) screening initiation; 2) assigning pass/fail determinations based on initial screening tests with a *Titmus* vision screen machine; and 3) age of screening. We include these regional issues here as discussion points to help establish a case for evaluation and dissemination of best practice components for school-based vision screening, given the aforementioned information concerning the current pan-Canadian state of vision screening practices.

Screening Initiation

Public health nurses within the health authority screen school-aged children by referral (opportunistic screening), meaning that

school-aged children are screened after a referral has been made, typically by a teacher. Most school-aged children who are referred will have verbally expressed difficulties with vision or will have demonstrated observable signs of visual deficit (i.e., squinting to see the board, complaints of blurry letters). Because current screening protocols only screen for visual acuity, this referral is arguably redundant: the child's verbal or behavioural expression of difficulties indicates the probability of a visual defect or complaint. As such, this could be considered a screen in and of itself. Since the visual acuity screen would not provide new information; the child should be referred to and assessed by a vision care professional. This scenario is redundant, provides no benefit to the child and contributes to poor utilization of time and human resources.

Pass/Fail Determination

Children who are placed (or are being placed) in groups using alternative curricula within the school systems are routinely referred to public health nurses for vision screening. The intent of this screening is to rule out vision problems as potential contributors to identified learning difficulties and exceptionalities. The risk inherent in this practice, we argue, is that passing a visual acuity screen does not necessarily mean vision issues are not present. Public health nurses screen for visual acuity only – the scope of screening is in no way a comprehensive visual assessment nor is it a diagnostic test. Children may continue to go on to have undetected visual difficulties that could further compromise their learning abilities and potentially lead to difficulties later in life.

Age of Screening

At what age is screening most effective? Currently, there seems to be a lack of consistency in the current approach. Across Canadian provinces and territories, a wide range of screening programs and practices exist, with very little consistency with respect to target age groups and type of screening (universal or opportunistic; Table 2). With the exception of Manitoba and Quebec, interventions are targeted largely at children aged five and under. Recent evidence-based public health approaches have not been conducted to determine at which school age universal vision-screening programs are most effective, yet this evidence is needed to make informed population health and cost-effectiveness decisions.

FUTURE DIRECTIONS

Recommendation for researchers and practitioners

With the inconsistencies, lack of consensus, and little research on the effectiveness of universal vision-screening programs for school-aged children, there is insufficient evidence to recommend universal vision screening in school-aged children within the health authority, a trend that is mirrored across the country, according to the lack of primary research in the area. While there is evidence to suggest that universal vision screening benefits children aged five and under, lack of robust primary research within the school-aged population has allowed vision practices across Canada to fall into practice silos. We hope that in our attempt to shed light on the practice in this region, practitioners and researchers will actively engage in research, evaluation, and dissemination of information on school-based screening programs.

Going forward, evidence-informed best practice is needed, as it will serve as a guide for streamlined and effective practice across all regions. Collaboration of this nature will contribute to narrowing the existing gap concerning universal vision screening within school-aged populations while simultaneously informing evidence-based best practice for these populations.

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RÉSUMÉ

Les programmes de dépistage visuel visent à détecter les causes courantes de déficience visuelle et à accroître les probabilités de diagnostic précoce et de traitement. Les responsables de la santé publique de l'autorité sanitaire Eastern Health de Terre-Neuve-et-Labrador ont exprimé des réserves quant à l'efficacité et à l'efficacité de leur protocole actuel de dépistage visuel chez les enfants d'âge scolaire, qui est opportuniste et non systématique. Une analyse environnementale des pratiques et des programmes de dépistage a été menée à l'échelle du Canada; elle a mis au jour de nombreuses disparités en ce qui a trait aux types de programmes, à la population cible et aux outils de dépistage. Un écart important dans les études factuelles portant sur les programmes de dépistage visuel universels dans la population d'âge scolaire (6 ans et plus) a aussi été noté. À la lumière de ces constatations (dans la pratique comme dans la recherche), nous recommandons aux chercheurs et aux praticiens de la santé publique du pays d'évaluer leurs pratiques actuelles de dépistage visuel en milieu scolaire et de diffuser leurs constatations en les publiant. Nous concluons que l'évaluation et la recherche sur les programmes actuels de dépistage en milieu scolaire (qu'ils soient opportunistes ou universels) fourniront les données probantes nécessaires pour guider les pratiques.

MOTS CLÉS : Dépistage visuel; surveillance de la santé publique; services de santé scolaire; strabisme; santé de l'enfant