Protocol: Screening for impaired visual acuity and vision-related functional limitations in adults 65 years and older in primary health care

Date & Version: December 7, 2016; Final version 1

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Suggested citation: Pillay J, Freeman EE, MacGregor T, Featherstone R, Vandermeer B, and Hartling L. Screening for impaired visual acuity and vision-related functional limitations in adults 65 years and older in primary health care: protocol for evidence review. Edmonton, AB; Evidence Review Synthesis Centre. Available at: http://canadiantaskforce.ca/ctfphc-guidelines/overview/

Author contribution:

JP drafted the protocol and RF developed the search strategy and provided text for the protocol. JP, LH, EF, and TM contributed to discussions with the CTFPHC and PHAC on the scope for this work. LH, EF, and BV critically reviewed the protocol.

Acknowledgements

We would like to acknowledge the contribution of the following individuals for their clinical and methodological input and/or their review of the protocol:

CTFPHC Working Group: Brenda Wilson (Chair), and the following members: Brett Thombs, James Dickinson, Scott Klarenbach, Maria Bacchus

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External Reviewers: The following individuals represent some of the content experts and stakeholders (6 others remain anonymous) that reviewed a draft version of this protocol during September, 2016. The ERSC and CTFPHC considered all input and responded to all comments.

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Declaration of funding

Funding for this protocol and evidence review is provided by the Public Health Agency of Canada. This funding will support the collection of the data, data management, analyses, and writing of the protocol and the technical report.

Section I. Purpose and Background

The purpose of this review is to examine the evidence on vision screening of community-dwelling older adults (ages ≥65 and not under the care of an eye professional) within primary care. The findings will be used by the Canadian Task Force on Preventive Health Care (CTFPHC)—supplemented by consultations with patients on outcome valuation and with stakeholder on issues of feasibility, acceptability, costs/resources, and equity—to inform recommendations to support primary care providers in delivering preventive health care.

Background

The prevalence of impaired visual acuity and vision-related functional limitations in the world is high. In World Health Survey data from 70 countries (not including Canada), 21% of adults overall reported difficulty in "recognizing a person you know across the road"; this proportion varied by country income status with high-income countries having a prevalence of 13%.[1] In 2007, the total financial cost of vision loss in Canada was estimated at $15.8 billion, and its prevalence was projected to double by the year 2032.[2] Prevalence of impaired visual acuity increases with age. Impaired visual acuity and other problems within the visual system negatively impact functioning and quality of life (QoL); in older adults this has been shown to manifest through various effects such as decreased participation in social and leisure activities, difficulty in family relationships, depressive symptoms, and injuries from accidents including falls.[3-12] They also affect one's instrumental activities of daily living (IADLs), or ability to work, drive safely, or maintain a driver's license.

Terms, Definitions, and Scope of Screening in Primary Care

Visual acuity refers to the sharpness or clarity of vision. Impairment in visual acuity may be caused by problems with the sharpness of the image reaching the retina (e.g. refractive error, media opacities such as cataract), by retinal disease, or by the central processing or interpretation of visual neural signals. The World Health Organization (WHO)[13] uses presenting distance visual acuity to classify individuals into categories of mild or none [≥20/70], moderate [<20/70 to ≥20/200], severe [<20/200 to ≥20/400] visual impairment, with blindness defined as a visual acuity worse than 20/400; the term low vision (replaced by moderate and severe impairment) is not used within the WHO classification any longer, to avoid confusion with the need for low

vision care which often occurs at a less severe threshold of visual acuity and is often not specific to visual acuity.[14, 15] The WHO classification is not always used, particularly in studies from North America which define visual impairment at worse than 20/40, when some form of vision-related functional limitation often begins, and blindness at 20/200 or worse.[16-19] Depending on the jurisdiction, in Canada <20/40 or 20/50 serves as the acuity required for an unrestricted driving license.

Some diversity exists in terminology. Although visual impairment is typically defined by degree of impaired visual acuity, this term may also be used to refer to other problems with visual function (e.g., visual field loss—areas in the field of view/peripheral vision in which objects cannot be seen, lowlight vision, colour vision, contrast sensitivity, binocularity).[15] Likewise, findings related to visual acuity (e.g., severe inability to see, blindness) may be interpreted in terms of vision disability[20] which more often refers to activity or functional limitations resulting from one or more problems in the visual system. For this review, we will use the term *impaired visual acuity* when referring to loss of visual function measured in terms of visual acuity and meeting WHO or North American thresholds (<20/70 or < 20/40); we will use *vision-related functional limitations* when referring to functional deficits such as inability to drive or perform instrumental ADLs (e.g., handle finances, take medication) directly resulting from impaired visual acuity and/or other functional or structural problems within the visual system. Other outcomes that vision loss may contribute to are defined as *potential adverse consequences of vision loss*, such as falls, fractures, depression, cognitive decline, loss of independence, etcetera.

These terms (*impaired visual acuity, vision-related functional limitations, potential consequences of vision loss*) align with a focus on screening tests used most often within primary care, including visual acuity charts (e.g., Snellen, near vision charts) and structured screening questions or tasks focusing on vision-related function (e.g., problems with reading, driving etc.); they also align with the outcomes chosen for this review. When tests (e.g., contrast sensitivity) or outcomes (e.g., anxiety) are used that do not fall into these categories we will use the terminology reported by the authors.

The CTFPHC uses the Institute of Medicine's definition of primary care as, "the provision of *integrated, accessible health care services* by *clinicians* who are *accountable* for addressing a large *majority of personal health care needs*, developing a *sustained partnership* with *patients*, and practicing in the *context of family and community.*"[21] The main clinicians involved are individuals who use a recognized scientific knowledge base and have the authority to direct the delivery of personal health services to patients; the CTFPHC's main audience is primary care physicians and nurses, although the Task Force recognizes the importance and relevancy of their recommendations to community and public health professionals (public health nurses, nutritionists), physician specialists, other health care and allied health professionals. This view aligns with Health Canada's functional definition of primary health care: (i) to direct provision of first-contact services (by providers such as family physicians, nurse practitioners, pharmacists, and telephone advice lines); and (ii) to coordination care to ensure continuity and ease of movement across the system, so that care remains integrated when Canadians require more specialized services (with specialists or in hospitals, for example) (http://healthycanadians.gc.ca/health-system-systeme-sante/services/primary-primaires/about-apropos-eng.php).

For this guideline, we acknowledge that optometrists regularly provide first-contact services and are considered primary care practitioners of the eye and visual system, but they are considered to be outside the scope of this review which is focusing on whether practitioners without considerable eye training or specialized equipment should be routinely conducting limited screening for potential vision problems. Rather, we are considering that optometrists could be sought by other primary care providers should screening indicate further diagnostics and/or treatment. For clarity, throughout this document we use the term *primary care* consistent with the IOM definition whereby there is focus on professionals covering a wide range of personal health care needs. We use the term *eye professional* to indicate optometrists or ophthalmologists.

Prevalence and Incidence of Impaired Visual Acuity in an Aging Population

Several studies in Canada and other developed countries have documented the prevalence of impaired visual acuity in older populations. The 2006 Participation and Activity Limitation Survey[22, 23] found that Canadians aged 75 years and older were significantly more likely than

respondents aged 15 to 24 years to have a "seeing limitation" (13.4% vs. 0.5%); more older than young people with limitations said they were severe (30.5% vs. 16.7%). Prevalence of best-corrected impaired visual acuity (<20/40) was between 2.62% (65-74 years) and 18.1% (85+ years) in a representative sample of Canadians attending ophthalmologists' practices in northern British Columbia.[17] A more recent population-based Canadian study found prevalences of impaired visual acuity (<20/40) of 3.9% (60-69 years) and 7.5% (>80 years) and an overall reduced visual acuity (<20/25) prevalence of 16.4%; an odds ratio (OR) of 3.56 (95% confidence interval [95% CI], 1.22–10.35) was found for impaired distance visual acuity in older (≥65 years) versus younger (39 to 64 years) people.[18]

Authors of the large-scale, population-based United States Beaver Dam Eye Study estimated 20-year incidences of impaired visual acuity (best corrected <20/40) of 3%, 14.8%, and 30.3% for people aged 60, 70, and 75 years or older (respectively);[24] an earlier report[25] found that 75 year olds were 12.8 times more likely (95% CI, 9.6 to 17.1) to develop impaired visual acuity over 15 years than those younger than 75 years. Other large studies in the United States (U.S.), Australia, and Europe have also found the prevalence of impaired visual acuity to increase dramatically (up to three-fold) over the age of 60.[26-28] Baseline prevalences of impaired visual acuity were 12% (<20/70) and 20% (<20/40) for the universal screening arm in a randomized trial in the UK of multidimensional assessment and management of older adults living in the UK.[29]

In general, reports from developed countries suggest that impaired visual acuity (as presenting or best corrected with refraction) typically affects about 10% of people ages 65 to 75 and 20% over 75; Evans *et al*[30] reviewed several studies, both population-based and selected samples, examining the prevalence of presenting impaired visual acuity worse than 20/40 in older adults. Prevalence rates in those 65 and older ranged from 11% in those attending an emergency department in a socially deprived area of London to 51% in those admitted to the geriatric department of a London hospital with an acute medical illness.[30] Residents of nursing homes are reported to have at least three times higher levels of impaired visual acuity than community-dwelling older adults.[31-34]

Etiology and Treatment for Conditions Causing Visual Impairment

Although uncorrected refractive error is the most frequent cause of impaired visual acuity,[18, 35, 36] cataract, macular degeneration, diabetic retinopathy, and glaucoma are the next most frequent causes and predominate as causes of visual impairment in older ages.[35] For example, a large study in the U.S. found that, until age 60, impaired visual acuity was due to uncorrected refractive errors in the majority of individuals (85–90%) while, after 60, at least 40% of impairment was caused by other ocular disease.[36] Glaucoma can cause vision loss (mainly from visual field loss) and diabetic retinopathy can cause impaired visual acuity, but screening for these conditions is not the focus of this review on screening in primary care settings. Glaucoma screening requires equipment (e.g., for visual field testing and viewing the optic nerve) and expertise only infrequently employed in a primary care setting, and testing for diabetic retinopathy is considered case finding (rather than screening) by specialist practitioners within a group of people with a high risk of acquiring the condition.

Refractive Errors. Refractive errors comprise myopia (nearsightedness), hyperopia (farsightedness), astigmatism (difference in refractive error in two meridia), and presbyopia. They occur when the eye is unable to bring parallel rays of light from infinity into focus on the fovea. Presbyopia, which occurs due to the eye's natural aging (e.g., loss of flexibility in the lens at about age 45), is the loss of the eye's ability to change its focus to see objects that are near. Impaired visual acuity may exist with or without refractive correction; for the purposes of this report we focus on presenting, or habitual, visual acuity. Refractive errors can be treated with spectacles, contact lenses, or reading glasses. Refractive errors may also be corrected with refractive surgery (e.g. laser in situ keratomileusis [LASIK] or epithelial keratomileusis [LASEK]), although this option is more often selected in younger adults.[37] Improvement in vision-related QoL of older persons has been demonstrated when uncorrected refractive error is corrected.[38, 39] In many people, though, impaired visual acuity may not be fully corrected due to unrecognized deterioration or severity beyond the corrective ability. Both refractive lenses and surgery are considered effective for correcting refractive errors and improving vision-related function in older adults with little harm.[40]

Age-Related Macular Degeneration (AMD). Age-related macular degeneration (AMD) is the most common cause of legal blindness in individuals over the age of 65 in North America.[35] It has been estimated that AMD causes about 50% of all cases of blindness in old age.[41] AMD affects the central retina, leading to progressive loss of central vision (i.e., blurring vision) and, if

severe, to scotomas (complete loss of central vision). The disease is multifactorial with a genetic component.[42, 43] Etiology includes retinal photoreceptor cell death, resulting from intrinsic cell death as in late stage dry (atrophic) AMD, or new vessel formation originating from the choroid (wet AMD).[44] Treatments available for wet AMD include thermal laser, photodynamic therapy, and antiangiogenic (anti-VEGF) drugs administered into the vitreous cavity.[45] Today anti-VEGF therapy dominates treatment. For both dry and wet AMD, aims are early identification and prevention of progression and permanent vision loss; rehabilitation strategies are also available to reduce associated harms (see Additional Therapy and Services below). Antioxidants and zinc have been shown to reduce conversion of dry to wet AMD.[46, 47] One large randomized trial,[46] the Age-Related Eye Disease Study, has shown reduced conversion to wet AMD (OR, 0.64; 95% CI, 0.50-0.82), and decreased risk of moderate (15+ letters) visual acuity loss (OR, 0.76; 95% CI, 0.63-0.93) from combined antioxidant and zinc supplementation over 10-year follow up in patients with early to advanced AMD. Tobacco smoking has been shown to be the principal modifiable risk factor for development and progression of AMD,[42, 48-50] such that smoking cessation interventions are speculated to potentially offer considerable benefit. Another modifiable risk factor is sun exposure (≥ 8 hours daily).[51]

Cataracts. Cataract occurs when denaturation of lens proteins in aging eyes cause the normally transparent lens to opacify, leading to blurring of vision, increased sensitivity to glare, and loss of contrast sensitivity. Cataracts represent the second most common cause of correctable impaired visual acuity after the correction of refractive error.[27, 52] Advancing age remains the most common risk factor, with progression typically extending over a long period of time. Other common risk factors include diabetes mellitus, smoking, alcohol, history of ocular trauma, ultraviolet light, and previous intraocular inflammation or surgery (e.g., for glaucoma).[53, 54] The most common treatment is surgical cataract extraction and intraocular lens implantation. Phacoemulsification, involving small incisions and soft artificial lens insertion, is the most commonly used method for removing the lens in developed countries.[55, 56] Based on a large number of observational studies and widespread clinical consensus, cataract surgery is believed to be highly effective in improving visual acuity without a high complication rate (including progression to wet AMD), in patients with mild to advanced cataracts.[40] Cataract surgery is the most common surgical procedure performed in health services in high income countries, leading to great public health implications.

Additional Therapy and Services

Vision Rehabilitation Therapy and Treatment. When other treatments do not adequately correct impaired visual acuity or improve vision-related function, or are contraindicated or otherwise not used, vision rehabilitation therapy and treatment should be considered.[14, 57] This can include training (e.g., eccentric viewing in AMD) and/or devices to improve vision-related tasks such as reading and mobility. Home modifications may be undertaken to improve visibility using contrast and lighting modifications. Optical devices are also often used, including magnifiers and high-magnifying videos. These services can include multidisciplinary assessment and training by optometrists, ophthalmologists, and others including social workers, occupational therapists, and orientation and mobility professionals; multidisciplinary clinics are located in some Canadian provinces including Ontario (n=10), Quebec (n=14), Alberta (n=2), and Manitoba (n=1), but in others, optometrists work independently to provide assessment and devices, with referral to the Canadian National Institute for the Blind (CNIB) for other aspects of rehabilitation.[14] There is also heterogeneity in the availability and extent of government funding for these services. A model has been proposed recently for integrated low-vision rehabilitation services in Canada.[14]

Organizations Serving People with Impaired Visual Function and Blindness. In Canada, the largest agency serving people with impaired visual acuity and blindness is CNIB which has nine geographic service divisions and over 60 regional offices; there is also a CNIB Library for the Blind which serves all areas of Canada. CNIB operates a variety of rehabilitative, low-vision and social service programs, as well as prevention of blindness and public education programs. Several other organizations exist within the country to provide services, with a few examples being the Canadian Council of the Blind (an organization of consumers), the *Institut Nazareth et Louis-Braille*, and MAB-Mackay.

Social Programs. Other supports exist for people with severe vision loss that meets certain criteria. According to the Canadian Ophthalmologic Society[35] "identification can lead to access to financial resources, through disability pensions or social programs geared to the visually impaired, that may enhance quality of life despite poor visual status." Although the national disability pension benefit program (Canadian Pension Plan Disability Benefits) is only offered to those under 65, disability tax credits and savings plans are available and provincial social assistance and support programs exist (e.g., Alberta's Cross Disability Support Services and Adult Health Benefit Program, British Columbia's Disability Assistance Program, the Ontario

Disability Support Program, PEI's Disability Support Program). In view of the possible impact of vision-related functional impairment on social roles and relationships, some Canadian experts have called for the creation of more community and other targeted interventions for allowing people to maintain active social participation.[11]

Screening Tests in Primary Care

Screening for impaired visual acuity or vision-related functional limitations in primary care does not imply replication of the comprehensive eye examinations (**Appendix A)** used in offices of eye professionals. Although eye professional organizations consider a comprehensive eye examination a form of screening (in terms of primary prevention in asymptomatic people),[35] such an examination within this review would be considered diagnostic in nature and would not be feasibly conducted in primary care. The intent of screening in primary care would be to use simple tests (with sufficient accuracy) to attempt to identify individuals with impaired visual acuity or other problems causing functional limitations, but who have not sought eye assessments or care themselves, for referral to, or care coordination with, eye or other professionals. Screening tests that would likely be feasible for application by a primary care provider without specialized equipment or extra training can be categorized into three groups: direct tests of near or far visual function (e.g., acuity tests with reading or describing text or symbols on charts or pages), direct clinical examination of the eye and its structures (e.g., fundoscopy), and structured enquiry about vision-related functional limitations/problems, either posed directly by a practitioner or by questionnaire. Screening tests may be used alone, or in combination with other tests evaluated within multicomponent assessment strategies (e.g., comprehensive geriatric assessments). As such, screening may be situated within prevention programs or interventions.

Eye Function Screening Tests

Most tests of eye function used in primary care practice will focus on testing for visual acuity. There are numerous charts used for near and distance visual acuity testing, but the most common charts are the Snellen (distance) and ETDRS charts (versions for near and distance).

***Snellen Chart*.** First introduced in 1862, the Snellen chart is a commonly used test in primary care because it is readily available and quick to perform.[58] The chart assesses high contrast visual acuity, using letters of different sizes arranged from largest at the top to smallest at the bottom, read one eye at a time or with both eyes from 6 meters (20 feet). It is scored using the line assignment method where most credit is given for lines read correctly, not letters. Results are

usually expressed as a fraction with the numerator equal to the distance from the chart and the denominator being the size of the smallest line that can be read. A person with 20/100 vision would need to be 20 feet away to read the smallest letters that someone with "normal" (20/20) vision could read at 100 feet. The fraction can also be given using the metric system (6/6 in meters is equivalent to 20/20 in feet) or using the decimal or the logarithm of the minimum angle of resolution (logMAR) conversion (Table 1). In logMAR units, lower scores represent better vision. Despite ease and widespread use, there are several disadvantages of the Snellen chart, including a lack of "crowding" control (i.e., letters and lines in good acuity regions are too close together affecting contours and acuity), a different number of letters per line, difficult statistical assessment (parametric analysis cannot be performed with its variable progression sequence), high test-retest variability, and lack of standardization.[58] Snellen charts from different manufacturers may use different fonts, different letters, and different spacing ratios, and they may be illuminated or projected differently.

Table 1. Conversion of Snellen acuity into logMAR, decimal, and metric units

logMAR	SNELLEN	DECIMAL	SNELLEN (METRIC)
1.5	20/640	0.03	6/192
1.4	20/500	0.04	6/152
1.3	20/400	0.05	6/120
1.2	20/320	0.063	6/96
1.1	20/250	0.08	6/76
1.0	20/200	0.10	6/60
0.9	20/160	0.125	6/48
0.8	20/125	0.16	6/38
0.7	20/100	0.20	6/30
0.6	20/80	0.25	6/24
0.5	20/63	0.32	6/19
0.4	20/50	0.40	6/15
0.3	20/40	0.50	6/12
0.2	20/32	0.63	6/9.5
0.1	20/25	0.80	6/7.5
0.0	20/20	1.00	6/6
-0.1	20/16	1.25	6/5
-0.2	20/12.5	1.60	6/3.75
-0.3	20/10	2.00	6/3

ETDRS Chart. A more standardized test available and considered the gold standard for clinical trials is the ETDRS chart which is an adaptation of another (Bailey-Lovie) chart and named after the Early Treatment of Diabetic Retinopathy Study.[59] The frequency of its use in primary care in Canada is not known but it appears to be feasible and practical for this setting. This chart has letters with equal legibility, rows with an equal number of letters, a true log progression in letter sizes down the chart, and consistent spacing between letters and rows (i.e., controlled crowding). These charts were developed to improve accuracy and repeatability, thus improving accuracy of longitudinal follow-up measurements. The test-retest reliability of the ETDRS charts (about ±0.10 to 0.15 logMAR [1 to 1.5 lines] in normal vision)[60-63] has been shown to be significantly better than with Snellen charts (up to ±0.33 logMAR[64]); the variability of both charts increases in poor vision situations,[65-67] and may be higher in typical than research setting usage.[60] Scoring for this chart is by letters read correctly (not lines) and for statistical analysis, acuity scores from both the Snellen and ETDRS charts can be converted into logMAR units. ETDRS charts are thus not synonymous with "logMAR charts" as they may be called.

Other Tests. Other visual acuity testing can also be assessed using a handheld card or other screening tools; a common threshold of reduced visual acuity is an inability to read a newspaper at a normal reading distance of 40 cm with best refractive correction.[68] Tools exist (e.g., Tumbling Es, Landolt C, Lea test) that incorporate symbols/optotypes that do not require familiarity with the Roman Alphabet. Pinhole testing may detect some, but not all, cases where refractive correction may improve visual acuity; it will not correct reduced acuity due to non-refractive causes such as cataract. Low or mixed contrast sensitivity cards or charts, such as the Pelli-Robinson Contrast Sensitivity Chart,[69] Smith Kettlewell Institute Low Luminance (SKILL card),[70] and Mixed Contrast Reading Card[71] may be used. The Amsler grid, with evenly spaced horizontal and vertical lines on paper, is used to detect retinal defects affecting central vision, including AMD (associated with distortion in the boxes on the grid or blank areas in the grid), although its sensitivity and specificity have been reported as poor.[72]

Clinical Examination of Eye and Its Structures

Clinically significant cataracts can be visualized via physical examination as change of colour or opacities in the lens. Early signs of retinal defects can be observed using fundoscopic examination. The majority of this testing is considered to apply within comprehensive eye examination by eye professionals.

Vision-Related Functional Limitations

Structured screening questions may be used (administered or self-reported) to elicit perceived problems in function (e.g., reading, driving) due to vision, but not specific to visual acuity. Questions may be used alone or within an interview schedule or assessment of various health domains (e.g., comprehensive geriatric assessment).

Rationale for Review of Vision Screening in Primary Care

Although regular eye examinations for older adults within professional vision settings (e.g., optometrist offices, ophthalmologist offices) are promoted, accessible (over 4,500 optometrists in Canada), and widely-funded in Canada, it is unclear whether primary care professionals should routinely screen for impaired visual acuity or other vision problems in this population. Decisions on whether or not to recommend screening in primary care depend on the degree to which identifying problems in this setting leads eventually to benefits that would not otherwise be achieved, and that any benefits achieved would be sufficient to justify any additional harms. Such benefits would include improvements, or prevention of decline, in visual acuity and/or vision-related functioning, and reductions in potential consequences of poor vision such as fractures or loss of independence. One factor is whether most older adults are routinely visiting eye care professionals (regardless of whether they have symptoms), or if there is a significant number not seeking this care who therefore may have undetected vision problems and may benefit from screening in primary care.

Self-reported data by seniors in the Canadian Community Health Surveys in 2005 suggested that 59% consulted with optometrists or ophthalmologists (in-person or via the telephone) during the previous year.[73] The survey also found that 86% of those with glaucoma, 76% of those with cataract, and 63% of those with diabetes had used an eye care provider in the last year. Despite these data, it is unclear what proportion of people who are not seeking eye professional care—because of complexities related to symptoms (e.g., vision changes can be relatively subtle, progress slowly over time, or occur in persons with cognitive dysfunction or other comorbid conditions) or other barriers to care such as geography or lack of access to resources—would benefit from either doing so, or receiving screening in primary care. Relatively high attendance at eye professional offices by older adults within Canada might be expected due to the widely

available public funding for periodic eye examinations for this demographic; beyond assessment, though, funding for spectacles, low vision services and equipment etcetera is quite variable.[14, 73, 74] Moreover, findings that over 40% of older adults have not sought a vision assessment[73] and that between 11-51% of older adults have undetected but highly correctable impaired visual acuity (<20/40)[30] suggest that there could be benefit from primary care screening.

Relevant Guidelines

Primary Care Physician Settings

The United States Preventive Services Task Force (USPSTF) has, to-date, offered the most relevant guideline in terms of targeting primary care providers (not eye professionals), on visual acuity screening in primary care for adults 65 years and older and not presenting with vision problems.[75] Their 2016 recommendation was "no recommendation" because of "insufficient evidence to assess the balance of benefits and harms of screening for impaired visual acuity in older adults." Of note, the most direct evidence on screening program effectiveness used for this guideline was from trials undertaken in primary care physician offices. Evidence from screening only in community settings or by other primary care professionals was not examined.

The American Academy of Family Physicians recommendation on screening for visual acuity in older adults is in agreement with this USPSTF recommendation (insufficient evidence).[76]

In 1995, the Canadian Task Force on the Periodic Health Exam, an earlier iteration of the CTFPHC, recommended performing visual acuity testing using the Snellen chart and fundoscopy or retinal photography as part of periodic health examination of elderly patients with diagnosis with diabetes for at least 5 years (B recommendation).[77] No recommendation was made for the general population 65 years of age or older.

Eye Professional Organizations

Most guidelines for vision screening are developed within the context of eye professional settings; the term "screening" in such guidelines refers to asymptomatic patients but usually involves tests which go well beyond what is possible in primary care (**Appendix A**).

The Canadian Ophthalmological Society's 2007 recommendations on periodic eye examinations (i.e., by an eye professional) specify comprehensive eye tests for: (i) asymptomatic, low-risk older adults (>65 years) at least every two years (Level 1 evidence), (ii) high-risk (e.g., those with diabetes, cataract, macular degeneration, or glaucoma [and glaucoma suspects], and patients with a family history of these conditions) adults over 60 annually (Consensus), and (iii) symptomatic adults of all ages noting changes in visual acuity, visual field, colour vision, or physical changes to the eye as soon as possible (Consensus).[35]

The Canadian Association of Optometrists recommends adults aged 65 years or older should undergo an eye examination annually (Level 1 evidence using 2001 USPSTF criteria).[78, 79]

The American Academy of Ophthalmology recommends comprehensive medical eye examinations (i.e., by an optometrist or ophthalmologist) every 1-2 years for asymptomatic patients 65 years and older without risk factors; recommendations for those with risk factors are limited to glaucoma.[80]

The American Optometric Association recommends comprehensive adult eye and vision examinations annually for those over 60 and asymptomatic or risk free, and annually or as recommended for those over 60 and at risk.[81]

Section II. Review Scope and Approach

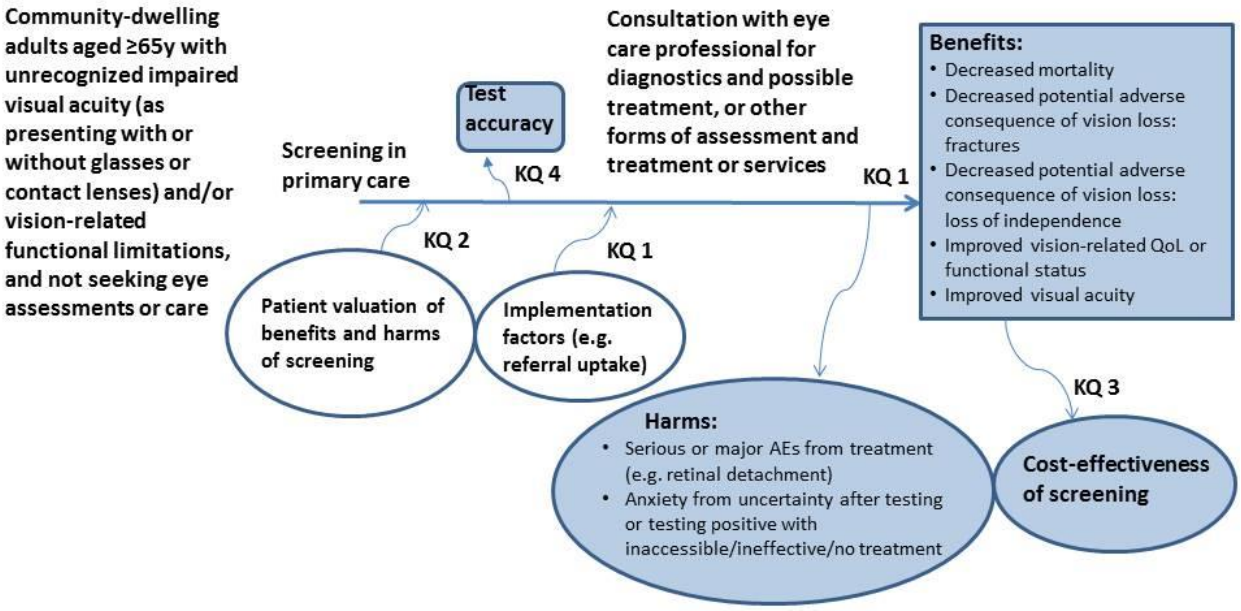
This review will be completed by the Evidence Review and Synthesis Centre (ERSC) at the University of Alberta. The review will be developed, conducted, and prepared according to the CTFPHC methods (http://canadiantaskforce.ca/methods/methods-manual/). A working group of CTFPHC members was formed for development of the topic, refinement of the key questions and scope, and rating of patient-important outcomes considered most important for creating a recommendation. The CTFPHC will not be involved in the conduct of the review including selection of studies and data analysis, but will comment on the draft report and provide input on the interpretations of findings. The Global Health and Guidelines Division science team at the Public Health Agency of Canada provided assistance and input on CTFPHC methodological considerations during the topic refinement and development of the protocol. Perspectives of

patients, and members of the public were incorporated regarding prioritization of outcomes (benefits and harms), and will be engaged once again after the review is complete during guideline development. A draft version of this protocol was reviewed by external topic experts and stakeholders, and all comments were considered when finalizing this protocol. This final version of the protocol has been approved by the entire CTFPHC and will be posted on the CTFPHC website and registered with the International Prospective Registry of Systematic Reviews (PROSPERO) database.

Analytical Framework

Figure 1 is an analytical framework that depicts the structure used to address the Key Questions (KQs) for evaluating the benefits and harms of primary care screening community-dwelling older adults (≥ 65 years) with unrecognized impaired visual acuity or vision-related functional limitations.

Figure 1. Analytical framework



AE = adverse effect; KQ = key question; QoL = quality of life

Staged Approach

A staged approach will be followed based on the quality of the body of evidence assessed using methods developed by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group (http://www.gradeworkinggroup.org/). The GRADE

methods for assessing the quality of evidence (classified as high, moderate, low, very low) are described in more depth later in the protocol, but, essentially, for each critical outcome, a rating of high quality evidence relies on precise and consistent effect estimates from studies having few limitations on internal validity (i.e., not high risk of bias) and examining directly relevant populations, interventions, comparators, and outcomes (i.e., PICOs). The staging approach of the CTFPHC relies on choices made when considering, primarily, the domains of study limitations and indirectness. Moreover, decisions made during the evidence review are based on the information needs of the CTFPHC for making a recommendation based on the balance of critical benefits and harms as defined by transparent rating processes.

Evidence with the potential to provide the most internal validity and direct evidence for the effectiveness of screening programs will be prioritized; that is, the review will start by examining evidence from randomized controlled trials (RCTs) of screening programs reporting on clinically important outcomes (most directly related to PICOTS and analytical framework). Further staging beyond this point will require careful deliberation with documentation of rationale. In cases where data from the initial stage is scarce for certain outcomes (e.g., critical harms) there may be a focused search for data from non-RCTs or observational studies, or trials of treatment, respectively. In cases where evidence on test accuracy and treatment effects may be used to provide indirect evidence on screening program effectiveness, limitations would be recognized that this evidence may not account for several factors (e.g., differences in absolute effects when comparing studies in general screening populations vs. those requiring treatment, follow up on referrals for diagnosis and/or treatment, adherence to screening and treatment, types of screening protocols) that would be captured by direct evidence. Even within this second stage, examining both accuracy and treatment data may not be useful in all cases; for example, if the CTFPHC becomes confident that test accuracy is poor there could be no need to further examine treatment (and vice versa). If the CTFPHC is confident that treatment effectiveness and/or test accuracy has already been demonstrated they may not examine this evidence in any greater depth. In general, subsequent stages will only be conducted when the evidence from the previous stage(s) is non-existent or of too poor quality (based on GRADE summary of findings tables) for the Task Force to make a recommendation based on the balance of critical benefits and harms.

For this review, the first stage will focus on identifying and using data from studies directly linking screening for impaired visual acuity or vision-related functional limitations to patient-important benefits and harms (KQ1). Study designs providing the highest internal validity for this KQ will be preferred with a hierarchy of evidence used after this point if necessary; that is, evidence from RCTs will be our first choice for benefit and harm data, followed by other experimental studies such as non-RCTs which may be defined as *experimental studies including participant allocation by investigators and a priori defined procedures for interventions/exposures and outcome assessment*. If the CTFPHC finds that the evidence from KQ1 indicates a favorable benefit-harm ratio such that screening may be recommended (Stage 1a), we will examine KQ2 on older adults' valuation of benefit and harm outcomes of screening, and KQ3 on the cost-effectiveness of screening programs (Stage 1b).

If this first stage does not provide high enough quality of evidence for making a recommendation, stage 2 will examine indirect evidence for screening effectiveness from data on accuracy of screening tests commonly used in primary care (KQ4). Because the indirectness of this stage 2 evidence would already provide limited evidence on which to base a recommendation, we will only seek data from study designs offering the greatest potential for high internal validity. That is, we will avoid studies having high spectrum bias (e.g., case control studies where cases all have profound or worse visual impairment).

Key Questions*

Stage 1a

KQ1: What are the benefits and harms of screening compared with no screening for unrecognized** impaired visual acuity or vision-related functional limitations in community-dwelling adults ≥65 years of age?

Stage 1b

KQ2: (a) How do community-dwelling adults ≥65 years of age weigh the benefits and harms of screening for impaired visual acuity or vision-related functional limitations, and (b) how do these values inform their acceptance or decisions to undergo screening?

KQ3: What is the cost-effectiveness of screening for unrecognized impaired visual acuity or vision-related functional limitations in community-dwelling adults ≥65 years of age?

Stage 2

KQ4: What is the accuracy of screening tests commonly used in primary care settings for impaired visual acuity or vision-related functional limitations?

*Decision process for staging outlined in section on Staged Approach, i.e. stage 2 is sequential to stage 1 and will proceed only if inadequate quality of the evidence from stage 1. Within stage 1, we will only conduct reviews for KQ2 and 3 if the evidence from KQ 1 (Stage 1a) suggests that screening may be recommended.

**By unrecognized we include people that may have symptoms but have not brought them to medical attention, or do not recognize they have a vision-related dysfunction; they will typically not have actively sought eye assessment or care.

Section III. Review Methods

Integration of Existing Systematic Reviews

To build in efficiencies and capitalize on other work conducted, we will follow our approach to integrating existing systematic reviews where suitable (see **Appendix B**). For this report, our approach will focus on examining existing reviews to identify studies meeting our criteria, with the addition of an update of the evidence to present date using an original comprehensive search; we may rely on other's risk of bias assessments or data extraction (both pending quality checks), but will re-interpret all findings, including assessment of the quality of the body of evidence. All decisions will be documented in the evidence report.

We have identified four good quality systematic reviews (below) to integrate into this review; reviewing their searches, scope, inclusion criteria and included/excluded studies lists indicates that they will capture the large majority of studies for KQ1 to 2012 and KQ4 to 2015.[40, 82-84] Our comprehensive search from 2012 for KQ1 will likely identify several other systematic reviews, which we will also examine to seek potentially eligible studies.

1. Mayo-Wilson E, Grant S, Burton J, et al. Preventive home visits for mortality, morbidity, and institutionalization in older adults: a systematic review and meta-analysis. PLoS One. 2014;9(3): e89257
2. Chou R, Dana T, Bougatos C, et al. Screening for Impaired Visual Acuity in Older Adults: A Systematic Review to Update the 2009 U.S. Preventive Services Task Force Recommendation. Evidence Report No. 127. AHRQ Publication No. 14-05209-EF-1. Agency of Healthcare research and Quality; March 2016.

3. Pleog J, Feightner J, Hutchinson B, et al. Effectiveness of preventive primary care outreach interventions aimed at older people: meta-analysis of randomized controlled trials. Can Fam Physician. 2005;51:124 -1245.
4. Smeeth LL, Iliffe S. Community screening for visual impairment in the elderly. Cochrane Database of Systematic Reviews 2006, Issue 3. Art. No.: CD001054.

Literature Search

A major contributor to our literature search for KQs 1 and 4 for this topic is the reference lists of the four relevant systematic reviews listed above. By reviewing their included and excluded study lists, we are confident that we will obtain all relevant literature for KQ 1 to 2012 and KQ4 to 2015. Further searching beyond this timeframe will be comprehensive.

The literature search strategy will be developed and implemented by a research librarian. The search strategy will consist of both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords, and will be peer-reviewed using the PRESS checklist. Methodological filters may be applied to limit retrieval by study design; study designs included for each KQ are identified in the section on inclusion and exclusion criteria. Searches will be restricted by language to include full texts published in English or French. The dates for inclusion vary by KQ and are included below.

We will conduct comprehensive searches in bibliographic databases most relevant for each KQ. For KQs 1 and 4 (if undertaken), we will search MEDLINE (1946-) via Ovid; Embase (1974-) via Ovid; Cochrane Library; CINAHL (1937-present) via EBSCOhost; and PubMed via NCBI Entrez. If KQs 2 (patients' outcome valuation) and 3 (cost-effectiveness) are conducted, we will modify the search to include relevant terms and will add suitable databases (e.g. PsycINFO for patient preferences, NHS Economic Evaluation Database [EED] for cost effectiveness). Draft search strategies for KQs 1 and 2 using MEDLINE are reported in **Appendix C** and will be adapted to accommodate the controlled vocabularies of each database. Full search strategies for all databases will be included in the final report.

Supplementary searches will be conducted and documented according to CTFPHC methods for grey literature searching, and will primarily include internet-based searches (via adapted Canadian Agency for Drugs and Therapeutics in Health [CADTH] grey literature checklists; https://www.cadth.ca/resources/finding-evidence/grey-matters) and trial registries (ClinicalTrials.gov, World Health Organization International Clinical Trials Registry Platform). Based on consultation with clinical experts, we will identify 2-3 key conference proceedings to hand-search for recent studies not yet published (2014-present). Websites of relevant Canadian stakeholder organizations will be searched. The searches will be supplemented by reviewing the bibliographies of included papers and relevant systematic reviews. We will contact authors (by email with three attempts) of relevant protocols, trial registries, and abstracts that identify studies not located in the searches to obtain any reports or publications of completed studies.

The bibliographic database searches will be updated six to eight weeks prior to publication of the CTFPHC Guideline to identify any new relevant RCTs addressing critical outcomes that may have emerged for inclusion in the review.

All results of the database searches will be imported into an EndNote® database (Thomson Reuters, New York, NY) for reference citation, and into DistillerSR (Evidence Partners Inc., Ottawa, Canada) for screening and selection procedures. Our grey literature search process will be documented in a Microsoft Excel database (Microsoft Corp., Redmond, WA) with literature entering the screening process identified in the PRISMA flow diagram.

Eligibility Criteria

Tables 2-6 outline each KQ's study eligibility criteria based on the population, intervention, comparator, outcomes, timing, setting, and study design (PICOTS-D). Following the tables we have provided details on outcome rating and additional criteria. For this review, the term *unrecognized* is used to represent people who may have symptoms but have not brought them to medical attention, or who do not recognize they have a vision-related dysfunction; they are people who have not recently sought eye assessment or care. Trials including younger participants will be included if the mean age minus one standard deviation (SD) is more than 65 years.

Table 2. Eligibility criteria using PICOTS-D for KQ1: Benefits and harms of vision screening

Criteria	Include	Exclude
Populations	Community-dwelling adults age 65 years and older with unrecognized* impaired visual acuity or vision-related functional limitations ***Population subgroups of interest*:** age (65-74 vs 75-84 vs 85+), socioeconomic status (i.e., education, income), ethnicity (i.e., percent non-Hispanic white versus others), geographical region (rural vs. urban)	Significant portion of participants (>25%) with visual acuity worse than 20/200 (i.e. severe or profound visual impairment) Focus on older adults having characteristics placing them at high risk for vision problems or when screening test application by primary care providers would be considered significantly challenging. This would exclude studies on patients with a history of falls, residency in nursing homes, diabetes, dementia (including Alzheimer's), other disorders of the vision system such as glaucoma as well as stroke, Parkinson's or other conditions making it difficult to participate in vision screening.
Interventions	Vision screening tests, alone or within multicomponent screening/assessment, performed by primary care professionals (may include home- or online-based tools interpreted by primary care professionals) Screening may be followed by interventions including referral and structured treatment or therapy provided by eye care professionals, occupational therapists, or social workers for screen positive participants in intervention arm ***Intervention subgroups***: type of screening test (i.e. self-report vs. charts or other more objective tests; visual acuity vs. vision-related function), active treatment vs. referrals vs. no referrals; health care provider interpreting the tests (physician vs nurse vs other); setting of program (physician office vs. community)	Tests or assessments that only evaluate reading speed or visual field Tests performed by eye professionals
Comparator	No vision screening, delayed screening, attention control (e.g. educational session without tests), screening/assessments involving all components as intervention except vision component; usual care (may include targeted screening/case finding)	Different vision screening test

Outcomes	Benefits: • Mortality • Potential adverse consequence of poor vision: fractures (risk or rate of incidence; will accept falls as surrogate) • Potential consequence of poor vision: loss of independence • Vision-related QoL or functioning: (i) using composite/index scores from validated scales (e.g., Activities of Daily Vision, National Eye Institute Visual Function Questionnaire, Visual Function Index) (ii) non-validated tools involving self-report of functional limitations related to vision (e.g., reading, IADLs) • Presenting (habitual with or without glasses) visual acuity: (i) mean change in acuity in logMAR units (ii) proportion with minimal clinically important change, i.e., change of 0.10 logMAR (ETDRS) (iii) proportion at follow up with acuity equal to or better than 6/18, 3/10 (0.3), 20/70, logMAR 0.5 (i.e., no or mild impairment using WHO classification) (iv) proportion at follow up with acuity equal to or better than 6/12, logMAR 0.3, 20/40 (i.e., impaired visual acuity using North American convention) (v) self-report of visual disturbances (e.g., blurred vision) Harms • Serious or major AEs from associated vision/eye treatment (requiring hospital admission, urgent intervention, causing disability, permanently limiting self-care or activities of daily living or as defined by authors) • Anxiety or stress if true positive/diagnosed but treatment options are limited or inaccessible (e.g., because of real or perceived costs) for condition (e.g., AMD, contraindications)	When vision screening is within a multicomponent screening intervention, the study will only be included in assessment of vision-related outcomes, i.e. not for mortality, falls etc., unless the outcome is attributed directly to a reduced or improved vision by the authors.

	Implementation Factors** • Uptake of referrals (proportion of intervention group) • Eye care professional visits (difference between groups)	
Timing	1980 to present (approximate onset of policy and research on vision screening in primary care screening) Any follow-up duration ***Subgroups***: short-term (0-<6 months), medium-term (6-<24 months), long-term (24+ months) follow-up	
Study designs	Health outcomes & implementation factors: RCTs only Harms: staged to RCTs, then controlled experimental, then controlled observational	
Language	English and French	
Setting	Primary care including physician offices, primary care clinics, community health centres, participant's home, prisons, remote stations	Eye specialist setting Any setting where it could not be reasonably generalizable to a Canadian primary care

***** By unrecognized we include people that may have symptoms but have not brought them to medical attention, or do not recognize they have a vision-related dysfunction; they will typically not have actively sought eye assessment or care.

**Secondary outcome in studies reporting on other outcomes.

Table 3. Eligibility criteria using PICOTS-D for KQ2: Patients' outcome valuation

	Include	**Exclude**
Populations	Community-dwelling adults age 65 years and older with unrecognized* impaired visual acuity or vision-related functional limitations ***Population subgroups of interest*:** age (65-74 vs 75-84 vs 85+), socioeconomic status (i.e., education, income),	Significant portion of participants (>25%) with visual acuity worse than 20/200 (i.e. severe or profound visual impairment) Focus on older adults having characteristics placing them at high risk for vision problems or when screening test application by primary care providers

	ethnicity (i.e., percent non-Hispanic White versus others), geographical region (rural versus urban)	would be considered significantly challenging. This would exclude studies on patients with a history of falls, residency in nursing homes, diabetes, dementia (including Alzheimer's), other disorders of the vision system such as glaucoma as well as stroke, Parkinson's or other conditions making it difficult to participate in vision screening.
Interventions/ Context	Vision screening tests (alone) performed in primary care. We will consider evidence where the assessment is conducted by an eye professional if no evidence is found screening in primary care. Participants must be provided with some information (may not include estimates of effects) on the magnitude and/or types of potential benefits and harms of screening.	Tests or assessments that only evaluate reading speed or visual field
Comparator	Depending on study design, comparator may be no screening or another form of screening (without vision component), or the study may not have a comparison. When only one arm (e.g., screening) of a comparative study is included in the assessment of patient preferences, this study will be classified as a non-comparative study. Comparator may be based on participant characteristics, such as age or socioeconomic status.	Another vision screening test.
Outcomes	• Relative ranking/ratings, or preference/utility weights of benefit and harm outcomes • Willingness to be screened • Acceptability of screening • Uptake of screening • Willingness to pay for screening • Factors related to benefit and harm outcome valuation that contribute to choices for screening (e.g. severity of harm, age, availability of treatment, perceived risk for severe impairment or blindness) • Other outcomes will be considered (e.g. intent to return for another screen)	

Timing	1980-present	
Setting	Primary care including physician offices, primary care clinics, community health centres, participant's home, prisons, remote stations); will accept optometry offices if no other evidence found	Any setting where it could not be reasonably generalizable to a Canadian primary care
Design	All study designs, examples including: • Utility-based stated and revealed preference studies (e.g. contingent analysis or valuation studies including discrete choice experiments, willingness to pay) • Studies used to develop health-state utility weights • Surveys • Qualitative studies (These studies may be embedded within RCTs or other controlled study designs)	
Language	English and French	

***** By unrecognized we include people that may have symptoms but have not brought them to medical attention, or do not recognize they have a vision-related dysfunction; they will typically not have actively sought eye assessment or care.

Table 4. Eligibility criteria using PICOTS-D for KQ3: Cost-effectiveness of vision screening

Criteria	Include	Exclude
Populations	Community-dwelling adults age 65 years and older with unrecognized* impaired visual acuity or vision-related functional limitations ***Population subgroups of interest*:** age (65-74 vs 75-84 vs 85+), socioeconomic status (i.e., education, income), ethnicity (i.e., percent non-Hispanic White versus others), geographical region (rural versus urban)	Significant portion of participants (>25%) with visual acuity worse than 20/200 (i.e. severe or profound visual impairment) Focus on older adults having characteristics placing them at high risk for vision problems or when screening test application by primary care providers would be considered significantly challenging. This would exclude studies on patients with a history of falls, residency in nursing homes, diabetes, dementia (including Alzheimer's), other disorders of the vision

		system such as glaucoma as well as stroke, Parkinson's or other conditions making it difficult to participate in vision screening.
Interventions	Vision screening tests alone, performed by primary care professionals (may include home- on online-based tools interpreted by primary care professionals). Interventions may include structured treatment or therapy provided by eye care professionals, occupational therapists, or social workers for screen positive participants in intervention arm.	Tests or assessments that only evaluate reading speed or visual field Tests performed by eye professionals
Comparator	No vision acuity screening, different vision screening test. delayed screening, attention control, usual care (may include targeted screening/case finding)	
Outcomes	Cost per quality-adjusted life-years (cost per QALY), cost per benefit (e.g. cases of prevented impaired visual acuity), incremental cost-effectiveness ratio (ICER), net benefit/cost	
Timing	1980-present	
Study designs	Economic evaluations	
Language	English	
Setting	Primary care including physician offices, primary care clinics, community health centres, participant's home, prisons, remote stations. Limited to countries rated as having very high Human Development Index	Eye professional setting Any setting where it could not be reasonably generalizable to a Canadian primary care

* By unrecognized we include people that may have symptoms but have not brought them to medical attention, or do not recognize they have a vision-related dysfunction; they will typically not have actively sought eye assessment or care.

Table 5. Eligibility criteria using PICOTS-D for KQ4: Accuracy of vision screening tests in primary care

Criteria	Include	Exclude
Populations	Community-dwelling adults age 65 years and older with unrecognized* impaired visual acuity or vision-related functional limitations	See study design row.
Index	Vision screening tests, that can be performed in primary care settings (i.e., quick, easy to administer and interpret, requires minimal specialty equipment or medication such as dilators)	Tests or assessments that only evaluate reading speed or visual field
Reference Test	Eye examination by optometrist or ophthalmologist	
Outcomes	Sensitivity, specificity, TP, TN, FP, FN, PPV, NPV, inconclusive results, positive and negative likelihood ratios	
Timing	1980 to present	
Study designs	Prospective and retrospective studies where a consecutive or random sample of participants receive both the index test(s) and reference standard, or where participants are randomized to different index tests but all receive the reference standard, and the reference standard is assessed cross-sectionally or within a short timeframe (<3 months) of the index test(s). Staged for inclusion of case-control studies when cases do not all have worse than 20/70 VA.	
Language	English	

***** By unrecognized we include people that may have symptoms but have not brought them to medical attention, or do not recognize they have a vision-related dysfunction; they will typically not have actively sought eye assessment or care.

Outcome Rating

The primary outcomes of interest for this review are listed in Table 2. The outcomes considered most patient-important, thus critical for making recommendations on screening for impaired visual acuity and vision-related functional limitations will be selected based on ratings by members of the CTFPHC, and on the basis of the findings of an engagement exercise with a sample of older adults in Canada, conducted by an independent group with expertise in knowledge translation from St. Michael's Hospital in Toronto, Ontario. All patient-important outcomes rated as critical (7 to 9 out of 9) and important (4 to 6 out of 9) are included up to a *maximum number of seven* per KQ, following guidance based on cognitive limits when guideline panels are considering net balance of benefits and harms per question. We have identified that the outcomes in the category of Implementation Outcomes will be considered secondary outcomes (not important or critical for decision making), therefore these will only be considered when studies also including one or more critical outcome. All outcome ratings will be conducted prior to final study selection and data extraction; that is, the CTFPHC will be blinded to the studies and their results.

Additional Eligibility Considerations

We do not have a minimum sample size for inclusion, nor do we have a minimum threshold for extent of incomplete follow-up or participant attrition; these factors will be considered during assessment of the quality of evidence (e.g., precision domain accounts for sample size across studies), and during sensitivity analyses in cases of substantial heterogeneity in findings at the data synthesis stage (see relevant sections).

Case reports and case series (i.e., group of patients selected based on particular outcome) will be excluded as will be papers not reporting primary research (e.g. editorials, commentaries, opinion pieces). Conference abstracts and systematic reviews will not be eligible for inclusion, but will be examined and serve to help identify full study reports and assess the quality of evidence in relation to potential publication and reporting biases.

Screening and Selecting Studies for Inclusion

For the database searches, two reviewers will independently screen the titles and abstracts (when available) using broad inclusion/exclusion criteria. Citations will be classified as

"include/unsure," "exclude," or "reference" (i.e., conference abstracts, protocols, and systematic reviews). One reviewer will review the "reference" group and will conduct all other searching (e.g., grey literature). The full text of all studies classified as "include/unsure" or identified after reviewing the reference citations will be retrieved for full review; two reviewers will independently assess eligibility using a standard form that outlines the inclusion and exclusion criteria. Disagreements on final inclusion of all studies will be resolved through consensus or third party adjudication. The title/abstract screening and full-text selection processes will be conducted and documented in DistillerSR. The flow of literature and reasons for full text exclusions will be recorded in a PRISMA Flow Chart.

At any stage of screening, we will screen as "include/unsure" studies evaluating multicomponent screening or assessments, where it is not clear if a vision test was incorporated and/or if vision outcomes were collected or analyzed. For this to occur in cases of missing test information at full text review, there must be enough description of the screening/assessment to suggest a vision component may have been included (e.g., mention of physical or medical function, or safety/risk assessment), or mention of referral to a range of specialists. Studies with a clear focus on one or more interventions (e.g., exercise therapy, cognitive therapy) unrelated to eye care will be excluded. For those we screen in but have insufficient data for inclusion/exclusion, we will contact the first or corresponding author by email (via published report or limited internet searching), up to three times over four weeks to obtain further clarification on the intervention and/or whether data for vision outcomes are available. We will accept individual patient data (raw data) on outcomes provided it is delivered in an easily accessible and analyzable format, and that resources allow.

Data Extraction & Reporting

One reviewer will independently extract data from each included study into DistillerSR; a second reviewer will verify data. Disagreements will be resolved through discussion or third-party consultation until consensus is reached.

For each key question, a narrative summary (with accompanying tables) will be provided to report on all studies by design, country of origin, sample sizes, population(s) (including

subgroups), intervention(s)/index tests (including data on thresholds and for subgroup questions), comparator(s)/reference test, setting, and outcome measures, as reported by studies.

When there are multiple publications associated with a study we will consider the earliest report of the main (primary) outcome data to be the primary data source. We will extract data from the primary source first and then add outcome data reported in the secondary/associated publications and data sources. We will reference the primary source throughout the evidence report; all associated literature will be tabulated for reference.

For continuous outcomes measures, we will extract (by arm) the mean baseline and endpoint or change scores, standard deviations (SD) or other measure of variability, and number analyzed. We will not include outcome data from studies that did not provide a follow up change or endpoint scores, or data that could be used to calculate follow up scores. If necessary, we will approximate means by medians. If standard deviations are not given, they will be computed from p-values, 95% confidence intervals (95% CIs), standard errors, z-statistics, or t-statistics. If computation is not possible they will be estimated from upper bound p-values, ranges, inter-quartile ranges, or (as a last resort) by imputation using the largest reported SD from the other studies in the same meta-analysis. When computing SDs for change from baseline values, we will assume a correlation of 0.5, unless other information is present in the study that allows us to compute it more precisely. For dichotomous outcomes, we will report counts or proportions, and sample size, by study arm. For KQ4 (accuracy), we will construct 2x2 tables.

For dichotomous data on harms, unless otherwise reported each adverse event (AE) will be counted as if it represents a unique individual; because a single individual might experience more than one AE, this assumption may overestimate the number of people having an AE. If we were to encounter a study where there is a reason for concern that many events are recorded but likely in a small number of patients, these could be evaluated in sensitivity analyses. Only numerical data for AEs will be extracted; that is, we will make no assumptions on lack or presence of an AE if this is not reported; authors that report only p-values or that one arm had fewer events than another (but where it is explicit that the outcome was captured in the study) will be contacted (3 times via email) to provide the data within 4 weeks.

Data on within-study analysis on or subgroups of interest will be collected, including: subgroups (independent variables), the type of analysis (e.g., subgroup/stratified or regression analysis), the outcomes assessed (dependent variables), and the authors' conclusions. We will collect data suitable for all patient and intervention subgroups (see Table 2) for performing our own subgroup analyses (e.g., stratified analysis, meta-regression) based on study-level data.

Units of Analysis Issues. Unit of analysis errors can occur in studies that employ a cluster design (i.e., a clinical practice) and yet are analyzed at the individual level (i.e., patients), potentially leading to overly precise results and contributing greater weight in a meta-analysis. For trials which are cluster-randomized, for example by medical practice but not individual homes, we will perform adjustments for clustering if this was not done in the published report. We will use an intra-class correlation coefficient (ICC) of 0.01 reported in Smeeth 2002.[85]

Risk of Bias Assessment

Two reviewers will independently assess the risk of bias (ROB) of each included study, with disagreements resolved through discussion or third-party consultation to reach consensus. The results for each study and across studies will be reported by each domain and for the overall ROB score. The ROB for each study will be assessed on an outcome basis where needed, particularly when different outcomes are assumed to have different susceptibilities to bias; for example, subjective outcomes and expected harms are more prone to bias from nonblinding than objective outcomes and unexpected/rare harms.

RCTs and controlled experimental studies (theoretically only differing from RCTs by lack of random sequence generation and not in other ROB domains) will be appraised using the Cochrane Risk of Bias tool.[86] This tool consists of six domains (sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and "other" sources of bias) and a categorization of the overall ROB. Blinding and incomplete outcome data will be assessed separately for patients/providers and outcome assessment, and may also be by outcome (e.g., subjective vs. objective). To assist with outcome reporting bias assessments, we will seek study protocols and studies/data from registries. The overall assessment is based on the responses to individual domains. If one or more individual domains are assessed as having a high

ROB, the overall score will be rated as high ROB. The overall ROB will be considered low only if all components are rated as having a low ROB. The ROB for all other studies will be rated as medium.

Controlled observational studies will be appraised using the Newcastle-Ottawa Quality Assessment Scale;[87] three domains (sample selection, comparability of cohorts, and assessment of outcomes) are evaluated. Each item that is adequately addressed is awarded one star, except for the "comparability of cohorts" item, for which a maximum of two stars can be given. The overall score is calculated by tallying the stars. We will consider a total score of 6 to 8 stars to indicate low ROB, 4 or 5 stars to indicate moderate ROB, and 3 or fewer stars to indicate high ROB.

For diagnostic accuracy studies (KQ4), the Quality of Diagnostic Accuracy Studies (QUADAS II)[88] will be used to assess ROB. This tool assesses concerns of ROB among four domains (patient selection, index test, reference standard, and flow and timing) and concerns of applicability across the first three domains; the review team may modify the tool (or specify criteria for some domains) as suitable and *a priori*. Studies answering KQ2 (patients' outcome valuation) will be evaluated by tools appropriate to their study design: for surveys and qualitative studies we will use tools developed by the Center for Evidence-based Management (http://www.cebma.org/resources-and-tools/what-is-critical-appraisal/). The quality of economic evaluation studies (KQ3) will be assessed using Drummond's[89] checklist for economic evaluation studies.

Data Analysis & Synthesis

We will provide summaries of intervention effects for each study by calculating the appropriate statistics based on types of outcomes.

Key Question 1

For pairwise meta-analysis in KQ1 (screening), we will employ a random effects model using Review Manager Version 5.0 (The Cochrane Collaboration, Copenhagen, Denmark). For continuous outcomes, we will report a pooled mean difference (MD) when one measurement tool is used, or other options that exist for communicating results when combining two or more

outcome scales measuring similar constructs (based on clinical input);[90, 91] one option is a standardized mean difference (SMD). For dichotomous outcomes, we will report relative risks (RR), rate ratios, and risk differences (RD) between groups with corresponding 95% CIs. For calculating the RD, we will use the median baseline risk for the control group in the included studies, although may perform sensitivity analysis using differing baseline risks if thought suitable.[92, 93]

When event rates are less than 1%, the Peto odds ratio method will be used. However, when control groups are of unequal sizes, when large magnitude of effect is observed, or when events become more frequent (5%–10%), the Mantel-Haenszel method without correction factor will be used for quantitative synthesis.[94]

The decision to pool studies will not be based on the statistical heterogeneity (I^2 statistic will be reported), but rather on interpretation of the clinical and methodological differences between studies. When substantial heterogeneity is suspected, we will conduct sensitivity analyses if appropriate (e.g., for studies rated as high risk of bias, parallel versus cross-over designs) or consider whether the heterogeneity is due to differing effects based on our population or intervention subgroups of interest (see Table 2 and section below). Where there are at least eight studies in a meta-analysis, we will analyze publication bias both visually using the funnel plot and quantitatively using Egger's test.[95] We will not combine results from RCTs with other study designs. When a meta-analysis is not appropriate a narrative synthesis will be performed.

Key Questions 2 & 3

For KQs 2 (patients' outcome valuation) and 3 (cost effectiveness), results will be narratively described in most cases. If more than one study is identified providing numerical values for ranking benefits and/or harms (KQ2) or similar outcomes (KQ3) these will be summarized descriptively and results across studies compared. Thematic analysis may be undertaken for KQ2, including coding data (meaning and context) into descriptive themes that accurately reflect the data and then summarizing this in a narrative.

Key Question 4

For KQ4 (accuracy), we will construct 2x2 tables and calculate sensitivity, specificity, and positive and negative likelihood ratios (LR+, LR-). Sensitivity and specificity are measures of test accuracy. Likelihood ratios are used to estimate the increased or decreased probability of disease for a patient and can be used to refine clinical judgement based on varying pre-test probabilities. The larger the LR+, the more accurate the test is and the greater the likelihood of disease following a positive test; the smaller the LR-, the more accurate the test is, the lesser the likelihood of disease following a negative test.[96] A LR+ that is >10 indicates a large and often conclusive probability that the condition is present; a LR- that is <0.10 suggests a large and often conclusive probability that the condition is not present. A likelihood ratio of one means that a positive or negative result is equally probable in a patient with and without the disease/condition.

If there are more than three studies and they are clinically homogenous (i.e., thresholds, diagnostic criteria), we will pool data using a hierarchical summary receiver-operator curve (HSROC) and bivariate analysis of sensitivity and specificity.[97] The HSROC simultaneously compares the sensitivity and specificity (taking their correlation into account) for all studies comparing a particular screening test with similar diagnostic criteria. We will use Review Manager Version 5.0 (The Cochrane Collaboration, Copenhagen, Denmark) to perform meta-analyses, and Stata 11.0 (metandi program; StataCorp LP, College Station, TX, USA) to fit the bivariate and HSROC models and produce the pooled estimates of sensitivity, specificity, and likelihood ratios.

The results will be organized by type of screening test and further grouped by the diagnostic criteria. Sensitivities, specificities, and likelihood ratios and their 95% confidence intervals (CI) will be presented in summary tables that include all screening tests and diagnostic criteria. Based on the findings for sensitivity and specificity and estimates of one or more relevant baseline prevalences, an evidence profile will be generated for the outcomes FN, FP, TN, and TP.[92]

Subgroup Analyses

Our primary approach for evaluating differential effect for subgroups (see Table 2) will be to record any within-study subgroup analyses performed by study investigators using individual patient data; these results preserve the within-study randomization. Because these results are

often based on diverse methodology and may be difficult to interpret across the body of evidence, we will also perform our own subgroup analyses using study-level data, as possible, using formal statistical approaches (e.g., meta-regressions) or by stratifying the results of the pairwise meta-analyses by subgroup variables. When determining whether entire studies fall into a particular subgroup category (e.g., non-Hispanic white or European ancestry), we will consider ≥80 percent of the study population meeting the criteria as sufficient. We will employ regression analyses when: for continuous variables there are at least six to ten studies reporting on the outcome within a specific subgroup, and for categorical variables there are at least three studies for each category level. The number of sufficient studies serves as a rule of thumb for the lower bound that investigators can consider for a meta-regression, but power will vary according to the size and variability of the effect.[94] These analyses would rely on study-level data, such that the results would be considered observational in nature.

Assessment of the Overall Quality of the Evidence using GRADE

Two reviewers will independently assess the quality of the body of evidence or confidence in the effect for each outcome of interest using the GRADE methodology.[98-103] Discrepancies will be resolved through discussion or third-party consultation to reach consensus. Assessments will be entered into the GRADEPro software and summarized in GRADE evidence profiles and Summary of Findings tables and an Evidence-to-Decision Table. Footnotes to the tables will explain all decisions. The CTFPHC will then use this evidence on each outcome, to assess the net benefits and harms of each service, consider patient preferences and values, and other elements of the GRADE methodology to develop the recommendations on screening for impaired visual acuity or vision-related functional limitations in primary care.

The general approach is outlined here although methods will align with GRADE guidance. For evidence on the benefits and harms of screening, as a starting point the quality is assigned as high for evidence from RCTs and low for evidence from observational studies, when used. For accuracy studies, cross-sectional or cohort studies in patients with diagnostic uncertainty and direct comparison of test results with an appropriate reference standard will be considered high quality. Thereafter, we will examine and potentially downgrade the quality based on five core domains: study limitations/ROB, inconsistency, indirectness, imprecision, and reporting bias. For

outcomes where there is evidence from observational studies and no other reason to downgrade the evidence, we will also consider the additional domains of dose-response association, plausible confounding, and strength of association (i.e., large magnitude of effect [i.e., large ≤ 0.5 or ≥ 2.0 or very large RR ≤ 0.2 or ≥ 5.0]), to potentially upgrade the quality.[102]

For the *study limitations* domain RCTs may be downgraded one or two levels depending on the proportion of trials (e.g., one very large trial may outweigh two very small trials) assessed as having high ROB for the particular outcome under consideration. Evidence from observational studies will be downgraded when most studies have moderate or high ROB. For *inconsistency* we will assess the magnitude of the effects of the included studies (e.g., inconsistent when lack of overlap in 95% CIs for some studies). *Indirectness* of the evidence is based on evaluating the relevance of the studys' PICOs compared to ours for our primary KQ1 (effectiveness of screening); when relying on test accuracy studies there will be downgrading by at least one level for this domain. We will assess *imprecision* on the basis of clinical decision thresholds and Optimal Information Size. For outcomes where clinical thresholds are used/determined (e.g., NEI-VFQ; 4-6 point change),[104] we will typically downgrade this domain once if the entire pooled 95% CI does not cross the threshold (i.e., only one limit of the CI crosses), and downgrade twice if the 95% CI crosses the threshold and no difference (0 MD or 1.0 RR) or does not cross the threshold at all. Thresholds may be determined a priori (i.e., by the CTFPHC prior to viewing results from studies and after seeking additional clinical input as required) but may also be revised post hoc based on careful benefit-harm considerations when considering all outcomes together (e.g., lower benefit threshold in cases of few and minor harms). A precise estimate is one that allows for a clinically useful conclusion. *Reporting bias* will be evaluated with respect to publication bias.

Interpreting these domains when relying on evidence from diagnostic test data (KQ2) has certain considerations, including how certain the CTFPHC is about the consequences of each outcome (FP, FN, TP, TN) in terms of their effects on the primary benefits and harms of interest.[92]

External Review

The evidence review will be peer-reviewed by external content experts (minimum 3) and invited stakeholder organizations (minimum 10), with response to all comments shared with all reviewers approximately two months after posting of the final review.

Planned Schedule and Timeline

Draft protocol approved by CTFPHC members: September 12, 2016

External peer review: September 20-October 3, 2016

Final protocol: December 1, 2016

Draft evidence review to CTFPHC working group: February 6, 2017

External review of draft report: March 10-27, 2017

Final evidence review: April 31, 2017

Conflict of Interest Statement

None of the study team members any known actual or perceived conflicts of interest related to this review.

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Appendix A. Canadian Ophthalmologist's Society Elements of a Comprehensive Eye Examination

Box 2—Elements of the comprehensive eye examination*

History

- **Patient name, date of birth, gender, and, if appropriate, race**
- Contact information (address, home and work phone numbers)
- Insurer
- Occupation
- **Driving status**
- **Chief complaint, if any**
- Family doctor
- Date of most recent eye examination
- **Current medication and allergies (ocular and systemic)**
- **Ocular history**
- **Medical history**
- Smoking history
- **Medical and ocular family history**
- Directed review of systems

Ocular examination should include:

- **Current vision acuity status with correction at distance (each eye separately) and near (refractive correction documented)**

Vision without correction

- **Best corrected visual acuity with refraction documented**
- Muscle balance
- Pupillary reaction
- Gross visual fields to confrontation
- External examination
- **Slit-lamp examination** of lid, lid margins, conjunctiva, cornea, anterior chamber (clarity and depth), lens
- **Intraocular pressure determination**

Dilated examination (if adequate view of posterior pole not obtained)

- **Lens**
- **Biomicroscopic examination of optic nerve head**
- **Fovea**
- Peripheral retina (employing appropriate accessory lens or indirect examination of peripheral retina)

Discussion with patient should include:

- Discussion of findings with appropriate correction and mitigating strategy
- Counselling with respect to lifestyle changes and co-morbidities (e.g. smoking cessation, hypertension control, diet, antioxidants and zinc supplements, blood glucose control, lipid control)
- Follow-up recommendation

*Essential elements of the examination are in boldface.[9,26,28,49]

From: Delpero W et al. and the Canadian Ophthalmological Society Clinical Practice Guideline Expert Committee. Canadian Ophthalmological Society evidence-based clinical practice guidelines for the periodic eye examination in adults in Canada. Can J Ophthalmol. 2007 Feb;42(1):39-45, 158-63. doi: 10.1139/i06-126e. PMID: 17361239.

Appendix B. Methods for Integrating Existing Systematic Reviews into New Reviews

One or more systematic reviews may exist that align with one or more key questions (KQs) of the reviews undertaken to inform CTFPHC guidelines. The CTFPHC and ERSCs have considered the manner in which new reviews conducted for CTFPHC guidelines can benefit from efficiencies by incorporating existing systematic reviews, while maintaining methodological rigor in their own systematic review conduct, closely aligning existing reviews within their review scope (i.e., inclusion/exclusion criteria), and maintaining consistency with other CTFPHC Methods. They have based their approach on work conducted by a methods working group composed of investigators from the Evidence-based Practice Center Program funded by the U.S. Agency for Healthcare Research and Quality.[1,2] A summary of the way the ERSCs will operationalize the 12 AHRQ recommendations (Box 1) to meet their needs is outlined below. This approach differs from situations when "updating" a single existing systematic review is deemed suitable, that is, in some cases a high-quality review will be used to answer one or more of the CTFPHC KQs in entirety, usually without revisions to the review's scope, search for evidence (apart from updating to present), methodological quality/risk of bias assessments, data extraction, or data analysis.

Summary of CTFPHC Approach

The recommendations developed by AHRQ (Box 1) will serve as an overall framework for ERSC reviews, although in most cases existing systematic reviews will be used to build efficiencies in discrete steps within the review process—mainly search and selection of literature, and data extraction—which will not generally include refinement of the scope or data analysis and interpretation. Moreover, we will not in most circumstances include a systematic review itself as a study design for inclusion (unless the intention is to specifically conduct an overview of reviews). The ability to use any given systematic review will largely depend on how it aligns with the CTFPHC review's scope (PICOTS). A further primary consideration will be the comprehensiveness of its search strategy and reporting of literature flow. It is important to note that some CTFPHC reviews need to be complex with multiple stages (e.g., a review of screening effectiveness for patient-important benefits and harms may require including evidence on indirect evidence of test accuracy and treatment) such that existing systematic reviews may exist for one or more discrete stages but not for others. Some key points on the operationalization, and minor revision, by the ERSCs of these recommendations are provided below.

1. **Choosing systematic reviews**: Following the identification of relevant reviews (a search for systematic reviews may be undertaken for some topics), the evidence for each will be mapped to the PICOTS elements and the quality of the review will be assessed (e.g., using the AMSTAR tool which has been evaluated and found effective to discriminate reviews with high and low quality of methods and reporting).[3] Some of the CTFPHC KQs may only have a single existing systematic review for possible incorporation, while

others may have more than one; if suitable, a decision between systematic reviews will be based on methodological quality, comprehensiveness and quality of its literature search and reporting (e.g., assessed using PRESS checklist), comprehensiveness of reporting on included studies, and the best fit within the CTFPHC scope and methods. In some cases two or more reviews may be integrated because, together, they capture the full scope of the CTFPHC KQ(s). Rationale will be provided for choices made.

Note: If no review is deemed a good fit for purpose for integration (i.e., de novo process all together appears to be best option) we will at minimum examine available reviews for their search strategies (to ensure that our search strategies are comprehensive) and review their reference lists for identification of studies.

2. **Searching**: Various strategies will be considered. If one or more reviews are fit for purpose (but do not meet criteria for classification as a systematic review update) and cover a scope that is *very similar or broader* than the CTFPHC topic, we may update the search(es) if the last search date was prior to 6 months before commencing our review. When there are multiple reviews being considered, updating the literature to present may involve a new comprehensive search strategy to identify studies published after the date of the earliest existing review; this may reduce complexities when trying to implement, document, and remove duplicates from multiple searches. Alternatively, if the scope of the existing review(s) is *narrower* (e.g., missing an element in PICOTS) or the search *deemed sub-optimal in some manner* (e.g., missing key terms, additional database viewed as highly relevant) we may re-run the existing review's search concurrent with an original (e.g., broader) search and remove the citations previously screened for the other review. If more appropriate, we may update the other review's search and use a new search for the missing PICO element(s) (e.g., one additional intervention) for a longer time period to meet our timeframe. In cases where we feel screening excluded studies lists is appropriate we will also undertake this. Careful consideration will be used to ensure a comprehensive search is conducted regardless of approach taken; moreover, the ERSC librarians will help determine on a case-by-case basis what approach would be feasible for implementation to ensure aims of building efficiencies are possible.
3. **Screening and selection**: We will assess articles included in all relevant reviews (based on full text if necessary) to determine if they meet our inclusion criteria.
4. **Data extraction and methodological quality assessments**: We will consider incorporating the data on study and participant characteristics rather than extracting these data anew; we may also use the review author's risk of bias assessments if the tools/methods are consistent with CTFPHC methods. These steps will create efficiencies but because they are dependent on the quality of the systematic review and extent of reporting, the ERSC staff will verify the data on at least 5 to 10% of studies.[1]
5. **Data analysis**: We will consider using quantitative outcome data from reviews (with verification), but will not typically use meta-analyses or quality (GRADE) assessments of existing reviews.
6. **Reporting**: Transparent reporting of all integration steps used will be included in the evidence review report.

Box 1. AHRQ recommendations on integrating existing systematic reviews for new systematic reviews.

1. Existing reviews should be confirmed as systematic reviews through the application of a minimum set of eligibility criteria. We propose that the minimum eligibility criteria for systematic reviews include an explicit and adequate search, application of predefined eligibility criteria to select studies, risk of bias assessment for included studies, and synthesis of results.
2. Criteria to assess the relevance, in terms of question elements and currency, and quality of existing systematic reviews under consideration for inclusion in reviews should be predefined.
3. The quality of relevant existing systematic reviews should be assessed in an explicit manner with a minimum set of quality criteria that include search of multiple sources, use of a generally accepted tool for risk of bias assessment, and sufficient information to assess the strength of the body of evidence that includes the major domains of risk of bias, directness, consistency, precision, and reporting bias.
4. The risk of bias assessments from the existing systematic review may be used when the review described an explicit process, including the use of a tool or method that is compatible with the approach of the current review and that assessed the key sources of potential bias.
5. We suggest that risk of bias assessment be repeated in a sample of studies from an existing review under consideration for inclusion in a new review to confirm concordance with current review team approach.
6. We recommend that at a minimum, reviews should narratively describe findings of the prior review(s), including the number and types of studies included, and the overall findings.
7. We recommend that newly identified studies be clearly distinguished from studies in the existing review(s) when presented in the narrative and any tables (eg, separate tables).
8. Summary tables should include sufficient information to support ratings for overall strength of evidence, including ratings for individual strength of evidence domains (study limitations, consistency, precision, directness, reporting bias). The strength of evidence ratings should be based on the underlying primary evidence, not the number or quality of existing systematic reviews.
9. Using strength of evidence domains as a framework (study limitations, consistency, precision, directness, and reporting bias), review authors should consider how new evidence would change estimates of effect or ratings for strength of evidence. A new quantitative synthesis (ie, pooled estimate) is needed if new studies would change conclusions or strength of evidence judgements, or to obtain a more precise or more up-to-date estimate.
10. In cases where the existing systematic review(s) did not complete strength of evidence grading for a comparison and outcome of interest, the strength of evidence should be assessed for the body of evidence, considering primary studies from prior review(s) and any new studies identified.
11. In cases where no new studies are added to the body of evidence, the strength of evidence assessment from the existing systematic review may be used if conducted using an acceptable grading approach consistent with current review context. In these cases, we suggest that the overall strength of evidence assessment be reviewed, considering the strength of evidence domains, to confirm consistency with current review team assessments.
12. In cases where new studies are added to the body of evidence, the strength of evidence may need to be reassessed on the basis of all studies/evidence.

[1]Robinson KA, Chou R, Berkman ND, et al. Integrating bodies of evidence: existing systematic reviews and primary studies. Methods Guide for Effectiveness and Comparative Effectiveness Reviews [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2015 Feb.

[2]Robinson KA, Chou R, Berkman ND, et al. Twelve recommendations for integrating existing systematic reviews into new reviews: EPC guidance. J Clin Epidemiol. 2016 Feb;70:38-44. PMID: 26261004.

Appendix C. Draft MEDLINE searches for KQ1 and KQ2

KQ1: Stage 1 – RCTs on screening effectiveness

1. *Accidental Falls/pc
2. *Cataract/di, pc
3. *Eye Diseases/di, pc
4. *Macular Degeneration/di, pc
5. *Vision Disorders/di, pc
6. Vision Screening/
7. Vision Tests/
8. exp Visual Acuity/ and (assess* or detect* or diagnos* or evaluat* or exam* or prevent* or screen* or test*).tw,kf.
9. Amsler.tw,kf.
10. ((AMD or ARMD or cataract* or eye or eyes or macular degeneration or ocular or ophthalm* or visual or vision) adj3 (assess* or detect* or diagnos* or evaluat* or exam* or prevent* or screen* or test*)).tw,kf.
11. (E chart* or E test*).tw,kf.
12. ((evaluat* or exam* or test*) adj3 (pin hole or pinhole)).tw,kf.
13. (fall* adj2 prevent*).ti.
14. funduscop*.tw,kf.
15. Jaeger.tw,kf.
16. Landolt*.tw,kf.
17. (Log-Mar* or LogMAR*).tw,kf.
18. Snellen*.tw,kf.
19. or/1-18 [**Combined MeSH & text words for vision screening - narrow**]
20. Community Health Services/
21. Community Health Workers/
22. Early Diagnosis/
23. Family Practice/
24. Geriatric Assessment/
25. Health Promotion/
26. Health Status/
27. Home Care Services/
28. Home Health Nursing/
29. House Calls/
30. Mass Screening/
31. Nurses, Community Health/
32. Nursing Assessment/
33. Office Visits/
34. Primary Health Care/

35. Preventive Health Services/
36. ((assess* or detect* or diagnostic* or evaluat* or exam* or prevent* screen* or test*) adj5 (family doctor* or family practi* or family physician* or general practic* or GP or primary care or primary health care)).tw,kf.
37. ((assessment* or education or promotion*) adj1 health*).tw,kf.
38. ((care* or service* or support* or visit*) adj2 (communit* or domicil* or home* or out-reach* or outreach*)).tw,kf.
39. (communit* adj3 (out-reach* or outreach* or practice* or program*)).tw,kf.
40. ((clinician* or health or doctor* or nurse* or physician* or volunteer*) adj2 visit*).tw,kf.
41. (early and detect*).ti.
42. geriatric assessment*.tw,kf.
43. (pre-dispos* or predispos*).ti.
44. or/20-43 [**Combined MeSH & text words for screening - broad**]
45. (assess* or detect* or diagnostic* or evaluat* or exam* or prevent* or screen* or test*).tw,kf.
46. and/44-45 [**text word filter on broad screening results**]
47. or/19,46 [Combined screening sets]
48. exp Aged/
49. Geriatrics/
50. Health Services for the Aged/
51. (aged or ageing or aging or elder* or geriatric* or octogenarian* or septuagenarian* or senior*).tw,kf.
52. ((adult* or citizen? or client? or consumer? or female? or male? or men or patient? or people or person* or wom#n) adj3 older*).tw,kf.
53. or/48-52 [**Combined MeSH & text words for older adults**]
54. and/47,53 [**Combined concepts for screening and older adults**]
55. "Clinical Trials as Topic"/
56. controlled clinical trial.pt.
57. randomized controlled trial.pt.
58. placebo.ab.
59. random*.ab.
60. trial.ti.
61. or/55-60 [Modified Cochrane **highly sensitive RCT filter**: sensitivity and precision maximizing version]
62. exp Animals/ not Humans/
63. (animal or animal-model* or animals or canine* or cat or cats or dog or dogs or feline or felines or hamster or hamsters or mice or monkey or monkeys or mouse or pig or piglet or piglets or pigs or porcine or primate* or rabbit or rabbits or rat or rats or rodent or rodents or sheep or swine or swines).ti.
64. 61 not (62 or 63)

65. 54 and 64 [RCT & animal filter applied]
66. (Adolescent/ or exp Child/ or exp Infant/) not exp Adult/
67. Adolescent Medicine/
68. exp Pediatrics/
69. (paediatr* or pediatr*).jw.
70. (adolesc* or babies or baby or boy* or child* or fetal or fetus or foet* or girl* or infan* or juvenile* or kid or kids or neo-nat* or neonat* or new-born* or newborn* or paediatr* or pediatr* or preadolesc* or prepubesc* or preteen* or pubescen* or teen* or toddler* or youth*).tw,kf.
71. or/66-70 [Combined MeSH & textwords for pediatric studies]
72. 65 not 71 [Pediatric records excluded]
73. (comment or editorial or news or newspaper article).pt.
74. (letter not (letter and randomized controlled trial)).pt.
75. 72 not (73 or 74) [Opinion pieces excluded]
76. case reports.pt.
77. (case report* or case stud*).ti.
78. 75 not (76 or 77) [Case reports excluded]
79. diabetic retinopath*.ti.
80. 78 not 79 [Diabetic retinopathy articles excluded]
81. (glaucoma* not (glaucoma* and (AMD or ARMD or cataract* or macular degeneration* or vision or visual))).ti.
82. 80 not 81 [Glaucoma articles excluded]
83. (optometrist* or ophthalmologist*).ti.
84. 82 not 83 [Specialist articles excluded]
85. limit 84 to (english or french)
86. limit 85 to yr="2012-Current"
87. remove duplicates from 86

KQ2: Patient valuation of outcomes

1. *Cataract/di, pc
2. *Eye Diseases/di, pc
3. Geriatric Assessment/ and (AMD or ARMD or cataract* or eye or eyes or macular degeneration or ocular or ophthalm* or visual or vision).tw,kf.
4. *Macular Degeneration/di, pc
5. Mass Screening/ and (AMD or ARMD or cataract* or eye or eyes or macular degeneration or ocular or ophthalm* or visual or vision).tw,kf.
6. *Vision Disorders/di, pc
7. Vision Screening/
8. Vision Tests/

9. exp Visual Acuity/ and (assess* or detect* or diagnos* or evaluat* or exam* or prevent* or screen* or test*).tw,kf.
10. Amsler.tw,kf.
11. ((AMD or ARMD or cataract* or eye or eyes or macular degeneration or ocular or ophthalm* or visual or vision) adj3 (assess* or detect* or diagnos* or evaluat* or exam* or prevent* or screen* or test*)).tw,kf.
12. (E chart* or E test*).tw,kf.
13. ((evaluat* or exam* or test*) adj3 (pin hole or pinhole)).tw,kf.
14. funduscop*.tw,kf.
15. Jaeger.tw,kf.
16. Landolt*.tw,kf.
17. (Log-Mar* or LogMAR*).tw,kf.
18. Snellen*.tw,kf.
19. or/1-18 [**Combined MeSH & text words for vision screening]**
20. exp Aged/
21. Geriatrics/
22. Health Services for the Aged/
23. (aged or ageing or aging or elder* or geriatric* or octogenarian* or septuagenarian* or senior*).tw,kf.
24. ((adult* or citizen? or client? or consumer? or female? or male? or men or patient? or people or person* or wom#n) adj3 older*).tw,kf.
25. or/20-24 [Combined MeSH & text words for older adults]
26. and/19,25 [**Combined concepts for vision screening and older adults**]
27. Choice Behavior/
28. *Consumer Behavior/
29. exp Consumer Participation/
30. Cooperative Behavior/
31. exp Decision Making/
32. Focus Groups/
33. Health Care Surveys/
34. exp Informed Consent/
35. Interviews as Topic/
36. Patient Acceptance of Health Care/
37. exp Patient Education as Topic/
38. Patient Participation/
39. Patient Preference/
40. Social Values/
41. "Surveys and Questionnaires"/
42. Treatment Refusal/
43. (15D* and (HRQoL or QoL or "quality of life")).mp.

44. ((accept* or consider* or choice? or choos* or chose? or decid* or decis* or input* or involv* or opinion* or participat* or perceiv* or percepti* or perspective? or prefer* or refus* or respons* or valuation or value? or valuing or view*) adj3 (citizen? or client? or consumer? or female? or male? or men or patient? or public or stake?holder* or user? or wom#n)).tw,kf.
45. ((analys#s or valuation? or value? or valuing) adj3 (conjoint or contingent)).tw,kf.
46. (choice? adj2 (behavio?r* or discrete or experiment*)).tw,kf.
47. ((choice? or choos* or consent* or decision*) adj1 informed).tw,kf.
48. ((choice? or choos* or decision*) adj2 (made or make or makes or making or shar* or support*)).tw,kf.
49. (EQ 5D or EQ5D or EuroQoL 5D or EuroQoL5D).mp.
50. (focus group? or interview* or questionnaire? or survey*).tw,kf.
51. gambl*.tw,kf.
52. health utilit*.tw,kf.
53. HUI.tw,kf.
54. (multi?attribute or multi?criteria).tw,kf.
55. (preference? adj1 (elicit* or scor* or state*)).tw,kf.
56. prospect theor*.tw,kf.
57. (SF 12 or SF 36 or SF 6D or SF12 or SF36 or SF6D).mp.
58. (trade off? or tradeoff?).tw,kf.
59. (willing* adj2 pay*).tw,kf.
60. or/27-59 [**Combined MeSH & text words for patient preferences & values**]
61. and/26,60 [Combined results for patient preferences and visual screening in older adults]
62. exp Animals/ not Humans/
63. (animal or animal-model* or animals or canine* or cat or cats or dog or dogs or feline or felines or hamster or hamsters or mice or monkey or monkeys or mouse or pig or piglet or piglets or pigs or porcine or primate* or rabbit or rabbits or rat or rats or rodent or rodents or sheep or swine or swines).ti.
64. 61 not (62 or 62) [Exclude animal studies]
65. (Adolescent/ or exp Child/ or exp Infant/) not exp Adult/
66. Adolescent Medicine/
67. exp Pediatrics/
68. (paediatr* or pediatr*).jw.
69. (adolesc* or babies or baby or boy* or child* or fetal or fetus or foet* or girl* or infan* or juvenile* or kid or kids or neo-nat* or neonat* or new-born* or newborn* or paediatr* or pediatr* or preadolesc* or prepubesc* or preteen* or pubescen* or teen* or toddler* or youth*).tw,kf.
70. or/65-69 [Combined MeSH & textwords for pediatric studies]
71. 64 not 70 [Pediatric records excluded]
72. (comment or editorial or news or newspaper article).pt.
73. (letter not (letter and randomized controlled trial)).pt.

74. 71 not (72 or 73) [Opinion pieces excluded]
75. case reports.pt.
76. (case report* or case stud*).ti.
77. 74 not (75 or 76) [Case reports excluded]
78. diabetic retinopath*.ti.
79. 77 not 78 [Diabetic retinopathy articles excluded]
80. (glaucoma* not (glaucoma* and (AMD or ARMD or cataract* or macular degeneration* or vision or visual))).ti.
81. 79 not 80 [Glaucoma articles excluded]
82. (optometrist* or ophthalmologist*).ti.
83. 81 not 82 [Specialist articles excluded]
84. limit 83 to (english or french)
85. remove duplicates from 84