



# An Evidence-Based Guideline for the Frequency of Optometric Eye Examinations

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## Abstract

**Background:** Visual impairment has been recognized as a global health problem. Periodic optometric eye examinations have long been recognized as the “backbone” of strategies to prevent vision loss and blindness. The purpose of this study was to develop a frequency of eye examinations guideline for typical optometric eye examinations in Canada using the best available evidence.

**Methods:** Guideline development involved: (1) an online search to identify existing evidence-based eye examination guidelines; (2) a literature review to identify studies investigating eye examination frequency and visual outcomes, and eye disease and refractive error epidemiology; (3) critical evaluation of the available evidence; (4) development of a draft guideline; (5) a workshop for optometric experts to appraise (and revise, where necessary) the draft guideline; and (6) an external review of the guideline by optometric patients and experts. The AGREE II Instrument and the RAND/UCLA Appropriateness Method were used to guide the development process.

**Results:** Through synthesis of the literature review, expert workshop, and external review, the following guideline is recommended: infants and toddlers should undergo their first eye examination between the ages of 6 and 9 months; preschool children should undergo at least one eye examination between the ages of 2 and 5 years; school children aged 6 to 19 years should undergo an eye examination annually; adults aged 20 to 39 years should undergo an eye examination every 2 to 3 years; adults aged 40 to 64 years should undergo an eye examination every 2 years, and; adults aged 65 years or older should undergo an eye examination annually.

**Conclusion:** The purpose of this guideline is to inform individuals who are either asymptomatic or have symptoms they do not recognize as being eye-related. Therefore, this guideline is meant to aid in the early detection of visual disorders in order to prevent or reduce future vision loss.

**Keywords:** Optometry; Clinical practice guideline; Primary prevention; Eye diseases; Evidence-based healthcare

## Introduction

Visual impairment, which includes both low vision and blindness, has been recognized as a global health problem [1]. The World Health Organization (WHO) defines visual impairment (moderate to severe) as presenting visual acuity worse than 20/60 to 20/400 in the better-seeing eye, and blindness as presenting visual acuity worse than 20/400 in the better-seeing eye [2]. In 2011, 285 million individuals were visually impaired worldwide [3]. While most affected individuals reside in developing countries [1], vision loss is still a significant issue in developed countries, including Canada [4]. In 2006, over 270,000 Canadians were visually impaired, with 108,000 of those being legally blind. By 2031, these numbers are projected to increase to 560,000 and 215,000, respectively [4]. It is well established that the prevalence of visual impairment increases with older age [5,6]. Specifically, population aging has been recognized as the single greatest factor responsible for the increasing prevalence of vision loss in Canada [4].

Periodic optometric eye examinations have long been recognized as the “backbone” of strategies to prevent vision loss and blindness [4]. An optometric eye examination is a comprehensive assessment of an individual’s visual ability, vision and eye health [7] and is considered the “gold standard” in the early detection of visual problems. While the specific tests included in this examination may vary according to an individual’s age or specific needs, the fundamental elements of the examination remain consistent across Canada and include: 1) Relevant history (ocular medical history, past medical history, family history); 2) Visual acuity examination; 3) Ocular motility examination; 4) Refraction and the provision of a written refractive prescription if required; 5) Slit lamp examination of the anterior segment; 6) Ophthalmoscopy by one

or more of direct, binocular indirect ophthalmoscope (BIO), monocular indirect ophthalmoscope (MIO) or non-contact fundus lens; and 7) Advice and/or instruction to the patient [7]. This is in comparison to vision screening which is, “A relatively short examination that can indicate the presence of a vision problem or a potential vision problem. A vision screening cannot diagnose exactly what is wrong with your eyes; instead, it can indicate that you should make an appointment with an ophthalmologist or optometrist for a more comprehensive eye examination” [8]. An optometric eye examination, as opposed to vision screening, is the recommended method to prevent, detect, and manage visual impairment as vision screening tests, such as those used in various preschool vision screening programs across Canada for example, tend to vary in their sensitivity and specificity, and no single test or group of tests have been shown to be superior for vision screening [9].

To date, there has been little consensus on the most appropriate frequency of optometric eye examinations. In 2007, the Canadian Ophthalmological Society (COS) published a clinical practice guideline for periodic eye examinations in adults aged 19 to 64 years in Canada,

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based on their review of available evidence and expert consensus [10]. While this document highlighted important steps in establishing evidence-based guidelines, further research was warranted.

The aim of the current study was to develop a guideline with a specific focus on typical optometric eye examinations, as defined by the Canadian Association of Optometrists (CAO), for individuals across the age spectrum in Canada. The purpose of this guideline is to inform individuals who are either asymptomatic or who may have symptoms they do not recognize as being eye-related. Therefore, this guideline is meant to aid in the early detection of visual disorders in order to prevent, reduce, or manage future vision loss.

## Materials and Methods

### Guideline development

The guideline was developed through a series of steps. Step one involved an internet search to identify all existing eye examination guidelines (February to March, 2009). This search focused on countries with similar optometric education and practice standards to Canada including Australia, New Zealand, Great Britain and the United States. Search terms included: eye exam frequency recommendations, standards of practice, guidelines to standards of practice, preventive care, clinical practice guidelines, preferred practice patterns or any variation of these terms. No additional evidence-based guidelines were uncovered through this review.

Step two involved an extensive literature review to identify articles related to the five major causes of visual impairment or loss (March to October, 2009); search strategies were designed for screening, prognosis/course of disease or condition, prevention, and the economic benefit of screening or the cost/impact of not screening (Appendix A). A total of 10,943 relevant articles were identified through this review, of which 588 were accepted (Figure 1).

Step three involved charting the accepted articles (N = 588) into a preset data extraction form [11]; each charted article was judged on evidence quality. Studies selected as evidence to develop the draft guideline recommendations included controlled trials and well-conducted population-based studies that examined visual acuity as an

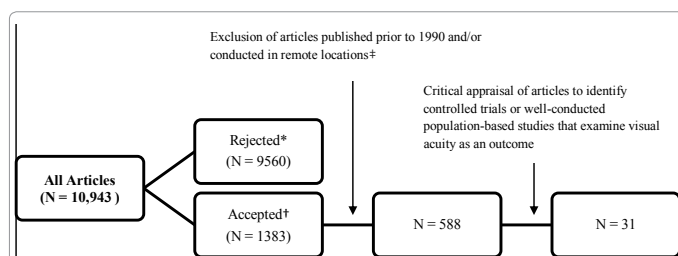
outcome (N=31; Appendix B). To provide a 'grade of evidence' [12] for each of the 31 articles, three raters (BR, PS, and KM) independently reviewed the evidence. Where consensus was not reached on a grade of evidence, a subsequent discussion ensued between the raters until it was achieved. The final product of this step included development of a draft guideline (Figure 1).

Step four involved an expert workshop with 14 optometrists and one specialist in the field of eye disease epidemiology, from across Canada. Most invitees were also attending an Optometric Leaders Forum being held in parallel with the workshop (January, 2011), enabling the participation of a geographically representative group of leading optometrists at a reasonable cost. The purpose of the workshop was to discuss and rate the appropriateness of the draft guideline and to reach consensus on eye examination recommendations for each age group using both evidence from the literature and the expert panel's clinical experience. The panel was also responsible for reaching consensus in areas where evidence was limited.

The AGREE II Instrument [13] and the RAND/UCLA Appropriateness Method [14] were used to guide the workshop process. The AGREE II instrument was used to provide a framework for assessing the quality of the clinical practice guideline. The AGREE II instrument contains six domains and 23 items; the workshop focused specifically on item ten [13]. The RAND/UCLA Appropriateness Method has been well described and employs the use of a formal voting system to reach consensus [14]. At the workshop, participants electronically voted on the appropriateness of each age group recommendation using a 9-point scale, where 1 = expected harms greatly outweigh the expected benefits, 5 = the harms and benefits are about equal, and 9 = expected benefits greatly outweigh the expected harms. Harm was defined as per the workshop participants and included: the eye exam itself; eye disease or refractive error is not detected; patient develops eye disease or refractive errors; impact on quality of life and productivity; and cost to society. Consensus was reached when the median of the voting result was seven or higher.

The final step involved an external review of the guideline (June to August, 2011), which satisfied items five and 13 of the AGREE II instrument [13]. For item five, the guideline was externally reviewed by optometric patients – the target population. Participants (both patients and non-patients) were recruited at the University of Waterloo Optometry Clinic through a convenience sampling approach to complete a questionnaire. Patients included individuals aged 18 years or older who were attending the clinic for an optometric examination; non-patients included individuals who were at the clinic because their dependent was receiving an optometric examination. The questions examined: guideline understanding and adherence, barriers to guideline adherence, and guideline education and promotion. Ethics clearance was granted from the University of Waterloo prior to data collection.

For item 13, the guideline was externally reviewed by a panel of clinical experts including ophthalmologists, optometrists, ophthalmic epidemiologists, general practitioners and academic professors, who had not attended the workshop in January, 2011. Feedback was obtained through an online questionnaire. The questions examined: guideline appropriateness, the guideline development process, concerns surrounding the guideline, barriers and facilitators to implementation. Specific demographic characteristics were not collected to maintain anonymity.



\*Exclusion criteria: the article was published prior to 1980; article did not contain original data, statistical analysis, and/or results; focus of the article was on a specific diagnostic tool; article heavily focused on treatment; article only discussed extremely rare conditions, and; focus of the article was on outcomes not related to the eye.

† Inclusion criteria: focus of article was frequency of eye examinations and visual outcomes, epidemiology of eye disease with an emphasis on natural history, and epidemiology and natural history of refractive errors; articles from both traditional and nontraditional journals were included; article had longitudinal methods that focus on detection, prognosis and/or epidemiology of eye disease (preferred), and; the article was published in English.

‡ Initially, all articles published prior to 1980 were rejected. Subsequently, articles published before 1990 and/or that were conducted in remote locations (e.g., Jordan) were also excluded in order to yield a manageable number for review

Figure 1: Sorting of articles identified in step two.

Age Group*	Recommendation†	Grade of Evidence‡	Supporting Evidence
Infants and Toddlers (Birth to 24 months)	Infants and toddlers should undergo their first eye examination between the ages of 6 and 9 months.	1	[15-19]
Preschool Children (2 to 5 years)	Preschool children should undergo at least one eye examination between the ages of 2 and 5 years.	2	[15,20,21]
School Age Children (6 to 19 years)	School children aged 6 to 19 years should undergo an eye examination annually.	2	[22-25]
Adults (20 to 39 years)	Adults aged 20 to 39 years should undergo an eye examination every 2 to 3 years.	3	[26,27]
Adults (40 to 64 years)	Adults aged 40 to 64 years should undergo an eye examination every 2 years.	1	[28-41]
Adults (65 years or older)	Adults aged 65 years or older should undergo an eye examination annually.	1	[5,6,32,37, 41-44]

\* The age group parameters selected for the guideline are based on those utilized by the Canadian Association of Optometrists (CAO).

†Guidelines are not appropriate for all clinical situations. The decision to follow or not follow the guideline must be made by the health professional on an individual basis, taking into account the specific condition of the patient. Deviations from guidelines for specific reasons are possible [45].

‡Where 1 = good evidence, 2 = fair evidence and 3 = poor evidence [12]

**Table 1:** Final guideline for the frequency of typical optometric eye examinations in Canada.

## Results

The evidence-based guideline for the frequency of typical optometric eye examinations in Canada developed through synthesis of the literature and finalized during the expert workshop and external review is provided in table 1. The grades of evidence assigned to each recommendation, as well as the literature used to develop and support the guideline are also provided in table 1 [15-45].

### Draft guideline development and the expert workshop

A total of 31 controlled trials and well-conducted population-based studies that examined visual acuity as an outcome were identified through the literature review and used to develop the draft guideline (Appendix B). Though most recommendations were adequately supported by current evidence, for the age group of adults 20 to 39 years, this was not the case. As limited evidence surrounding both the frequency of eye examinations and the epidemiology of eye disease and refractive errors was available for this age group, the recommendation was primarily formulated through consensus by the expert panel at the workshop.

### External review of the guideline

**Optometric Patients:** A total of 296 eligible individuals were approached in the University of Waterloo Optometry Clinic to complete a questionnaire; 172 individuals agreed to participate and returned a questionnaire (response rate = 58%). The mean age of the sample was 49 years (range = 19 to 88 years) and most were female (63%) (Figure 2).

Almost all participants who responded agreed that they understood the recommendation for each age group (Table 2). For infants and toddlers, the greatest source of misunderstanding surrounded the wording of the recommendation. As a result, the wording was subsequently revised.

When participants were asked to indicate whether they could follow the guideline recommendation for their own age group, less than 10% of the sample responded with 'no'.

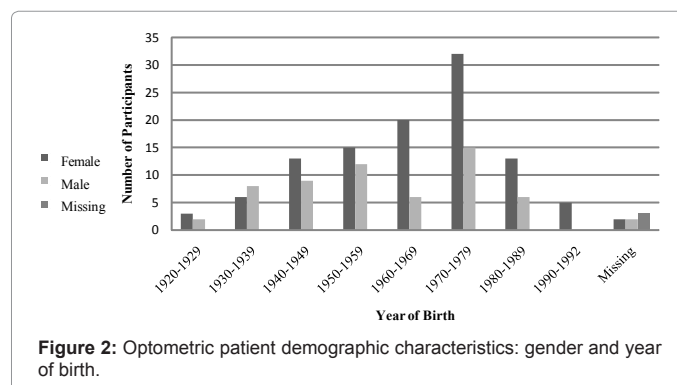
To capture guideline appropriateness for the age groups not meeting the eligibility criteria for study participation the following question was asked, "If you have dependents, for each age group that applies, do you feel the recommendation is appropriate (i.e., it could be followed)?" Only participants who had a dependent(s) were to provide a response. Overall, most participants responded with 'yes' (Table 3).

**Expert review panel:** Eight individuals were approached to provide feedback on the guideline; four completed a questionnaire, two provided feedback via email, one declined to participate and one did not respond (response rate=75%). Participants included: two ophthalmologists, an optometrist, a primary care physician, a university professor with expertise in pediatric optometry, and an ophthalmic epidemiologist.

The expert review panel also mentioned the unclear wording of the recommendation for infants and toddlers. This provided further impetus to modify the recommendation to state 'between 6 and 9 months of age' as opposed to 'by at least 9 months of age'. Support to initiate screening as young as six months of age was provided by the reviewers [46]. Most reviewers felt that the guideline development process was adequately described and that the completeness of reporting was high quality. However, regarding guideline development, several comments were provided that shed light upon several important issues. First, it was stated that the recommendation for infants and toddlers is "Somewhat controversial given the lack of data on this age group. Are screening tests good in this age group?" It was further expressed that "this is a particularly vulnerable group and therefore perhaps extra justification is needed." To address these comments, the studies that provided evidence for the recommendation were explicitly referenced (Table 1). In addition, the intent of this guideline is not on screening but rather on complete optometric eye examinations, as the utility of vision screening has yet to be completely ascertained. Second, one participant highlighted that two Canadian studies [47,48] were excluded from the literature review. These references were likely not included as they were published following completion of the literature review. However, they were reviewed by the research team, but were not found to include information that would require revision of the guideline. Third, one reviewer expressed concern that no other guidelines were referenced within the report. This occurred as no additional evidence-based guidelines for the frequency of optometric eye examinations, aside from the COS guidelines, emerged from the online search.

## Discussion

Periodic or routine comprehensive optometric eye examinations



**Figure 2:** Optometric patient demographic characteristics: gender and year of birth.

	Infants and Toddlers (Birth to 24 months)	Preschool Children (2 to 5 years)	School Age Children (6 to 19 years)	Adults (20 to 39 years)	Adults (40 to 64 years)	Older Adults (65+ years)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	142 (95%)	149 (99%)	141(95%)	149 (97%)	146 (97%)	149 (98%)
No	7	2	7	4	4	3
Total	149	151	148	153	150	152
No response	23	21	24	19	22	20

**Table 2:** Recommendation for each age group listed.

	Infants and Toddlers (Birth to 24 months)	Preschool Children (2 to 5 years)	School Age Children (6 to 19 years)	Adults (20 to 39 years)	Adults (40 to 64 years)	Older Adults (65+ years)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Yes	24 (89%)	36 (95%)	52 (96%)	20 (91%)	16 (89%)	8 (100%)
No	3	2	2	2	2	0
Total	27	38	54	22	18	8

**Table 3:** If you have dependents, for each age group that applies, do you feel the recommendation is appropriate (i.e., it could be followed)?

have been recognized as a key component in promoting optimal eye health [49]. In 2007, the COS published an evidence-based clinical practice guideline for periodic eye examinations in adults aged 19 to 64 years in Canada [10]. The aims of the current study differ from those of the COS guideline process in that we aimed to include all age groups, and had a specific focus on developing a guideline for the frequency of typical optometric eye examinations. Our methodologies for guideline development differed in our application of the AGREE II Instrument and the RAND/UCLA Appropriateness Method, as well as the inclusion of a wider range of literature, including internet sources.

As the leading cause of preventable visual impairment in both developing and developed countries is not ocular disease but uncorrected refractive error [50] the current guideline is stratified by age groups that reflect the natural history of refractive error. At birth, there is a wide distribution of refractive errors with a convergence towards low hyperopia in the first year of life [16], followed by a general shift away from hyperopia and towards myopia during the school years [51], with the “peak myopia age” occurring when individuals are in their thirties [52]. Two additional population-based studies, the Beaver Dam Eye Study and the Blue Mountains Eye Study, have demonstrated how the eye continues to undergo refractive changes throughout adult life [32,37]. According to a randomized clinical trial in England, early treatment for amblyopia leads to better outcomes than later treatment; and such treatment has been shown to be cost-effective [53,54]. For older adults, uncorrected refractive error is a primary cause of reduced vision [55]; however, refractive error correction has been shown to significantly improve quality of life within this population [56]. Overall, these studies help to support our recommendations, particularly for infants and children, as a means to facilitate early detection and treatment of problems such as strabismus, anisometropia and high refractive errors.

Though uncorrected refractive error is the leading cause of preventable visual impairment in Canada, over four million adults are afflicted by one of the leading blinding ocular diseases - age-related macular degeneration, glaucoma, diabetic retinopathy, and cataract [4]. Vision loss has been shown to cause significant personal suffering, such as increased difficulties with activities of daily living, social functioning, mental health and risk of falls, and results in tremendous cost to the health care system [4]. In 2009, vision loss in Canada accounted for 15.8 billion dollars of health care expenditure [57]. For all ocular diseases but macular degeneration, cost-effective treatment interventions exist, granted the disease is detected early and treatment is initiated in a timely manner. The goal of the developed guideline is the primary prevention

of vision loss in the Canadian population. It is estimated that 80% of the world’s blindness is avoidable with the early detection and treatment of eye disease and refractive error [58]. Many causes of blindness, such as glaucoma, do not have symptoms that indicate the presence of disease at its early stages. For example, a recent Canadian study found that 50% of subjects with open-angle glaucoma had moderate/advanced disease at diagnosis [59]. An additional study found that the late presentation of chronic glaucoma was strongly associated with the more years since the last visit to an optometrist [60].

While evidence was available to support most guideline recommendations in the current study, research surrounding eye exam frequency and visual outcomes was lacking for the age group of adults 20 to 39 years. As a result, this recommendation was primarily developed through expert opinion at the workshop. This dearth of knowledge speaks to the need for further research to be conducted surrounding eye exam frequency and visual outcomes for this age group, in order to support an evidence-based recommendation.

During the expert workshop, several participants stated that the prescribed frequency of eye examinations will depend on the cost of the exam versus the benefits to the patient. While it is important to consider this when developing guidelines, cost was not considered as a factor in the development of the current guideline due to the limited availability of Canadian studies that examine the cost-benefit of eye examination frequency. However, we recognize that research to assess the cost-effectiveness of eye examinations will be an important future stage in the development of these guidelines.

In Ontario (and most other provinces and territories), periodic oculo-visual assessments are covered as an insured service for those less than 19 years of age or aged 65 years or older [7] with a maximum of one assessment per 12-month period allowed. Our guideline recommendations are in clear alignment with the allotted eye care coverage provided for these age groups across the country. In addition, many Canadians, either through their employers or on their own, are covered by private health insurance (which often includes vision care), though the level of coverage provided varies according to the plan purchased.

While guidelines have been recognized as an effective tool in improving care quality, they are often not implemented into practice in a timely manner [61] or followed by health care professionals following their dissemination [62]. For example, Ploeg et al. examined factors surrounding implementation of nursing best practice guidelines. Several barriers were uncovered including: negative staff attitudes and beliefs,

limited integration of the guideline into organizational structures, time and resource constraints, and organizational and system level change [61]. In addition, Cabana et al. conducted a comprehensive literature review to examine physician adherence to clinical practice guidelines and uncovered similar barriers [63]. It is important that barriers to both implementation and adherence are recognized, specifically within the optometric practice setting, to ensure that appropriate strategies are put in place to facilitate the dissemination, adoption and adherence to the developed guideline.

This study possesses several strengths including: an extensive review of the literature (with the inclusion of both academic journals and grey literature), use of generally accepted methods for evidence-based research, use of previously published criteria to summarize and appraise the evidence, and the inclusion of multiple key stakeholder groups in the guideline development and appraisal process. For the latter strength, the members of the research team have specific expertise in epidemiology, public health and vision health, thus adding to the diversity of the group responsible for developing the guideline.

This study also possesses several potential limitations. First, the expert opinion workshop panel was selected based on their attendance at the Optometric Leaders Forum being held in parallel with the workshop. Participants were not randomly selected; instead, they were purposefully recruited from a list provided by the principal investigator of the study. This may limit the generalizability of the workshop findings, as participant views may not be representative of all optometrists in Canada. As well, it would have been advantageous to include an expert in clinical practice guideline development to enhance the diversity of the panel. Second, social desirability bias may have been an issue during the surveys completed in the optometry clinic, as participants may have been more inclined to answer favourably due to the presence of a student investigator. However, we attempted to temper such bias by ensuring that the investigator did not remain with the participant and by having the participant place their own completed questionnaire in a sealed envelope and deposit it within a locked drop box. Third, optometric patients were recruited from a single site. While we recognize that the addition of other clinic populations from across Canada would have broadened the relevance, it was impractical for the scope of this study. Fourth, for the external review we recruited individuals already attending an optometric clinic. It is possible that these individuals may have been more inclined to seek eye examinations compared with the general public. These individuals may have greater interest in their eye health and may have been more motivated to respond to each of the questions favourably or in a manner that promoted the guideline. Future research that examines the views of individuals who are not seeking optometric eye care may be warranted. Finally, although only 31 studies that examined visual acuity as an outcome were identified through the literature review and used to develop the draft guideline, this number is larger than what has been referenced in previous guideline studies, and most of these previous studies focused on vision screening as opposed to complete optometric eye examinations, which was the focus of our study.

## Conclusion

The purpose of this guideline is to inform individuals who are either asymptomatic or have symptoms they do not recognize as being eye-related. Therefore, this guideline is meant to aid in the early detection of visual disorders in order to prevent or reduce future vision loss.

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