Review of the Canadian Association of Optometrists Frequency of Eye Examinations Guideline – An Evidence-Based Approach

FINAL REPORT

The Canadian Association of Optometrists / L'Association canadienne des optométristes

UNIVERSITY OF WATERLOO

Principal Investigators: Barbara E. Robinson, PhD., Paul Stolee, PhD.
Research Team: Katie Mairs, MSc., Selena Santi, MA., Christine Glenny, MSc.
Prepared by: Katie Mairs, MSc.

University of Waterloo, Waterloo, Ontario, Canada

Executive Summary

Expert opinion has traditionally been used to develop frequency of eye examination guidelines, but the emergence of evidence-based health care has led many to feel that it is time to evaluate these guidelines using evidence-based techniques. The primary objective of this study was to provide a document based on current evidence and expert opinion supporting a "frequency of eye examinations guideline" for individuals across the age spectrum in Canada. This guideline is for typical optometric eye examinations as outlined by the Canadian Association of Optometrists (CAO). 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.

Development of the guideline occurred through a series of methodological steps:

- Step 1: Finding existing evidence-based guidelines or recommendations for the frequency of eye examinations in addition to the Canadian Ophthalmological Society (COS) guidelines.

The search focused on countries with similar optometric education and practice standards to Ontario. In addition to the rest of Canada - Australia, New Zealand, Great Britain and the United States were targeted. An internet search was completed to find all national and provincial/state professional associations and regulatory bodies for both optometry and ophthalmology. No additional evidence-based guidelines emerged from this review.

- Step 2: Comprehensive research literature review for articles related to screening for the five major causes of visual impairment or loss including refractive errors, glaucoma, diabetic retinopathy, macular degeneration and cataracts.

The leading medical, health sciences and vision specific journal article databases were searched. Search strategies were designed for screening, prognosis/course of disease or condition, prevention, and the economic benefit of or the cost/impact of not screening. Searches strategies to locate research pertaining to screening for refractive errors, glaucoma, diabetic retinopathy, macular degeneration and cataracts were developed for each of the five conditions.

- Step 3: Sorting articles from Step 2 using an online bibliographic management program (Refworks).

All articles identified in Step 2 (N = 10943) were sorted using an online bibliographic management program – Refworks. Articles were deemed 'accepted' or 'rejected' based on specific inclusion and exclusion criteria. Articles placed in the 'Accepted' folder were further separated into either a

'Screening Articles' folder (studies examining screening interventions), or an 'Epidemiology Articles' folder (studies examining the prevalence, incidence and risk factors of eye disease).

- Step 4: Article Charting from Step 3 and Evaluation of the Evidence.

All accepted articles in the 'Screening Articles' folder and the 'Epidemiology Articles' folder were charted and summarized into a preset data extraction form. From these forms, comprehensive written summaries of the evidence were prepared for the screening articles and the epidemiology articles separately. For the purposes of the workshop (see Step 5 below) these summaries were shortened so as to the present the data in a more easily comprehendible form. A method similar to that used by the Canadian Task Force on Preventative Health Care (Zaza et al., 2000) was used to judge the quality of the published evidence. A detailed critical appraisal of all articles used to develop the guideline recommendations was completed.

- Step 5: Recommendations for the Canadian Association of Optometrists Guideline Workshop

An expert committee consisting of 15 members of the optometric profession was selected to attend the workshop. The committee was comprised of representatives from across Canada including Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, P.E.I, and Newfoundland. Each committee member received a summary of the literature review prior to the workshop date. This summary contained the frequency of eye examination recommendations based on the available evidence, outlined where evidence currently exists for the frequency of eye examinations, and detailed where there are gaps in the evidence. The purpose of the workshop was to vote on and discuss the appropriateness of guideline and to reach consensus on eye examination recommendations for each age group using both evidence from the literature and the clinical experience of the expert committee. The committee was also responsible for reaching consensus in areas where evidence does not currently exist for the frequency of eye examinations.

- Step 6: External Review

An external review of the guideline was conducted with a sample of optometric patients as well a panel of optometric professionals who did not attend the previous workshop. From this external review, one modification was made to the guideline. Specifically, for the age group of infants and toddlers, the wording of the recommendation was modified to improve comprehension and clarity.

The final guideline for the frequency of typical optometric eye examinations in Canada is provided below.

Age Group	Recommendation*
Infants and Toddlers (Birth to 24 months)	Infants and toddlers should undergo their first eye examination between the ages of 6 and 9 months.
Preschool Children (2 to 5 years)	Preschool children should undergo at least one eye examination between the ages of 2 and 5 years.
School Age Children (6 to 19 years)	School children aged 6 to 19 years should undergo an eye examination annually.
Adults (20 to 39 years)	Adults aged 20 to 39 years should undergo an eye examination every 2 to 3 years.
Adults (40 to 64 years)	Adults aged 40 to 64 years should undergo an eye examination every 2 years.
Adults (65 years or older)	Adults aged 65 years or older should undergo an eye examination annually.

* 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 [Schwartz et al. (1999). The legal implications of medical guidelines – A task force of the European Society of Cardiology. *Eur Heart J, 20(16*)].

This final report is extensive, with transparent and defensible methodology. This report clearly shows where evidence exists and the level of evidence that is available for each recommendation. This report identifies where such evidence is lacking and points out where further research is needed. Further dissemination of the results and any further review of the frequency of eye examinations guideline reported in this document will be the responsibility of the Canadian Association of Optometrists.

Table of Contents

Tables and Figures

Appendices*

**Appendices are available in a separate document*

1.0 Introduction

Expert opinion has traditionally been used to develop frequency of eye examination guidelines, but the emergence of evidence-based health care has led many to feel that it is time to evaluate these guidelines using evidence-based techniques.

In 2006, the Canadian Ophthalmological Society (COS) published an evidence-based clinical practice guideline for periodic eye examinations in adults aged 19 to 64 years in Canada (COS, 2006). This document highlighted important steps in establishing evidence-based guidelines, however further research is warranted. The primary objective of our study was to provide a document based primarily on current evidence that supports a "frequency of eye examinations guideline" for individuals across the age spectrum in Canada. This guideline is for typical optometric eye examinations as outlined by the Canadian Association of Optometrists (CAO). 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.

2.0 Study Methodology

2.1 Step 1: Literature Review and Evaluation of the Evidence

Part A: Finding existing evidence-based guidelines or recommendations for the frequency of eye examinations in addition to those developed by the Canadian Ophthalmological Society (COS).

The search for existing evidence-based guidelines or recommendations for the frequency of eye examinations focused on countries with similar optometric education and practice standards to Ontario. In addition to the rest of Canada - Australia, New Zealand, Great Britain and the United States were targeted. An internet search was completed to find all national and provincial/state professional associations and regulatory bodies for both optometry and ophthalmology. Websites and associated downloadable documents were hand searched for the following terms: 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. If these terms were found, the content was searched for specific recommendations for the frequency of eye examinations and evidence to support the recommendation. If clarification was required, email contact was initiated to ascertain whether

recommendations existed in that country. The Canadian Medical Association website and its provincial counterparts were also located and searched. Other guideline sources, research or advocacy organizations with potential interest in the issue were identified and available grey literature was searched. Examples included the National Guidelines Clearinghouse, National Eye Institute and the Mayo Clinic in the United States, the Canadian National Institute for the Blind (CNIB) in Canada, and the Department of Health and Aging and the Department of Health Directorate of Commissioning and System Management in Australia. Overall, no additional evidence-based guidelines were uncovered through this review (refer to Appendix A for a summary of the findings of this review).

Part B: Comprehensive literature review for articles related to screening for the five major causes of visual impairment or loss including refractive errors, glaucoma, diabetic retinopathy, macular degeneration and cataracts.

The leading medical, health sciences and vision specific journal article databases were searched. These included PubMed, Scopus, VisionCite and VISIONET. Reference Sight was not searched separately as its sources were searched by either PubMed or VisionCite. 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. A summary of the search strategy for each condition in each database is listed in Appendix B**.**

Searches strategies to locate research pertaining to screening for refractive errors, glaucoma, diabetic retinopathy, macular degeneration and cataracts were developed for each of the five conditions. A basic search strategy was developed and implemented for each condition in each database. Trial searches were run and based on the results each strategy was revised to improve the precision of the search. PubMed's Clinical Study Category search and Systematic Review search were also used where appropriate. These enhanced searches can be found on the Clinical Queries page of the PubMed website.

As an example, the basic search strategy for screening, using the database PubMed and the condition of Refractive Errors was *Refractive Errors [MeSH term] AND ("Vision screening" [Text Word] OR "early detection"[Text Word] OR periodic exam [Text Word] OR "eye exam" [Text Word]*. The search results were then reviewed and it was noted that there were a great many results that focused on the efficacy of specific types of diagnostic or screening tools. To

eliminate these types of studies, the results were reviewed to identify the types of diagnostic or screening tools and then each was revised to filter out diagnostic tools testing research. The revised search added the following to the basic search: *NOT (Shin-Nippon OR autorefractor OR autorefraction OR video-autorefraction OR video-refraction OR photoscreen* OR Plusoptix OR aberrometer OR Bruckner test).* Each of the other conditions had a uniquely altered revised search designed to eliminate research testing for the efficacy of specific diagnostic tools. For example, in other conditions the terms *NOT (Sensitivity OR Specificity)* were used to eliminate the diagnostic tools research. The first 100 results of the basic and revised search were compared by hand, to ensure the "NOT….." addition to strategy was not eliminating valuable articles. It was also noted that there was considerable duplication of articles within the results of the five conditions. This provided an additional safeguard against missing any relevant articles.

In each database, a similar strategy was used but adapted to the search field's template and indexing allowed by that database. For example, in Scopus the search for screening for refractive errors was as follows: *TITLE-ABS-KEY ("refractive errors") AND TITLE-ABS-KEY ("Vision screening" OR "early detection" OR "periodic exam" OR "eye exam")) AND NOT (Shin-Nippon OR autorefractor OR autorefraction OR video-autorefraction OR video-refraction OR photoscreen* OR Plusoptix OR aberrometer OR Bruckner test.*

Prognostic or course of condition studies were also identified. The high specificity strategy used by PubMed's Clinical Queries - Clinical Study Category search was used. This search strategy is based on the work of Haynes, Wilczynski, McKibbon, Walker & Sinclair et al. (1994). For example, the refractive errors search consisted of *Refractive Errors [MeSH] AND (prognos*[Title/Abstract] OR (first [Title/Abstract] AND episode [Title/Abstract]) OR cohort [Title/Abstract]).* In the search strategies for prognostic/course of condition studies trial searches and revisions were made to filter for unwanted results. For example, *(glaucoma) AND (prognos*[Title/Abstract] OR (first [Title/Abstract] AND episode [Title/Abstract]) OR cohort [Title/Abstract]) NOT (surgery OR drug OR injection OR therapy).* The Scopus search consisted of *(TITLE-ABS-KEY (refractive errors AND (prognos* OR (first AND episode) OR cohort)) AND NOT TITLE-ABS-KEY (laser OR autorefract* OR retinoscopy OR extraction OR keratoplasty OR surgery OR sensitivity OR specificity).*

Prevention articles were also identified in the literature search. This strategy used the PubMed Medical Subject headings (MeSH) as the basis for the search. An example of the basic

search strategy was as follows: *"diabetic retinopathy/prevention and control"[Mesh] NOT (surgery OR injection OR drug) Limits: Humans*. Again, search strategy revisions were made to suit the specific database being used along with the condition being searched. The Boolean operator 'NOT' was used to refine the search to remove surgical, genetic or drug research for the purposes of this study. For example, in Scopus the unique revision for diabetic retinopathy was *(TITLE-ABS-KEY ("diabetic retinopathy" AND prevention) AND NOT TITLE-ABS-KEY (sensitivity OR specificity OR surgery OR injection OR drug OR cryotherapy OR angiogenesis)).* In Vision Cite, the search *"macular degeneration" AND prevention* was all that was required.

The fourth search was designed to find the research pertaining to the economic benefit of screening and the impact of not screening. The strategy combined all conditions into one search. The strategy *(screening OR prevention OR control) AND (cataracts OR glaucoma OR "diabetic retinopathy" OR "macular degeneration" OR "refractive errors") AND (economics OR cost* OR "cost analysis" OR "cost benefit" OR "health care costs") NOT (sensitivity OR specificity)* was used in PubMed. A similar strategy was used in the other databases again altering the NOT section of the search strategy to suit the database indexing system and content.

Part C: Sorting articles from Part B using an online bibliographic management program (Refworks).

All articles identified in Step B (N = 10943) were sorted using an online bibliographic management program – Refworks. Each article was initially sorted into one of the following folders: Rejected Pre-1980, Rejected, Literature Review, Non-English, Interesting Articles and Accepted (see Appendix C for a definition of each folder and Appendix D for a flowchart illustrating article sorting). The articles were deemed 'accepted' or 'rejected' based on specific inclusion and exclusion criteria:

<u>Inclusion criteria:</u>

1) 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.
2) Articles from both traditional and nontraditional journals were included.
3) Article had longitudinal methods that focus on detection, prognosis and/or epidemiology of eye disease (preferred).
4) The article was published in English.

Exclusion criteria:

1) The article was published prior to 1980 (note: "key articles" that were published prior to 1980 were included, these were identified during the hand-searching phase).
2) Article did not contain original data, statistical analysis, and/or results.
3) Focus of the article was on a specific diagnostic tool.
4) Article heavily focused on treatment (e.g., comparing two treatment options).
5) Article only discussed extremely rare conditions (e.g., small case study).
6) Focus of the article was on outcomes not related to the eye (e.g., outcome of interest was the occurrence of a cardiac event).

Articles placed in the 'Accepted' folder (N = 1418) were further separated into either a 'Screening Articles' folder (N = 85) or an 'Epidemiology Articles' folder (N = 1333). The 'Screening Articles' folder contained studies that examined specific screening interventions or programs, while the 'Epidemiology Articles' folder contained studies that examined the prevalence, incidence and risk factors of eye disease. In order to reduce the number of accepted epidemiology articles, studies that were dated (published pre-1990) and that were conducted in remote locations (e.g., Jordan) were excluded, leaving 623 accepted epidemiology articles (refer to the 'Pre-1990 and Locations Excluded' folder). No articles were excluded from the 'Screening Articles' folder.

Epidemiology articles in the 'Pre-1990 and Location Excluded' folder (N = 623) were further sorted into the following folders based on their respective eye disease focus: Diabetic Retinopathy (N = 159), Macular Degeneration (N = 105), Refractive Errors (N = 89), Cataracts (N = 89), Glaucoma (N = 74), Multiple Eye Diseases (N = 72) and Other (N = 35). Within each of the eye disease folders listed above, the articles were separated into one of three sub-folders: Incidence/Prevalence Studies, Risk Factor Studies and All Other Studies (refer to Appendix C for a definition of each folder).

All articles in the 'Multiple Eye Diseases' folder were subsequently sorted into their respective eye disease folders (note: it is possible that the same article was placed in multiple folders depending on the types of eye disease under study). Articles in the 'Other' folder were not summarized, and thus rejected, as they did not focus on any of the five major causes of visual impairment or loss.

Part D: Article Charting and Evaluation of the Evidence.

All accepted articles in the 'Screening Articles' folder (N = 85) and the epidemiology 'Pre-1990 and Locations Excluded' folder (N = 623) from Part C were summarized and charted using a preset data extraction form (see Appendix E). From these forms, comprehensive written summaries of the evidence were prepared for the screening articles and the epidemiology articles separately (see Appendix F). For distribution at the workshop (see Section 2.2 below), these summaries were abbreviated in order to present the data in a more easily comprehendible form (see Appendix G).

A method similar to that used by the Canadian Task Force on Preventive Health Care (Zaza et al., 2000) was used to judge the quality of the published evidence (see Appendix E, Part III). Appendix H outlines the results of the critical appraisal for each study upon which the guideline recommendations were based. Studies selected as evidence to develop the guideline included controlled trials and well-conducted population-based studies that examined visual acuity as an outcome. For each recommendation, in order to assign a 'grade of evidence' (Harris et al., 2001), three independent raters reviewed the evidence. Where consensus was not reached on a grade of evidence, a subsequent discussion ensued between the raters until consensus was achieved.

2.2 Step 2: Recommendations for the Canadian Association of Optometrists Guideline Workshop

Purpose

The *Recommendations for the Canadian Association of Optometrists Guideline Workshop* was held on January 27, 2011 at the Westin Harbour Castle in Toronto, Ontario with an expert committee of 15 members (of a total of 19 invited). The committee was comprised of representatives from across Canada including Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, P.E.I, and Newfoundland who were attending the Optometric Leaders Forum in Toronto, Ontario (being held in parallel with this workshop). These individuals included Presidents of Optometric Associations, College Registrars and Directors of Schools of Optometry. Each committee member received a summary of the literature review prior to the workshop date (see Appendix G). This summary contained the frequency of eye examination recommendations based on the available evidence, outlined where evidence currently exists for the frequency of eye examinations, and detailed where there are

gaps in the evidence. The purpose of the workshop was to vote on and discuss the appropriateness of each recommendation and to reach consensus on frequency of eye examination recommendations for each age group, using both evidence from the literature and the clinical experience of the expert committee. The committee was also responsible for reaching consensus in areas where evidence does not currently exist for the frequency of eye examinations (i.e., 20 to 39 year old age group).

Procedures

Upon arrival at the workshop, the participants were separated into three tables of five members each (on a first come, first serve basis). Each participant received a package that included: the workshop agenda, a list of workshop participants, the biographies of the principal investigators, the study purpose, grades for overall quality of evidence for each recommendation, a conflict of interest form, an evaluation form (see Appendix I for a copy of each of these documents) and overview of evidence and recommendations documents for each age group (see Appendix G). Copies of the comprehensive summaries (Appendix F), AGREE Instrument (Appendix J), article sorting flow chart (Appendix D), case studies (Appendix K), case study worksheets (Appendix L) and knowledge translation and communication worksheets (Appendix M) were provided on each table. A member of the research team was situated at each table in order to hand-record all dialogue that occurred during the session. As well, a professional facilitator was responsible for facilitating the discussions, the voting process and ensuring the flow of the session.

Two specific instruments were used to guide the workshop process: the AGREE Instrument and the RAND/UCLA Appropriateness Method. The AGREE instrument is a tool that assesses the methodological rigor and transparency of clinical practice guidelines (The AGREE Research Trust, 2010) This instrument was used in this project in order to provide a framework for assessing the quality of clinical practice guidelines, specifically for the frequency of eye examinations in Canada (see Appendix J). The AGREE instrument contains 6 domains and 23 items or steps. The workshop specifically addressed Step 10 of this instrument, which states that, "There should be a description of the methods used to formulate the recommendations and how final decisions were arrived at. Methods include for example, a voting system, formal consensus techniques (e.g. Delphi, Glaser techniques). Areas of

disagreement and methods for resolving them should be specified" (The AGREE Research Trust, 2010). In order to reach consensus on the frequency of eye examination recommendations during the workshop, the RAND/UCLA Appropriateness Method was implemented.

The RAND/UCLA Appropriateness Method combines best available scientific evidence with the collective judgments of experts to yield a statement regarding the appropriateness of performing a procedure (Fitch et al., 2001). For the purpose of this project, the procedure referred to the eye examination frequency recommendation for each age group under investigation. This method employs the use of a formal voting system to reach consensus (see Figure 1). At the workshop, participants were asked to vote on the appropriateness of the recommendation for the specific age group using a scale ranging from 1 to 9; where 1 = expected harms[1] greatly outweigh the expected benefits, 5 = the harms and benefits are about equal, and 9 = expected benefits greatly outweigh the expected harms. Consensus was reached when the median of the voting result was 7 or higher. The voting was carried out electronically using audience response technology (Reply Systems, 2011). All voting was anonymous.

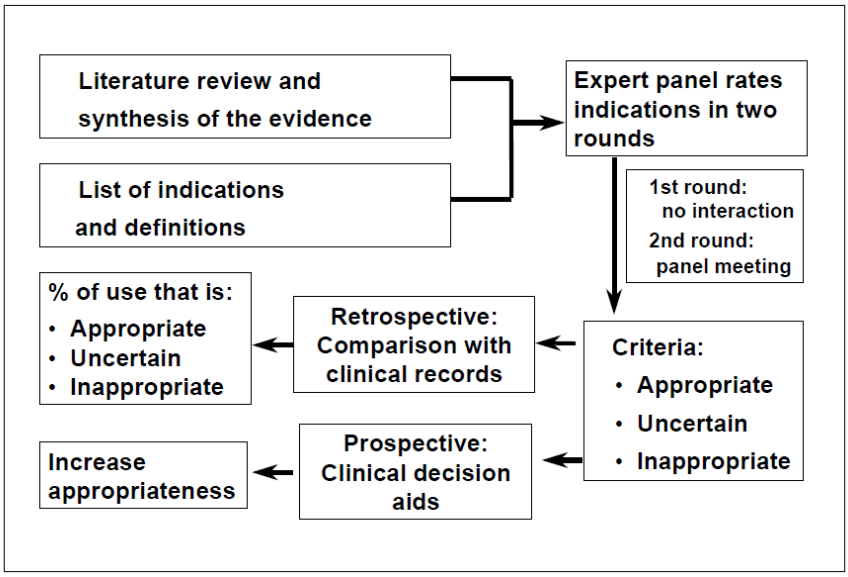


Figure 1. The RAND/UCLA Appropriateness Method

[1] Harm was defined as: the eye exam itself, disease is not detected, patient develops disease, impact on quality of life and productivity and cost to society.

The voting process utilized during the workshop is described below. It is important to note that each age group was examined separately. Thus, these steps were repeated for each individual age group under investigation (total of six age groups).

Steps followed when consensus was reached after first vote:

- Step 1: Overview of the Evidence – Evidence from the literature review was summarized and presented verbally to all workshop participants (see Appendix G, column entitled 'Overview of the Findings').
- Step 2: Vote 1 – For the age group under investigation, the recommendation was presented and all participants voted individually on the appropriateness of the recommendation based on both the available evidence and their own clinical experience.
- Step 3: Consensus Reached after First Vote – Following consensus, participants discussed the appropriateness of the recommendation with respect to a specific case study at their individual tables (i.e., table 1 examined case study 1 for that age group; see Appendix K). Each table was responsible for completing the respective case study worksheet (i.e., table 1 completed the worksheet for case study 1; see Appendix L). The case studies and worksheets were then shared and discussed as a larger group.
- Step 4: Vote 2 – A final vote on the recommendation was conducted taking into account the evidence from the literature, their own clinical experience and the case studies discussion.

Steps followed when consensus was not reached after first vote:

- Step 1: Overview of the Evidence – Evidence from the literature review was summarized and provided verbally to all workshop participants (see Appendix G, column entitled 'Overview of the Findings').
- Step 2: Vote 1 – For the age group under investigation, the recommendation was presented and all participants voted individually on the appropriateness of the recommendation based on both the available evidence and their own clinical experience.
- Step 3: Consensus Not Reached after First Vote – A group discussion was subsequently held to determine the reasons for non-consensus. Areas of concern were discussed in order to reach agreement.

- Step 4: Vote 2 – After reaching consensus through discussion, the recommendation was presented again and all participants voted on the appropriateness of the recommendation.
- Step 5: When consensus was confirmed, at each table, the participants discussed the appropriateness of the recommendation with respect to a specific case study (i.e., table 1 examined case study 1 for that age group; see Appendix K). Each table was responsible for completing the respective case study worksheet (i.e., table 1 completed the worksheet for case study 1; see Appendix L). The case studies and worksheets were then shared and discussed as a larger group.
- Step 6: Vote 3 – A final vote on the recommendation was conducted taking into account the evidence from the literature, their own clinical experience and the case studies discussion.

Following completion of the formal voting process, a discussion session regarding the recommendations across all age groups was conducted. At this point, participants indicated how often they felt this guideline should be reviewed and also voiced any concerns or issues with the final recommendations. The workshop concluded with a discussion surrounding the knowledge translation and communication of the guideline. At their individual tables, the participants were asked to discuss the two questions listed on the Knowledge Translation and Communication Worksheet (see Appendix M). The worksheet responses were then shared with the larger group.

2.3 Step 3: External Review of the Guideline

An external review of the guideline was conducted (June to August 2011) in order to satisfy Steps 5 and 13 of the AGREE instrument (see Appendix J). Ethics clearance from the University of Waterloo was granted prior to data collection.

For Step 5, the guideline was externally reviewed by seeking the views and preferences of the target population - optometric patients. This information was obtained through a questionnaire (see Appendix N) disseminated to patients attending the University of Waterloo Optometry Clinic. Study participants were recruited by a convenience sampling approach. Participants included patients and non-patients attending the clinic. Specifically, patients included individuals aged 18 years or older (age of consent) who were attending the clinic for an optometric examination. Non-patients included individuals who were at the clinic because of a

dependent (e.g., child, parent etc.) and had brought this dependent in for an optometric eye examination. The potential study participants were provided with a brief description of the study and what participation would entail (see Appendix O). If the participant was interested in learning more about the study, they were provided with an information/consent letter (see Appendix P). Consent to participate in the study was indicated by completion of the questionnaire. Upon completion, the participant was provided with a thank-you letter (see Appendix Q). Completed questionnaires were placed in a sealed envelope and deposited within a locked dropbox by the participant. The envelope was only opened by a member of the research team affiliated with this project. All feedback was anonymous.

For Step 13, the guideline was externally reviewed by an expert panel consisting of six members including ophthalmologists, optometrists, ophthalmic epidemiologists, general practitioners and academic professors. The expert panel was formed of people who had not attended the workshop in January. Potential expert panel members received an email that included a summary document of the research highlighting the study purpose, methodology, literature review, workshop results and the final guideline. Feedback on the guideline from this panel was obtained through an online questionnaire using Fluid Surveys (see Appendix R). Consent to participate in the study was indicated by completion of the online questionnaire. All feedback was anonymous.

3.0 Guideline Development

3.1 Final Guideline Recommendations: Literature Review, Expert Committee Workshop, and External Review

3.1.1 Final Guideline Recommendations

Table 1 below describes the frequency of eye examination recommendations that were developed from the literature review and that were finalized during the expert committee workshop and external review.

Table 1: Final Recommendations for the Frequency of Eye Examinations in Canada

Age Group	Recommendation*
Infants and Toddlers (Birth to 24 months)	Infants and toddlers should undergo their first eye examination between the ages of 6 and 9 months.
Preschool Children (2 to 5 years)	Preschool children should undergo at least one eye examination between the ages of 2 and 5 years.
School Age Children (6 to 19 years)	School children aged 6 to 19 years should undergo an eye examination annually.
Adults (20 to 39 years)	Adults aged 20 to 39 years should undergo an eye examination every 2 to 3 years.
Adults (40 to 64 years)	Adults aged 40 to 64 years should undergo an eye examination every 2 years.
Adults (65 years or older)	Adults aged 65 years or older should undergo an eye examination annually.

* 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 [Schwartz et al. (1999). The legal implications of medical guidelines – A task force of the European Society of Cardiology. *Eur Heart J, 20(16)*].

3.1.2 Supporting Evidence from the Literature Review

Evidence from the literature to support the guideline was graded on strength using the U.S Preventive Services Task Force approach, where 1 = good evidence, 2 = fair evidence and 3 = poor evidence (Harris et al., 2001).

Infants and Toddlers (Birth to 24 months

Recommendation: Infants and toddlers aged birth to 24 months should undergo their first eye examination between the ages of 6 and 9 months *[Level of evidence = 1]*

- The Avon Longitudinal Study of Parents and Children (ALSPAC) reported findings from a nested randomized control trial. (Williams, Northstone, Harrad, Sparrow & Harvey et al., 2002). They found that children who were randomized into intensive visual screening were less likely to be amblyopic at 7.5 years of age than children in the control group (0.6% versus 1.8%). The intensive screening included 6 visits between the ages of 8 months and 37 months while the control group received a 1-time visual screening at 37 months (Williams et al., 2002).

- In this age group, increased risk factors for amblyopia include anisometropia (>1D difference), hyperopia (>3D), and/or strabismus (Donahue, 2006; Sjostrand & Abrahamsson, 1990).
- A longitudinal study of infants from the Cambridge, England population followed children from 9 months to 36 months of age (Atkinson et al., 2000; Ehrlich et al., 1997). They found that, "Partial correction of infants with hyperopia reduced the incidences of strabismus and poor acuity by two-thirds in those who comply in wearing the prescribed correction." (Atkinson et al., 2000).

Preschool Children (2 to 5 years)

Recommendation: Preschool children should undergo at least one eye examination between the ages of 2 and 5 years *[Level of evidence = 2]*

- A population-based cohort study from Sweden found that amblyopia was treatable in > 95% of cases if straight-eyed amblyopes were detected by 4 years of age and strabismic cases early after onset (Sjostrand & Abrahamsson, 1990), The authors state, "The most important factors for a successful outcome: lower age at presentation, good compliance, early referral of strabismic cases, and effective visual acuity testing from 2.5 years and onwards."
- This longitudinal study also found that infants who do not reduce or "emmetropize" their astigmatism or anisometropia by 3 years of age are at risk for amblyopia (Abrahammson et al 1990a, Abrahammson et al 1990b).

School Age Children (6 to 19 years)

Recommendation: School children aged 6 to 19 years should undergo an eye examination annually *[Level of evidence = 2]*

- The prevalence of refractive error in children rapidly increases from the age of 6 to 19 years. This change is primarily due to an increase in the prevalence of myopia (SER ≤ -0.50 D) (Junghans & Crewther, 2003; Pointer, 2001).
- Data from the National Health and Nutrition Examination Survey (NHANES) showed that 32.3% of children between the ages of 12 and 18 wore corrective lenses (Kemper et al., 2007). NHANES found an additional 19.5% who didn't wear corrective lenses were visually impaired (VA ≤ 6/12).

Adults (20 to 39 years)

Recommendation: Adults aged 20 to 39 years should undergo an eye examination every 2 to 3 years *[Level of evidence = 3]*

- There is a gap in evidence for this age group. This age group is not included in population-based cohort studies or studies that analyzed risk factors associated with the occurrence of visual impairment. As a result, this recommendation was developed by consensus during the expert opinion workshop (see section 3.1.3).
- There is prevalence data that shows the prevalence of clinically important refractive error is 46.3% in this age group in the United States (Vitale et al., 2008). There is also data from Canada that shows that the prevalence of eye disease in a clinical population is 9 % for those ≤ 24 years of age and 20.9% for those 25 to 44 years of age (Robinson, 2003).

Adults (40 to 64 years)

Recommendation: Adults aged 40 to 64 years should undergo an eye examination every 2 years *[Level of evidence = 1]*

- Population-based cohort studies from two different continents have documented the changes that occur in the ocular health and refractive status of adults followed for 10 to 15 years (Chandrasekaran et al., 2006; Guzowski et al., 2003; Klein, Klein & Linton, 1992; Klein et al., 1997; Klein et al., 2002a; Klein et al., 2002b; Klein et al., 2007; Lee et al., 2002; Mitchell et al., 2002; Mukesh et al., 2002;Wang et al., 2007). Increasing age (> 40 years of age) increases the risk for cataracts, age-related macular degeneration, diabetic retinopathy, glaucoma and uncorrected refractive error. Three population-based studies have shown the risk of visual impairment due to uncorrected refractive error and how the risk increases significantly with time since last eye examination (Liou, McCarty, Jin & Taylor, 2002; Munoz et al., 2002; Robinson et al., 2011). Two of the studies have demonstrated an increased risk of visual impairment if the time since last eye examination is greater than two years (Munoz et al., 2002; Robinson et al., 2011).
- Routine eye examinations are necessary to identify persons with treatable vision loss such as uncorrected refractive errors or cataracts and persons with early eye disease, in whom treatment can prevent vision loss.

Older Adults (65 years or older)

Recommendation: Older adults aged 65 years or older should undergo an eye examination annually *[Level of evidence = 1]*

- A longitudinal observational study of persons aged 65 years or older found that persons with more regular eye examinations were less likely to experience a decline in vision or in functional status (Sloan, Picone, Brown & Lee, 2005). The study included 14,215 Medicare beneficiaries observed between 1994 and 1999, linked to the 1994 and 1999 National Long Term-Care Survey (NLTCS) (Picone, Brown, Sloan & Lee, 2004; Sloan et al, 2005). They found that on average, an additional year with an eye exam was associated with a 0.12 decrease in the probability of becoming unable to read newsprint (Sloan et al, 2005).
- Two population-based cohort studies from two different continents have demonstrated that refractive error continues to change over a person's lifespan (Guzowski, 2003; Lee et al., 2002). The prevalence and incidence of visual impairment also increases with age (Klein et al., 2001; Ryskulova et al, 2008). There is an increased risk of visual impairment due to eye disease in adults aged 60 and older (Robinson et al., 2011; Vitale, Cotch & Sperduto, 2006).

3.1.3 Workshop Results

For a complete listing of the voting questions and response options presented at the workshop refer to Appendix S.

Prior to starting the voting process, the participants were asked to indicate whether they agreed with the definition of 'harm' that was provided with respect to the response options[1]. Several workshop participants voiced their concern regarding this definition and considered other important aspects to keep in mind:

- Important to take into account cost-effectiveness, cost-benefits of screening.
- Important to consider what eye care services are covered under the current health care system within each province.
- It was noted by the research team that cost was not taken into account when the guidelines were developed.

The results of the voting process for each age group are described in detail below.

[1] Definition of harm: the eye exam itself, disease is not detected, patient develops disease, impact on quality of life and productivity, and cost to society.

Infants and Toddlers (Birth to 24 months)

Original Recommendation: Infants should be screened by at least 6 months of age.

Following an overview of the evidence (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- It is difficult to examine 6 to 9 month olds.
- There is a lack of evidence regarding the benefits of screening at 6 months of age (studies are available that examine 9 month olds).
- Is there a difference in the ability to detect eye disease problems between 6 and 9 months of age? Would there be harm to the patient? Additional research is needed.

Vote 1: Infants should be screened by at least 6 months of age (no consensus, median = 5).

As consensus was not reached, a discussion was held to determine the reasons for non-consensus and to reach agreement on a recommendation. The following key points emerged from this discussion:

- Amongst those who supported the original recommendation (voted 7 to 9):
    - The consequences of not detecting eye disease are too great.
    - If screened at 6 months, we can be certain whether or not there is a vision problem.
    - If eye disease is detected earlier, the potential benefit to improve a child's vision is greater.
    - There is low harm to screening at 6 months.
- Amongst those who did not support the original recommendation (voted 1 to 4):
    - If the infant is examined too early, there is the possibility of missing the eye disease (since the concern is with asymptomatic disease).
    - It is easier to be certain that there is not a problem at 9 months of age than earlier (as it is easier to detect a problem at this age).
    - Most available evidence focuses on infants screened at 9 months of age.
    - There is a lack of evidence to support screening at 6 months of age.
    - The benefits of screening at 6 months are not apparent – only see cost and burden to family and society.

Following this discussion, it was decided to modify the recommendation to 'infants should be screened by at least 9 months of age'.

Vote 2: Infants should be screened by at least 9 months of age (consensus, median = 8).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1: A 6 month-old boy was born prematurely and weighed less than 2500 grams. He is hitting all of the normal developmental steps for his age. His older sister (currently going to senior kindergarten) was just discovered to have anisometropia and received her first pair of spectacles.

Question 1: Why do you support this recommendation?

- Family history, risk factors.
- All premature infants are seen by an ophthalmologist at birth in urban settings, this may not be the case in rural settings.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- There needs to be a standard of care for premature infants – need to ensure that these infants are examined.
- Optometrists are often not comfortable examining children less than 6 months of age.
- An assumption is being made that risk factors are part of collaborations between health professionals.

Case Study 2: A 9 month-old girl was normal birth weight and born at term. Her parents notice that one of her eyes occasionally tends to turn but only when she is tired. They use it as a signal that it is time for her to have a nap.

Question 1: Why do you support this recommendation?

- Parents may be unaware of their child's vision problem. With this guideline, the child would be addressed and treatment would be initiated.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- Cost issue – need cost-benefit analysis to see if this recommendation is affordable, especially to policymakers.
- Need to inform parents that early detection leads to early treatment.
- Need evidence to provide to policymakers.

Case Study 3: A 12 month-old boy is developmentally delayed. He is not walking, not verbalizing and doesn't respond to facial expressions. He is easily upset and doesn't seem to enjoy playing with his older siblings. Mom thinks he is just shy.

Question 1: Why do you support this recommendation?

- The child should be examined by 9 months of age to rule out any vision problems.
- Issues of not meeting milestones if vision problems go undetected. There are many treatment options at this age.
- Important to identify vision problems for developmental reasons.
- If the problem is visual, then this problem can be picked up and other problems ruled out.
- Decreased juvenile delinquency if vision problems are caught early on.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- If glasses are prescribed early on, there is less social stigma compared to if they are prescribed later in life.
- There is a cost to society regarding developmental delays. There is less social and learning catch-up for children that are detected early.
- There is less of a need for social services when vision problems are detected earlier. Leading to increased self-esteem on behalf of the parent and child.
- Need to provide education that an examination is possible at this age.

Vote 3: Infants should be screened by at least 9 months of age (consensus, median = 8).

Final Recommendation: Infants aged birth to 24 months should undergo a complete eye examination by at least 9 months of age.

Preschool Children (2 to 5 years)

Original Recommendation: Preschool children who have not been previously detected with a problem should have at least one full eye examination between the ages of 2 and 5 years.

Following an overview of the evidence, (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- A full examination should be done between the ages of 3 and 5 years as this will capture any vision problems that may be present.
- It is possible to measure visual acuity at this age.
- Recommended screening prior to school entry. However, the age range is controversial as children in different provinces start school at different ages.

Vote 1: Preschool children who have not been previously detected with a problem should have at least one full eye examination between the ages of 2 and 5 years (consensus, median = 9).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1: A 3 year-old boy, a fraternal twin, has a constantly bruised forehead from banging his head against the headboard every night. The family doctor has recommended tranquilizers. The mother does not want to drug her child but is uncertain what to do next.

Question 1: Why do you support this recommendation?

- The visual system is flexible/plastic at this age. Therefore, this is an optimal time to address any vision problems and provide treatment.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- Early intervention leads to best outcomes.

- Other health professionals need to be aware of these recommendations. This could be done through seminars with groups such as school administrators, teachers, boards, general practitioners, government etc.
- The consequences of not having their child examined needs to be communicated to parents.
- Need to create public awareness surrounding these recommendations.

Case Study 2: A 4-year old girl loves to read. Her mom and dad are impressed with how well she reads for her age. She also likes to sit really close to the flat screen when her favorite shows are on.

Question 1: Why do you support this recommendation?

- Early detection leads to early treatment.
- Screening at this age will set up the child to be ready for school.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- Screening will prepare children for school entry. School performance and learning ability increases with early treatment.
- This is an asymptomatic case, however, because of the recommendation the child is examined even though there is no problem evident.

Case Study 3: A 5-year old boy is currently involved in T-Ball. He really enjoys it but his parents notice that he doesn't seem to catch balls thrown to him from his left side.

Question 1: Why do you support this recommendation?

- There is an obvious visual deficit present that could have been detected if the child was examined earlier.
- Patching is easier at this age. Also, there is greater compliance and fewer stigmas if children are treated earlier.
- There are many treatment options available to children of this age.

Question 2: What do we need to communicate to other professional groups, consumers, patients and policymakers about this recommendation?

- Undetected vision problems are associated with educational, social and developmental issues later in life (reference to the Kentucky Study).

Additional discussion regarding the recommendation followed the case study discussion. The following key points were highlighted:

- Concern was expressed about the age group of 2 to 5 years being too large. Suggested changing it to 2 to 4 years (especially if a child's last exam was at 9 months of age).
- Picking up disease by age 4 is important because at age 5 it is harder to intervene.
- Age range is controversial as children in different provinces start school at different ages.
- Suggested adding an eye examination to the school entrance checklist. This will allow any vision problems to be caught prior to the start of school.
- Letting visual issues go undetected means greater educational and social developmental issues later in life (reference to Kentucky Study).
- CAO, ICI Learn Program in Alberta: if vision problems are detected by kindergarten and they are given free glasses, follow-up by grade 9 shows that juvenile delinquency is reduced.
- The committee agreed that if you see a child at 2 years of age, that you should have them back between the ages of 3 and 5 years.
- Overall, it was decided to keep the age range of 2 to 5 years for preschool children.

Vote 2: Preschool children who have not been previously detected with a problem should have at least one full eye examination between the ages of 2 and 5 years (consensus, median = 9).

Final Recommendation: Preschool children who have not been previously detected with a problem should undergo at least one complete eye examination between the ages of 2 and 5 years.

School Age Children (6 to 19 years)

Original Recommendation: School age children should have a complete eye examination annually.

Following an overview of the evidence, (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- Refractive error changes rapidly within this age group. Most problems are with refractive error not being detected or screened for.
- Refractive error correction is associated with success, productivity and learning.
- 19% of visually impaired children of this age are not wearing glasses.
- The cost-effectiveness of screening has been shown to be favourable within this age group.
- Important to consider whether screening is covered by the province for this age group (there could be variability in coverage across the provinces).

Vote 1: School age children should have a complete eye examination annually (consensus, median = 7).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1*:* An 8 year old girl (grade 3) receives average grades for most of her subjects at school but may be a little behind the rest of the class in reading. She prefers outdoor sports to reading books. She can read street signs before her 33 year-old father can make them out. She must have great vision.

Question #1: Why do we support this recommendation?

- Prescription changes occur frequently within this age group.
- Do not want children to get behind in school or socially.
- There are symptoms evident here that are not being addressed – she is a poor reader.

Question #2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Interventions need to be initiated by school administrators, teachers, school board, GP's, government etc. to address the importance of regular eye care.
- The government will often not initiate interventions because of cost. However, short term pain leads to long term gain.

Case Study 2: A 16 year old girl bought some coloured contact lenses on the internet that she thought would make her eyes look bluer. She got the same type that her friend was prescribed by the optometrist. She had some initial irritation but used eye drops from the drug store and everything is fine.

Question 1: Why do we support this recommendation?

- Early detection leads to early treatment.
- Screening will provide optometrists a chance to educate children on eye health.
- The early detection of vision problems reduces the potential for engagement in risky behaviour within this age group.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this Guideline?

- Need to inform policymakers about the impact of vision problems on learning.

Case Study 3: A 19 year old, insulin-dependent diabetic is greatly enjoying his freedom at University although his mother continues to nag him about his glycemic control. He has not had a dilated fundus eye exam since his mother took him to the optometrist's office when he was 12 years old. He had no problems at that exam and think he sees fine.

Question 1: Why do we support this recommendation?

- Vision is changing rapidly within this age group.
- A high risk individual means a different recommendation to follow. The Canadian standard is every two years for type 1 diabetics and annually for type 2 diabetics.
- Even if this individual was not diabetic, they are not following the recommendation.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- B.C problem: if we defend the recommendation of an annual eye examination with evidence of rapidly changes refractive error, this could be perceived by the government as children only needing refraction ever year and not a complete eye exam.

Additional discussion regarding the recommendation followed the case study discussion. The following key points were highlighted:

- It is good practice and public policy to not remove services from children and seniors.
- Need to consider the cost-effectiveness of annual exams. Specifically, a cost-effectiveness analysis is needed in provinces where eye examinations are not covered.
- Suggested changing the recommendation to every 2 years. However, it was noted that if the recommendation was changed then people may think it's okay to be examined every four or five years and so on.

Vote 2: School age children should have a complete eye examination annually (consensus, median = 8).

Final Recommendation: School children aged 6 to 19 years should undergo a complete eye examination annually.

Adults (20 to 39 years)

Original Recommendation: There is insufficient scientific evidence surrounding both the screening and epidemiology of eye disease within this age group. As a result, the recommendation was formulated through consensus by the expert committee at the workshop.

Following an overview of the available evidence (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- Most cohort studies that examine eye disease amongst adults include individuals aged 40 years or older (as uncorrected refractive error is more problematic for those aged 40+).
- Clinical experience indicates that the age group of 20 to 39 years needs to be changed. Recommended splitting it into 20-34 years and 35-65 years as there is a greater decline and more ocular health problems beginning at age 35. In the end, it was decided to keep the age group as is.
- Discussed the possibility of basing recommendations on evidence from the United States, Australia and other developed countries. However, it was noted that there is no evidence to support these screening intervals either.
- Recommended setting the interval at every 2 years. The following evidence supports this recommendation:

    - The incidence of asymptomatic eye disease within this age group is 9%. As this percentage is high, it was argued that this should be enough evidence to support screening every 2 years.
    - There is prevalence data available within the scientific literature. Therefore, this recommendation could be supported by this evidence.
    - Prevention is key.
    - Important to be upfront and state that there is no evidence available and therefore they are erring on the side of caution in recommending 2 year screening intervals.
- Studies that examine the number of diseased individuals who could be detected with an exam every 'x' years are not available for this age group. As a result, the recommendation will have to be supported by the available prevalence data and the clinical experience of the expert committee. Ideally, incidence data is needed to formulate this recommendation.
- The age group of 20-39 years is a mobile age group and therefore it is difficult to follow them.
- The World Council of Optometry has defined uncorrected refractive error in North American as a predominate issue. Glaucoma is also a concern for this age group, especially in those who are asymptomatic.

Vote 1: How often should eye exams be performed for 20-39 year old adults? (No consensus; median = 3 years).

As consensus was not reached, a discussion was held to determine the reasons for non-consensus and to reach agreement on a recommendation. The following key points emerged from this discussion:

- Amongst those who voted 'every 2 years':
    - Adults should be screened every 2 years to detect vision problems early (prevention).
    - Those with identified refractive error need to be seen every 2 years to detect any changes that may have occurred.
    - The prevalence of glaucoma is high for those aged 35-39 years. Glaucoma will go undetected for those who are truly asymptomatic if the screening interval is > 2 years.

    - There is enough asymptomatic eye disease in this age group from clinical experience to warrant an exam every 2 years.
    - This age group engages in more risky behaviour.
    - The government and insurance companies currently support vision screening every 2 years for this age group. It is important to not run the risk of de-insuring this service.
- Amongst those who voted 'every 3 years':
    - The likelihood of refractive error or disease to occur in this age group plays into the recommendation.
    - Family history is important to consider. If there are no signs or symptoms of vision problems, then three years is a secure time frame.
    - Possible to detect all possible causes of blindness with screening every 3 to 4 years. However, this is practically-based, not evidence-based.
    - Patients may not comply with screening every 2 years, however, they might with 3 years.
    - At this age, not many diseases cause low vision. If screening occurred every 3 years then there is a high probability of picking up visual problems; every 5 years, moderate probability, every 10 years, low probability.
- Amongst those who voted every '4', '5', '6', '7', '8', '9' or '10' years:
    - The risk of ocular disease is low for this age group and there is no evidence of rapid change in vision.
    - If patients followed guidelines, any vision problems would have already been detected previously.
    - Screening every year is self-serving, but screening every 10 years is not advantageous to the patient – a middle ground is needed.
    - Suggested a range of years (visit an optometrist every _ to _ years).
    - Concern was expressed about the age group of 20-39 years being too large. It was recommended to separate this group into three groups: 20-24, 25-34 and 35-39. However, as agreement could not be reached, the age group was kept as is.

Vote 2: How often should eye exams be performed for 20-39 year old adults? (No consensus; median = 3 years).

As consensus was not reached again, a discussion was held to determine the reasons for non-consensus and to reach agreement on a recommendation. The following key points emerged from this discussion:

- Discussed the possibility of including a range with respect to the screening interval. Every 2-3 years was suggested and agreement was reached on this recommendation.
- There is strong clinical evidence to support examinations every 2 years.
- Although there is a knowledge gap for this age group, it was decided to err on the side of caution in recommending more frequent eye examinations in order to ensure life-long ocular health (prevention).
- With respect to public health policy, the cost of not detecting issues justifies the benefit.
- Prevalence is an important factor in determining whether an exam is needed. However, screening intervals are often based on incidence, and this is the part that we are missing for this age group.

Vote 3: Adults aged 20-39 years should be examined every 2 to 3 years (consensus; median = 8).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1: A 23 year-old university student who doesn't drive finds that she now has to sit at the front of the lecture theatre in order to see the PowerPoint presentations. She has occasionally not recognized her friends when they are across the street.

Question 1: Why do we support this recommendation?

- Visual issues have a direct effect on learning ability, which can impact quality of life.
- Important to consider public safety, especially related to driving (i.e., meeting road requirements).

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- From an epidemiological perspective, optometrists are biased by the evidence within their office. That is, those patients who attend for regular screening. But

what about the 50% who are not examined. It is important to consider the entire population, not just those who attend for screening.

- Insurers base their coverage decisions on current utilization (i.e., the 50% that use the services).

Case Study 2: A 30-year-old's only eye test was at the MTO when he got his driver's license. He passed that test so thinks he sees well. He has noticed lately that he needs to be closer to street signs before he can identify the street name. He blames this on the poor placement of the signs by the city

Question 1: Why do we support this recommendation?

- Need to consider the safety of the individual and others. They often cannot see well but are in denial and will not seek treatment.
- Increasing the number of assessments means increasing the likelihood for treatment outcomes; early treatment = better outcomes.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Need to communicate the importance of proper eye health, identifying refractive errors and driving safety.

Case Study 3: A 39-year-old construction worker has never had an eye examination. He doesn't think he has any problems. He has his 8-year-old daughter read the price tags for him at Canadian Tire.

Question 1: Why do we support this recommendation?

- Cost to the family and society is increased if the individual has an accident (e.g., while driving, on the job etc.).

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Visual problems can directly impact the safety of an individual (e.g., on the job), leading to increased costs to the patient and their family as well as decreased productivity and quality of life.

Vote 4: Adults aged 20-39 years should be examined every 2 to 3 years (consensus; median =9).

Final Recommendation: Adults aged 20-39 years should undergo a complete eye examination every 2 to 3 years.

Adults (40 to 64 years)

Original Recommendation: Adults aged 40 to 64 years should have a complete eye examination at least every 2 years.

Following an overview of the evidence (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- Refractive error is the most common cause of visual impairment within this age group. Cataracts also start to develop at this age.
- If the screening interval is greater than 2 years, this dramatically increases the risk eye disease going undetected.
- Myopic individuals will often attend for regular appointments, a hyperope may not.

Vote 1: Adults aged 40 to 64 years should have a complete eye examination at least every 2 years (consensus, median = 9).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1: A 42-year old female executive from Manulife has never had an eye examination. She uses a large font size on her computer and has her secretary look up phone numbers for her. The company requires her to have annual physical examinations. At her last visit her family physician told her that she was borderline hypertensive and needed to de-stress.

Question 1: Why do we support this recommendation?

- There are many changes in reading occurring at this age, along with other health issues.

- Most often with healthy adults of this age, optometrists are their first contact with a health care professional in a while as they do not have the need to see a physician.
- Reading glasses are detrimental to vision but this is the option that many go for instead of visiting an optometrist for a complete eye examination.

- Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?
  - Prevention and early intervention to ensure lifelong vision, while reducing the cost to society in the long term.
  - Individuals often forget that optometry is part of the health care team. They need to be reminded of this.
  - Most insurance plans, except for those of teachers, will not cover eye care extensively.

Case Study 2: A 55-year old who is a heavy smoker had an eye examination 5 years ago and everything was "normal". The doctor did mention that there was something different about the inside of his eye but he can't remember what. He is currently using a pair of +2.50 reading glasses from the pharmacy. He notices that straight lines look a little wavy but doesn't do a lot of near work so he isn't concerned.

Question 1: Why do we support this recommendation?

- Early detection leads to early treatment (prevention).
- Many adults are in denial about their vision changes. However, if it is recommended that they be screened regularly, they will often comply.
- A primary reason adults do not seek optometric care is because they purchase reading glasses. This, however, does not cancel out the need for a full eye examination to screen for other ocular health issues.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Early detection leads to early treatment.

Case Study 3: A 64 year-old does have glasses for distance but only wears them when she is driving. She has some readers that she uses when she is doing a lot of near work. She has stopped driving at night due to glare from oncoming headlights. She blames it on those new "blue" lights that some cars have. She's okay driving during the daytime so she just makes her husband drive at night.

Question 1: Why do we support this recommendation?

- If this recommended is followed, the deficit will be detected earlier and treatment can be initiated.
- Screening in this age group will pick up progressive vision issues (e.g., visual problems at night may move into the daytime as well). This will ensure lifelong vision and increased quality of life.
- This individual does not think she has a problem; therefore, education about regular eye care and how these problems could progress needs to be shared.

- Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?
  - Need to communicate with GP's as vision is starting to change rapidly within this age group. There is the possibility of educating the individual about the importance of seeing an optometrist at the time of their regular physical examination.
  - Age-related changes in vision can occur earlier than 65+ years, especially early cataracts.

Vote 2: Adults aged 40 to 64 years should have a complete eye examination at least every 2 years (consensus, median = 9).

Final Recommendation: Adults aged 40 to 64 years should undergo a complete eye examination every 2 years.

Older Adults (65 years or older)

Original Recommendation: Older adults aged 65 years or older should have a complete eye examination on a yearly basis**.**

Following an overview of the evidence (see Appendix G, column entitled 'Overview of Findings'), several key points emerged from the subsequent discussion:

- There is extensive literature available for this age group. There is good strong evidence supporting the frequency of eye examinations.
- Changes in refractive error increase dramatically after 75 years of age.
- According to the CURES study, 52% of vision problems in this age group are correctable by changing glasses (Robinson 2011).

Vote 1: Older adults aged 65 years or older should have a complete eye examination on a yearly basis (consensus, median = 9).

As consensus was reached, the participants subsequently discussed the appropriateness of this recommendation with respect to a specific case study.

Case Study 1: A 68 year-old has found that he no longer needs his reading glasses. He is ecstatic and believes that those eye exercises that he found on YouTube are finally starting to work. He decides to buy a new sports car to celebrate.

Question 1: Why do we support this recommendation?

- The recommendation is evidence-based.
- Age-related changes can occur earlier than 65 years of age.
- Annual examinations ensure that vision meets the minimum requirements for driving. Thus, protecting their safety and the safety of others.
- Screening every year is too frequent as usually there is no change in their vision.
- By this age, they are old enough to know when they should be coming in; they should know when their vision is changing.
- A problem with this recommendation is that older adults will visit an optometrist annually because this is the recommendation, even if there is no change in their vision. This creates long wait times and patients with an actual problem must wait longer to see an optometrist while their condition may worsen.

- Examining older adults annually is a waste of resources and money.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Having 20/20 vision does not mean perfect eye health.
- As optometrists may not be an older adult's first contact with the health care system, we need to communicate to GP's, senior health teams etc. the importance of regular eye examinations.

Case Study 2: A 75 year-old finds that reading is becoming more difficult. She finds that letters appear doubled and she sometimes loses her place. She accepts this since she feels it's a normal part of aging.

Question 1: Why do we support this recommendation?

- Early detection leads to early treatment
- There is evidence-based data to support this recommendation.

Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?

- Need opportunities to educate the public about the recommendations and the importance of regular eye care.

Case Study 3: The children of an 80 year-old man notice that his car fenders appear to have several new dents in them. The father when questioned reports that everything is fine and the dents have always been there. His wife tells the children that Dad was in a collision with a city bus last week and was cited for failing to give way. Everyone blames it on Dad's notorious impatience.

Question 1: Why do we support this recommendation?

- There is evidence-based data to support this recommendation.
- If older adults undergo annual examinations, then we can ensure that their vision is adequate.
- Annual examinations will ensure that their vision meets the minimum requirements for driving.

    - It is not just refractive error occurring within this age group, but other ocular health problems as well (e.g., cataracts, macular degeneration etc.).
- Question 2: What do we need to communicate with other professional groups, consumers, patients and policymakers about this recommendation?
    - There is a need to increase awareness about the importance of regular eye care.
    - Early detection leads to better outcomes.
    - Most times an optometrist is not their primary contact within the health care system. Therefore, we need to communicate the importance of annual examinations with other health professionals, such as physicians and other senior resource centres and groups. Communication could also occur via social media sites such as Facebook, the use of government publications, senior's newsletters, and social services to ensure that they are seen earlier.

Additional discussion occurred following the case studies. The key points discussed included:

- An older adult may not need to come in, and their optometrist will inform them of this. However, it is likely that they will still be examined because that is the recommendation.
- Insurance companies dictate when older adults should see an optometrist. Therefore, it is imperative that insurance companies are made aware of these guidelines.
- Add to all recommendations: or as recommended by your optometrist.

Vote 2: Older adults aged 65 years or older should have a complete eye examination on a yearly basis (consensus, median = 9).

Final Guideline: Older adults aged 65 years or older should undergo a complete eye examination annually.

Discussion: All Age Groups

- The expert committee recommended that these guidelines be reviewed every 5 years (as most policies are in agreement with this time period). However, the process should not be as intensive as this workshop.

    - Recommended looking at utilization rates based on these new recommendations to examine the uptake of these new guidelines.
- The RAND/UCLA model ensured the transparency of the guidelines since it is the most rigorous tool and it facilitated step 10 of the AGREE instrument.
- The committee queried whether there was a way to influence research funding to fill the knowledge gaps in this area? It is hoped that this workshop will encourage this.
- The committee suggested that all recommendations be stated in a consistent fashion.
- For the external review, it was explained that University of Waterloo optometric patients would be surveyed. The committee expressed concern as this population includes those already going for an exam and they are also primarily an urban population. They discussed the possibility of doing a multi-centre questionnaire in optometrist's offices (with national representation) as provincial differences may exist. However, we will need to keep in mind the language barrier. They also discussed the possibility of having focus groups through the CAO (contact: Carol Doman).
- It is important that GP's are on board with these recommendations.
- As the CNIB is a large advocacy group, they should also be involved in rolling out policy.
- Need to provide education to parents as they often notice changes in their child's vision first.

Knowledge Translation and Communication

Workshop participants were asked to respond to two questions regarding the knowledge translation and communication of the frequency of eye examinations guideline.

Question 1: What questions would you like to ask patients and consumer groups?

- Do you understand the guidelines?
- Is the wording of the policy clear, concise and understandable?
- Do you agree with the recommendation for each age group? Your age group?
- Would you follow this guideline? Are you currently following the recommendation for your age group?
- What are the barriers to adherence to the guideline? Is cost a barrier to adherence?
- Do you know what an exam would cost if not covered by insurance?
- Should vision be covered under the Canadian Health Act?

- On a scale from 1-10, how much do you value your vision?
- Would you attend an educational session based on your eye health?
- Additional comments/questions?

Question 2: What ideas do you have about how to communicate the Guidelines with professional groups?

- Ask stakeholders to spread the information to others beneath them. Need support from other professional groups (including Association of Nurse Practitioners, public health nurses, GP's, educators, insurers, workers compensation groups etc.). There is also a need to communicate this guideline to parents.
- Within education sector, need get message out to children, early elementary school teachers.
- Meet with The Canadian Ophthalmological Society to individually explain each recommendation and possibly reach an agreement.
- Circulate papers and invite stakeholders to presentations. Publish guideline in newspaper articles, non-optometric academic journals, prevention magazine, social media sites including Facebook and Twitter etc.
- CNIB is a strong advocate for eye health. They would likely be willing to aid in the dissemination of the guidelines as they are currently in partnership with the CAO (pamphlets).
- Disseminate this information through the National Public Awareness Campaign.
- Integrate the Guidelines in to the current CAO TV campaign.
- Cross-referencing between organizations: Ontario and National Eye Health Council.
- Produce magnets where you can record information on your next eye examination.

3.1.3.1 Workshop Evaluation

Prior to the conclusion of the workshop, each participant was asked to complete an anonymous workshop evaluation form (see Appendix I). The purpose of this evaluation was to inform the research team of the benefits and limitations of the workshop process, format and materials. Overall, the results of the evaluation were positive and participants expressed gratitude for their involvement in the research. Detailed results of the evaluation are presented in Table 2.

Table 2. Results of the Workshop Evaluation

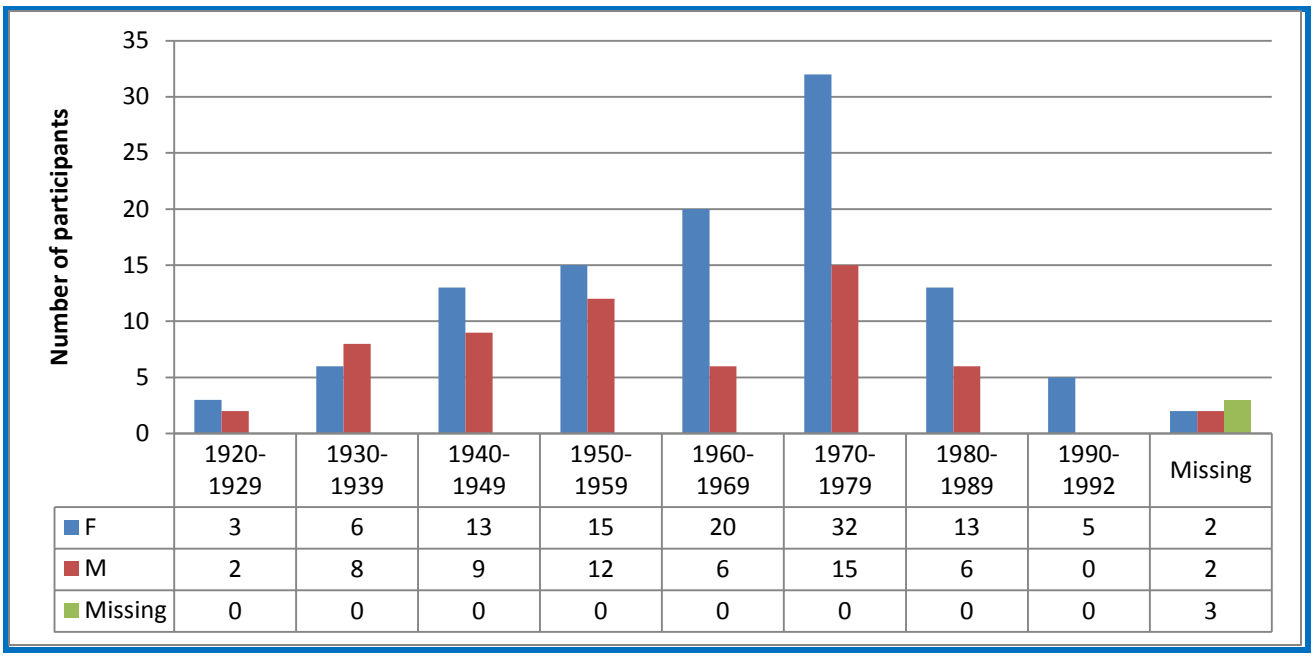
Question	Responses[1]
1) The pre-reading materials provided me with the background information I needed to fully participate in the workshop.	Median = 4.0 Mean = 4.2
2) The workshop process gave me worthwhile opportunities to contribute to a formal consensus process	Median = 5.0 Mean = 4.4
3) The discussions gave me worthwhile opportunities to contribute my clinical experience	Median = 4 Mean = 3.9
4) The workshop was valuable	Median = 5.0 Mean = 4.3
5) What were the strengths of this workshop process?	• Expertise involved in decision-making. • Captured differing opinions. • Well organized and lead. • Defensible methodology for guideline development.
6) What were the limitations of this workshop process?	• Need to receive background information earlier. • Shorter time period for workshop. • Slow moving. • Lack of evidence for the 20-39 year old age group. • Research includes those patients screened; it does not consider the entire population. • Would have been advantageous to compare developed guideline with current CAO guideline or other available eye examination guidelines.
7) Other comments	• Great job. • Research is needed in this area.

[1] Where 1 = strongly disagree and 5 = strongly agree

3.1.4 Results from the External Review of the Recommendations

3.1.4.1 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%) (see Figure 2). Regarding current frequency of eye examinations, the majority of the sample reported have their eyes examined every two years (46%).



	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1992	Missing
F	3	6	13	15	20	32	13	5	2
M	2	8	9	12	6	15	6	0	2
Missing	0	0	0	0	0	0	0	0	3

Figure 2. Optometric Patient Demographic Characteristics: Gender and Year of Birth

In order to provide an external review of the guideline, Questions 1, 2 and 3 of the questionnaire were posed to optometric patients (see Appendix N). Additional questions (4, 5, 6, 7, 8, and 9) were also included on the questionnaire as they were of interest to the research team. However, the responses to these questions were not used to judge the quality of the guideline.

Questions Used for the External Review of the Guideline

In response to Question 1 of the questionnaire, almost all participants who responded agreed (responded 'yes') that they understood the recommendation for each age group (see Table 3). For infants and toddlers, the greatest source of misunderstanding surrounded the wording of the recommendation. For example, one participant stated that, "… by at least 9 months is ambiguous" while a second participant asked, "Do you mean before 9 months or after?" As a result, we modified the original recommendation wording from 'at least 9 months' to 'between 6 and 9 months'.

Table 3. Question 1: Do you understand the 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	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

For Question 2, 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'. The reasons provided for not being able to follow the guideline recommendation included: for school age children, annual examinations are not necessary unless there is a problem; for adults aged 20 to 39 years, some stated that frequent eye examinations are not necessary unless there is a problem, while others stated that eye examinations in this age group should be more frequent; for adults aged 40 to 64 years, most could not adhere to the guideline as they felt that annual examinations should be necessary due to rapidly changing vision in this age group; and, for adults aged 65 years and older, it was noted that annual examinations are too frequent and they may be unable to adhere to the recommendation due to their health status or ability to attend an appointment.

In order to capture the appropriateness of the guideline for the age groups not meeting the eligibility criteria for study participation (infants and toddlers, preschool children and school age children aged 6 to 17 years), Question 3 was asked. For this question, only participants who had a dependent(s) were to provide a response. Overall, most agreed (responded 'yes') that they could follow the guideline recommendation for the corresponding age group of their dependent(s) (see Table 4). For those who could not follow the guideline, the following reasons were provided: infants and toddlers are too young to be examined; preschool children should be examined more frequently; for school age children, unless there is a problem, annual testing is not necessary; for adults aged 20 to 39 years, unless they have coverage through their school/employer eye examinations every 2 to 3 years is too costly; and adults aged 40 to 64 years should be examined annually as vision changes rapidly in this age group.

Table 4. Question 3: If you have dependents, for each age group that applies, do you feel the recommendation is appropriate (i.e., it could be followed)?

	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**

Questions of Interest to the Research Team

Questions 5a and 5b asked participants to indicate whether they were currently covered under insurance for eye examinations and whether a lack of coverage would prevent them from following the guideline, respectively (see Table 5). For those individuals with insurance (full or partial coverage) who responded to Question 5b (n = 94), 46% stated that a lack of insurance would prevent them for following the guideline. Conversely, for individuals with no coverage who responded to Question 5b (n = 45), 47% stated that a lack of insurance would prevent them from following the guideline.

Similarly, Question 5c asked participants to indicate whether there were any factors, aside from cost, that would influence their ability to follow the guideline (n = 165). The majority of respondents answered 'no' to this question (82%), while 4% answered 'yes'. Factors that were indicated as being prohibitory in their ability to follow the guideline included: lack of transportation, poor physical mobility, availability of an optometrist, convenience of scheduling an appointment, fear of diagnosis, lack of awareness of guideline and a busy schedule.

Participants were further asked to indicate how much they think an eye examination would cost if not covered by insurance (Question 6; n = 166). Just over half of responding participants (52%) stated that they did not know the cost of an eye examination. For those who stated that they did (48%), the mean cost indicated was $92.25 (range $35-$300).

Table 5. Question 5a: Are you currently covered under insurance for eye examinations? Question 5b: Would not being insured for eye examinations prevent you from following the guideline?

	Full Coverage	Partial Coverage	No Coverage	Total
Yes Coverage	**64**	**36**	**n/a**	**100**
Lack of insurance ***wouldn't prevent*** following guideline	33	18	n/a	51
Lack of insurance ***would prevent*** following guideline	28	15	n/a	43
No response				6
No Coverage	**n/a**	**n/a**	**46**	**46**
Lack of insurance ***wouldn't prevent*** following guideline	n/a	n/a	24	24
Lack of insurance ***would prevent*** following guideline	n/a	n/a	21	21
No response				1
Total non-response				7

For Question 7, participants were asked to specify whether they felt that regular eye examinations should be fully covered by the Canadian government (n = 165). The large majority of responding participants answered 'yes' (90%).

Finally, Questions 8 and 9 focused on guideline awareness and dissemination amongst the general public. First, when participants were asked to indicate the best ways of educating the general public about the guideline, most stated 'television' (n = 108). Other modes of education are highlighted in Table 6.

Table 6. Question 8: What do you think are the best ways of educating the general public about the guideline?

Mode of Education	**n**
Television	108
Print advertisement's (e.g., newspaper)	47
Internet (e.g., website advertisements, social media)	36
Doctor (e.g., informed by GP or brochure at office)	23
Radio	16
Sending pamphlets home from school	15

Secondly, when participants were asked to list the ways in which they would like to be reminded of when their next full eye examination should be, most indicated postcards (n = 90), followed by telephone (n = 78) and email (n = 61).

3.1.4.2 Expert Review Panel

A total of eight individuals were approached to provide feedback on the guideline. Of these individuals, four completed a questionnaire, two did not complete a questionnaire but provided feedback via email, one declined to participate and one did not respond (response rate = 75%). The six individuals who participated included two ophthalmologists, an optometrist, a general practitioner, a university professor with expertise in the field of pediatric optometry, and an ophthalmic epidemiologist. Specific demographic characteristics for this sample were not collected in order to maintain their anonymity.

Regarding clarity of the guideline, one issue mentioned by the expert review panel included the unclear wording of the recommendation for infants and toddlers. This issue was similar to that previously acknowledged by patients. 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 6 months of age was provided by two expert review panel members. They stated that visual problems can be evident at six months of age and that it may even be easier to exam a six month old compared to a nine month old (Mayer & Dobson, 1982; Mutti et al., 2009). In addition, concern was expressed in excluding '6 months' from the recommendation as this is the current norm acknowledged by both parents and clinicians. Thus, by excluding this age in the recommendation, confusion may ensue and the message surrounding proper eye care in infancy may become diluted. Conversely, for the age group of school age children, one panel member suggested that screening may be more appropriate every two years as opposed to annually for children with no risk factors for vision problems. However, they did suggest that children with risk factors continue to be seen annually; a reference to support this claim was provided by the panel member (Jones et al., 2005).

Though most reviewers felt that the guideline development process was adequately described and that the completeness of reporting was of high quality, comments were provided that shed light upon several important issues. First, one reviewer asked whether "extra weight was given to clinical trial evidence?" The response to this question is 'yes', as evidence was

weighted according to the U.S Preventive Services Task Force, which rates clinical trial studies as good quality evidence (reference). Second, it was asked how the expert committee for the workshop was chosen. This information was subsequently added to the methodology section of this report. Finally, one reviewer commented on the exclusion of the start and end dates utilized to conduct the literature review. This information was also added to the methodology section of this report.

Several comments were also provided regarding the literature used to develop the guideline recommendations. 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? Are there any data on harms 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, we explicitly referenced the studies from the literature that provide evidence for the recommendations. In addition, it is important to recognize that the intent of this guideline is not on screening but rather on complete optometric eye examinations. Second, one participant highlighted that two Canadian studies were excluded from the literature review. The specific references for these studies were provided (Perruccio et al., 2010; Jin & Trope, 2011). These references were likely not included as they were published following the completion of the literature review. 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 eye examinations, aside from the COS guidelines, emerged from the comprehensive literature review.

In order to determine the feasibility of implementation of the guideline reviewers were asked to list potential barriers and facilitators. The barriers listed included: insufficient patient education on the benefits of regular eye examinations, lack of guideline promotion by physicians or other health care professionals, inadequate funding and resources to conduct examinations, lack of patient coverage for eye examinations, inaccessibility to eye care professionals, and inadequate screening tests for specific populations. The facilitators listed included: simplistic recommendations, guideline is well justified by the literature, medical student education regarding the guideline, ease of accessibility to optometrists in large cities, and political lobbying.

4.0 Discussion

Through an extensive systematic literature, an expert opinion workshop, and an external review of the recommendations by patients and optometric experts, a final evidence-based guideline for the frequency of typical optometric eye examinations in Canada, as described by the Canadian Association of Optometrists (CAO), was developed. 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.

The first component of the guideline development process included a systematic literature review. The evidence uncovered through this review enabled the formation of individual frequency of eye examination recommendations for each age group under investigation. It is important to note that each recommendation was based on the available evidence. However, in some cases, it was clear that evidence to fully support the guideline was insufficient or lacking. As a result, it was necessary to include optometric experts in our study in order to fill the necessary gaps and to provide further support for each guideline recommendation. This was achieved through an expert opinion workshop. During this workshop, consensus on a recommendation was reached for each age group using both the available evidence from the literature and their own clinical experience. This workshop incorporated a tailored, novel methodology that utilized the AGREE Instrument and RAND Appropriateness method in combination to reach consensus. In addition, a technology-assisted voting system was employed that allowed each participant's response to the recommendation to be captured and analyzed in a timely manner, while ensuring the maintenance of their anonymity. Overall, from this workshop, a primarily evidence-based guideline for the frequency of typical optometric eye examinations in Canada emerged.

As a final assessment of the guideline, an external review was completed as per Step 13 of the AGREE II Instrument (see Appendix J). This step states that a guideline should be reviewed externally prior to its publication in order to improve the quality of the guideline and to assess its applicability and feasibility. This step further explains that the reviewers should not have been involved in the development group, which they were not, and that it should include experts in both clinical and methodological fields, which it did. From this external review, the only substantial modification to the guideline that was made surrounded the recommendation for infants and toddlers.

Specifically, both patients and the external review panel found the recommendation to be unclear and ambiguous. As a result, the recommendation was modified from "Infants aged birth to 24 months should undergo a complete eye examination by at least 9 months of age" to "Infants and toddlers should undergo their first eye examination between the ages of 6 and 9 months." No other significant issues that required our attention were uncovered throughout the external review process.

During the expert opinion workshop, the topic of cost-benefit analyses for regular vision screening was discussed. At this time, several participants stated that the prescribed frequency of eye examinations will depend on the cost of the exam versus the benefits to the patient. As the research team does not possess sufficient knowledge in the field of health economics and limited Canadian studies are available that examine the cost-benefit analysis for eye examination frequency, cost was not considered as a factor in the development of the guideline. However, future research to determine the cost-effectiveness of the guideline may be warranted. In addition, during the external review, one participant provided references to two Canadian studies that were omitted during the literature review (Perruccio et al., 2010; Jin & Trope, 2011). These studies were subsequently reviewed by the research team to determine their relevance to the current study and to ascertain whether additional evidence was present that provided support to a recommendation.

There are a number of limitations associated with this study. First, for the workshop, the expert opinion panel was selected based on their attendance at the Optometric Leaders Forum, which was being held in parallel with our workshop. Participants were not randomly selected; instead, they were recruited from a list provided by the principal investigator. This limits the generalizability of our workshop findings, as their views may not be representative of all optometric clinicians in Canada. Second, social desirability bias may have been an issue, as optometric patients may have been more inclined to answer favourably due to the presence of the student investigator. However, we attempted to temper such bias by ensuring that the investigator did not remain with the participant while they completed the questionnaire and by having the study participant place their own completed questionnaire in a sealed envelope and deposit it within a locked drop box. These strategies ensured that it would not be possible to match the data to a specific participant. Third, the patients who participated in the external review were recruited from a single site, the University of Waterloo Optometry clinic. This may be problematic as these

individuals include a population who are more inclined to seek eye examinations compared with the general public. Therefore, these individuals likely have a vested interest in their eye health and therefore may have been more motivated to respond to each of the questions favourably or in a manner that promoted the guideline. In addition, as we only recruited patients from a single site, caution should be exercised when generalizing the findings to other clinic populations. Although it would have been advantageous to sample patients from various optometric clinics nationally, it was impractical and time-consuming for the scope of this study. Fourth, the majority of questions included in the survey instrument do not have published information regarding their validity and/or reliability as they were created by the research team. It is important to determine whether the survey questions and scales possess adequate validity and reliability in order to ensure accurate interpretation of the survey results.

5.0 Conclusions

This final report is extensive, with transparent and defensible methodology. This report clearly shows where evidence exists and the level of evidence that is available for each recommendation. This report identifies where such evidence is lacking and points out where further research is needed.

It is anticipated that several academic papers will be published from this data (September to December, 2011). Further dissemination of the results and any further review of the frequency of eye examinations guideline will be the responsibility of the Canadian Association of Optometrists.

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