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Complete List of Authors:	McGilton, Kathy; Toronto Rehabilitation Institute, Department of Research; University of Toronto, Lawrence S. Bloomberg Faculty of Nursing Hobler, Fiona; Toronto Rehabilitation Institute, Department of Research; University of Toronto, Department of Speech-Language Pathology Campos, Jennifer; Toronto Rehabilitation Institute, Department of Research; University of Toronto, Department of Psychology Dupuis, Kate ; Baycrest Health Sciences, Department of Audiology; University of Toronto, Department of Psychology Labreche, Tammy; University of Waterloo, Centre for Sight Enhancement, School of Optometry and Vision Science Guthrie, Dawn; Wilfrid Laurier University, Department of Kinesiology & Physical Education and Department of Health Sciences Jarry, Jonathan; Universite de Montreal, School of Optometry Wittich, Walter; Universite de Montreal, School of Optometry; McGill University, School of Physical and Occupational Therapy
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Hearing and Vision Screening Tools for Long-term Care Residents with Dementia: Protocol for a Scoping Review

Katherine S. McGilton [1, 2], Fiona Höbler [1, 3], Jennifer Campos [1, 4], Kate Dupuis [4, 5], Tammy Labreche [6], Dawn M. Guthrie [7], Jonathan Jarry [8], Walter Wittich [8, 9, 10, 11]

1. Department of Research, Toronto Rehabilitation Institute-University Health Network, Toronto, ON, Canada.
2. Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, ON, Canada.
3. Department of Speech-Language Pathology, University of Toronto, Toronto, ON, Canada.
4. Department of Psychology, University of Toronto, Toronto, ON, Canada.
5. Department of Audiology, Baycrest Health Sciences, Toronto, ON, Canada.
6. Centre for Sight Enhancement, School of Optometry and Vision Science, University of Waterloo, Waterloo, ON, Ontario.
7. Department of Kinesiology & Physical Education and Health Sciences, Faculty of Science, Wilfrid Laurier University, ON, Canada.
8. School of Optometry, University of Montréal, Montréal, QC, Canada.
9. School of Physical and Occupational Therapy, McGill University, Montréal, QC, Canada.
10. CRIR/Centre de réadaptation MAB-Mackay du CIUSSS du Centre-Ouest-de-l'Île-de-Montréal. Montréal, QC. Canada.
11. CRIR/Institut Nazareth et Louis-Braille du CISSS de la Montérégie-Centre, Montréal, QC, Canada.

Corresponding author: Katherine S. McGilton, RN, PhD
Senior Scientist, Toronto Rehabilitation Institute – UHN
Lawrence S. Bloomberg, Faculty of Nursing, University of Toronto
130 Dunn Ave, Toronto, M6K 2R7.
Tel: +1 416 597-3422 (2500). Email: kathy.mcgilton@uhn.ca

Email contact for all authors: fiona.hobler@utoronto.ca, jennifer.campos@uhn.ca, kdupuis@baycrest.org, tammy.labreche@uwaterloo.ca, dguthrie@wlu.ca, jonathan.jarry@umontreal.ca, walter.wittich@umontreal.ca.

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Abstract (294 words)

Introduction: Hearing and vision loss amongst long-term care (LTC) residents with dementia frequently goes unnoticed and untreated. Despite negative consequences for these residents, there is little information available about their sensory abilities, and care assessments and practices seldom take these abilities or accessibility needs into account. Without adequate knowledge regarding such sensory loss, it is difficult for LTC staff to determine the level of an individual's residual basic competence for communication and independent functioning. In this first phase of a larger study, we will conduct a scoping review to identify the assessment measures used in research and clinically that test hearing and vision in adults aged over 65 years with dementia, aiming to: 1) provide an overview of the use of hearing and vision assessments in older adults with dementia; and 2) evaluate the sensibility of these assessments.

Methods and analysis: This scoping review will be conducted using the framework by Arksey and O'Malley (2005) with methodological enhancements from Levac et al. (2010), Armstrong et al. (2011), Daudt et al. (2013), and Colquhoun et al. (2014). We will conduct electronic database searches in CENTRAL, CINAHL, Embase, MEDLINE, and PsycINFO, as well as a web and interview-based grey literature search for new and existing hearing and vision assessments used in research and by clinical professionals in the field. Abstracts will be independently reviewed twice for acceptance based on agreed eligibility criteria by a multidisciplinary team.

Ethics and dissemination: This review will inform health professionals working with this growing population. With the review findings, we aim to develop a tool kit and an algorithmic process to select the most appropriate hearing and vision screening assessments for LTC residents with dementia that will facilitate accurate testing and can inform care planning, thereby improving residents' quality of life.

Strengths and limitations of this study

- This scoping review takes a rigorous and systematic approach to a broad research question that brings together two traditionally standalone areas of research and clinical practice to answer the critical issue of how to most effectively assess both hearing and vision abilities in older adults with dementia, residing in a long-term care setting.
- The scoping team will also consolidate its expertise in areas of vision, hearing, cognition, gerontology and communication, which complement each other in further enhancing the development of a systematic team approach and interpreting a wide range of research data.
- We are using several data sources to comprehensively answer a clearly defined, yet broad research question. We will include all published literature with original research data from electronic databases and online search engines, in any language, and within any setting that has measured hearing and/or vision in older adults with any form of dementia, whether for research or clinical purposes. In addition, we will enhance these search results with information obtained from relevant healthcare professionals through environmental scan interviews; thus yielding a more comprehensive scope of applicable findings for both researchers and practitioners alike.
- This review will describe the psychometric properties of assessments found in the literature and those used in the field, and evaluate the acceptance and feasibility of their use with this population by providing a sensibility appraisal.
- However, a limitation of this scoping review may lie in the possibly very large scale of its findings, and, for reasons of feasibility, we may not be able to provide a more in-depth quality analysis of the individual studies reported therein.

INTRODUCTION

Dementia affects a person's ability to understand and express information (Kim & Bayles, 2007), such that these individuals may not be able to understand explanations, follow directions, or correctly interpret interpersonal communication. These problems have profound implications for effective interactions in long-term care (LTC) facilities, with a prevalence of 58% dementia amongst residents in this setting (Seitz et al., 2010), and increasing incidence rates of this disease in a rapidly aging population (Prince et al., 2015; Alzheimer Society of Canada - ASC, 2012). When residents cannot articulate their needs or cannot be understood because of their dementia, they frequently become frustrated or agitated. Furthermore, LTC staff may underestimate the prevalence of sensory loss and its effects on communication, as well as mislabelling the causes for associated communication breakdown (Burnip & Erber, 1997).

The challenges of the resulting communication difficulties in residents with dementia are compounded by hearing and vision problems that are commonly present as people age (Pichora-Fuller et al., 2013). Hearing loss is the most widespread disability in older adults (Canadian Hearing Society, 2013) and the third most prevalent chronic condition (Yueh et al., 2003), estimated in up to 50% of adults aged over 65 years (Cruickshanks et al. 1998). Vision impairment (low vision with visual acuity < 20/70) is reported in 18% of individuals aged 70 years or over (Crews & Campbell, 2004). The prevalence of such sensory loss amongst adults with dementia has been shown to be higher than in those who are cognitively intact (Uhlmann et al., 1989; Uhlmann et al., 1991), with hearing loss alone recorded in more than 90% of cognitively impaired patients (Gold et al., 1996). Research has demonstrated an increased risk of cognitive impairment and an accelerated cognitive decline in those with hearing impairment; however, the underlying mechanisms of this association are unestablished, with suggestions of a possibly attributable common neuropathological origin, effects of social isolation, or cognitive load caused by hearing loss (Lin et al., 2013).

This evidence suggests significant increases in the prevalence of, and association between sensory and cognitive decline in a population of older adults (above 65 years) that is rapidly increasing (Ortman et al., 2014; Statistics Canada, 2012). Unsurprisingly, the incidence

of sensory impairment is higher in the LTC setting, with approximately 80% of LTC residents experiencing at minimum mild hearing loss and approximately 50% having a moderate to severe impairment (Weinstein, 2000; Garahan et al., 1992; and Schow & Nerbonne, 1980). Visual impairment is twice as high in LTC as amongst the general population of the same age, with a reported prevalence of between 30% - 57% (Yamada et al., 2014; Owsley et al., 2007; Tielsch et al., 1995; and Woodruff & Pack, 1980); and, ultimately, hearing and/or vision loss found in two thirds of residents and dual sensory loss affecting one third of LTC residents (Yamada et al., 2014).

For accumulative reasons, there is a pressing need to further investigate the relationship between these interacting comorbidities, as well as the most appropriate interventions and rehabilitative treatments by employing a comprehensive interdisciplinary, collaborative approach (O'Malley, 2013; Swenor et al., 2013). We will adopt this approach in our search for sensitive hearing and vision screening tools that appropriately identify sensory impairment as the first step in this rehabilitation process.

Pilot Project in Training Resident Centered Communication

In a recent pilot project funded by the Alzheimer Society of Canada (ASC), our research team investigated the effects of enhancing interactions between staff and LTC residents through training in a Resident Centered Communication Intervention, RCCI (McGilton et al., in preparation). RCCI involved individualised resident communication plans by a Speech-Language Pathologist (SLP), the development of reflective focus groups, dementia care workshops, and support systems for care providers. In order to address concerns raised in the literature and by LTC staff, sensory assessments, as well as linguistic and cognitive testing, was undertaken to better understand each resident's current linguistic and cognitive abilities from the outset (Dupuis et al., 2015; Wittich et al., 2014; Weinstein & Arnsel, 1986). Two major problems were identified:

1) **Usual screening in LTC Facilities:** Only residents who are flagged by staff or family members as possibly having sensory problems are assessed by the relevant specialist. At other times, identification of sensory problems may arise through the standardised resident

assessment (known as the MDS 2.0), which includes items on hearing and vision, and is completed at admission, quarterly, and with a change in the clinical status of the resident (www.interRAI.org). Nonetheless, these assessments rely heavily on observation and reporting, are not comprehensive, and have been shown to be frequently inadequate in identifying those in need of specialist referral (Swanson et al., 2009).

2) **Standard test procedures:** The tests used to supplement information about hearing and vision acquired from patient records have been validated in a non-cognitively impaired population. There are no equivalent vision screening tests designed specifically for persons with dementia in LTC facilities, and no best practice protocols for audiological examination of this population (Reed, 2012). Not surprisingly, in our pilot study, there was limited success in administering standardised tests (e.g., audiogram assessment and Functional Linguistic Communication Inventory - FLCI), as residents often had difficulty following instructions.

Although previous literature reviews have been carried out in the area of dual sensory loss, reporting on its frequency and effects on functionality (Schneider et al., 2011), comorbidities and impact on older adults above 65 years (Heine & Browning, 2015), as well as the sensory impact on dementia care (Behrman et al., 2014), vision related quality of life in residents with dementia (Bédard et al., 2015), and hearing loss with cognitive impairment (Pichora-Fuller et al., 2013; Gallacher, 2004), a comprehensive review of hearing and vision assessments and their clinical utility in this growing population is not yet available. Therefore, this scoping review aims to address the need for adaptable and standardised assessments by identifying suitable and validated hearing and vision screening assessments for persons with dementia that can be used in LTC residencies. The main objective of our larger study is to address the reported problems of identifying adults in LTC facilities who are in need of referral to a hearing or vision specialist for second level assessment, and thereby enable more specialised care and treatment for hearing and vision loss in this vulnerable population, which in turn will serve to promote their participation, engagement and improve quality of care.

Methods and analysis

1. Methodology:

Our scoping team of reviewers will be multidisciplinary in composition, covering professional fields of nursing, audiology, optometry, cognitive and perceptual psychology, clinical neuropsychology, and speech-language pathology. Consistent with the broad scope of our areas of interest, we will adopt the methodological framework set out by Arksey and O'Malley (2005) to seek in-depth results from all relevant literature, including the following prescribed stages in our review process:

1) Identifying the research question
2) Identifying relevant studies
3) Study selection
4) Charting the data
5) Collating, summarising and reporting the results
6) Consultation exercise.

We will further adhere to the methodological enhancements based on previously published scoping reviews by providing transparency, reproducibility and utility with the presentation of this protocol (Armstrong et al., 2011), adhering to consistency in labelling and definition of scoping terms (Colquhoun et al., 2014), maintaining a broad search strategy with clearly defined concepts and their continuous refinement (Levac et al., 2010), using multidisciplinary expertise and group consultation within the scoping team to inform and guide the definition of the search criteria and clinical applicability of data for extraction (Daudt et al., 2013; Levac et al., 2010), and by allowing for post-hoc development of inclusion/exclusion criteria and data synthesis in terms of the value yielded by qualitative or quantitative analysis of results (Armstrong et al., 2011). We will also conduct interviews with frontline practitioners and LTC staff to add more information, meaning and applicability to our search results. Finally, we will provide a summary of the current research activity and possible clinical implications of the evidence to further clinical research, practice and policy (Levac et al., 2010).

Encompassing the fields of hearing and vision, we bring together two standalone concepts using established guidelines (Moher et al., 2015: Preferred Reporting Items for Systematic review and Meta-Analysis Protocols - PRISMA-P; Colquhoun et al., 2014) to form the research question: Which hearing and vision screening assessments and practices are effective in identifying hearing and vision impairments in older adults with dementia? Our aims are to: **1)** provide an overview of the use of hearing and/or vision screening assessments in persons with dementia; and **2)** evaluate the sensibility of these assessments. Sensibility will be defined as the feasibility and acceptability of an instrument in a specified assessment context (Yeung et al., 2015). Finally, our scoping results will then be reported in partitioned reviews dedicated to: **a)** hearing; **b)** vision; and **c)** dual sensory assessment.

2. Search Methods:

In order to investigate the extent of assessment literature available and to identify any gaps in research and clinical practice, we are defining screening assessments as objective tests and instruments appropriate for use in the preliminary evaluation of hearing thresholds and/or visual acuity. These screening instruments are not necessarily used for the diagnosis of a hearing or vision problem, but rather a reliable, valid and sensitive tool for detecting when further evaluation is warranted by a hearing or vision specialist (The American Speech-Language-Hearing Association - ASHA, 2016). A broad definition of screening methods will be adopted that include paper-based tests, as well as technologies involving software solutions in the form of apps for mobile devices, and higher-tech devices such as portable ophthalmic or audiometric equipment.

Electronic database searches will be conducted in CENTRAL, CINAHL, Embase, MEDLINE, and PsycINFO by an Information Specialist at the Toronto Rehabilitation Institute-University Health Network. This will be augmented by web-based grey literature and test searches using Google Scholar and Opengrey, and the instrumental database for Health and Psychosocial Instruments (HAPI). Trialed key search terms appropriate to each database will be used, with more narrow definitions of the following terms utilised in the grey literature search:

- Hearing Tests, or (hearing or audito* or audiolog*) adj2 (test* or screen* or assess* or eval*)
- Vision Tests, or (vision or visual or sight) adj2 (test* or screen* or assess* or eval*)
- Hearing Disorders/di [Diagnosis]
- Vision Disorders/di [Diagnosis]
- Deaf-Blind Disorders/di, or ("dual sensor*" adj2 (test* or screen* or assess* or eval*))
- Persons with Hearing Impairments
- Visually Impaired
- Long-Term Care, Nursing Homes, Homes for the Aged, old age home*, aged care facilit*
- Dementia, Delirium, Amnestic, Cognitive Disorders, Neurodegenerative Diseases, (dement* or Alzheimer*), (degenerative adj2 neurologic adj2 (disorder* or disease*), (neurodegenerative adj2 (disorder* or disease*)
- Aged or elder or elderly or geriatric or older or senescent

The publication years will be limited to between 1995 and 2015, without any language restrictions applied, to capture the full variation of possible tests being used. Search results will be filtered with removal of duplicates. Both peer reviewed and non-peer reviewed publications will be considered, including quantitative and qualitative research articles, assessment and treatment studies, as well as conference proceedings and academic dissertations that involve the reporting of original data.

Further to the grey literature search of online databases, information on available assessments and published research will also be gathered through interviews with frontline LTC staff and experts in optometry and audiology, and used to identify assessment methods currently employed in the field, ultimately enriching the scoping results. Ten optometrists and audiologists, along with a convenience sample of twenty frontline nursing staff working in LTC with residents who have dementia, and who are responsible for completing the MDS 2.0, (including sensory screening items), will be invited to participate in these interviews. These professionals will be interviewed by a member of the research team and asked about: 1) their experiences of working with persons who have dementia, as well as hearing and vision loss; 2)

how they identify which residents have sensory impairments; 3) ways in which sensory assessments could be improved; and 4) which key elements should be included in a screening assessment package. This will also mark the first step in continuous engagement and consultation with hearing and vision specialists throughout this study (Levac et al., 2010).

3. Study selection

Consistent with recommendations by Levac et al. (2010), the selection of studies: **1)** will involve searching the literature, refining the search strategy based on the scope of the initial results and judged feasibility of reviewing all articles for study inclusion; **2)** will require the scoping team to convene by teleconference at the beginning of this process to discuss decisions surrounding study inclusion and exclusion, for a second time after a trial run of the search strategy for possible refinement of procedures, and after all reviews have been completed for discussion of the full process; and **3)** will employ at least two reviewers to independently read and rate each abstract for possible inclusion, with final arbitration by a third reviewer if consensus is not reached.

The resulting studies will be screened by this team of reviewers based on the title and abstract, with two reviewers appraising each article to ensure the following inclusion criteria are met:

1) Human participants diagnosed with a form of dementia
2) The use of hearing and/or vision assessments
3) Participants with a mean or median age of 65 years or older
4) Original data from cross-sectional, longitudinal, observational, interventional or case studies
5) Can be judged based an available abstract
6) Publication is not a duplicate
7) Published between January 1995 and November 2015

As a result, each article will be rated twice using numeric exclusion codes, with reviewers instructed to use a top-down approach and rate each article for exclusion by use of the first exclusionary code that applies.

Further in line with guidelines by Levac et al. (2010), each scoping team member will be briefed by advance conference call on the exclusion criteria, their rationale and the coding system, providing the facility to raise any concerns and offer clarification where needed. Exclusion criteria and coding procedures will be trialed by reviewers on the first 50 citations before the team reconvenes by phone to discuss and resolve any issues with the coding guidelines, with the objective of reaching 100% consensus on the scoring procedures. Our scoping team will have expertise in areas of gerontology, vision, hearing or cognitive evaluation; however, examples of hearing and vision assessments will be provided to reviewers as reference points prior to the review process to facilitate clarification where expertise is not established e.g., the *ETDRS Chart* (Ferris 3rd et al., 1982) or *Cardiff Acuity Test (CAT)* for visual acuity, or Otoacoustic emissions and pure-tone audiometry for hearing abilities.

Finally, as with the screening of abstracts, the full articles will be reviewed by two independent reviewers to confirm inclusion, with disagreements arbitrated by a third reviewer (Levac et al., 2010). Nevertheless, this process will remain iterative with each step continuously assessed for feasibility based on the search results and the analytical resources available within the scoping team.

4. Data extraction

After being approved for inclusion, research data will be extracted independently by two reviewers, with final confirmation by a third reviewer (Arksey & O'Malley, 2005). The data collection form will be developed in collaboration with and following the approval of all members of the scoping team and charted in a standardised Excel spreadsheet, again approved by all collaborators. The spreadsheet will chart relevant data that will attempt to answer the research questions, as well as satisfy study objectives for the evaluation of test sensibility

(Armstrong et al., 2011), whilst also providing information required by content experts in the final stage of the consultation exercise, including:

- authors
- year of publication
- country
- testing environment (e.g., clinic, research lab, care home, LTC facility)
- study design
- sampling method
- participant demographics (age, gender, dementia type, comorbidities)
- name of assessment
- areas of assessment (vision or hearing)
- assessment duration (time required to complete)
- successful completion of assessment (including number of incomplete assessments)
- adaptations made for this clinical population (instructions provided)
- measurement outcomes
- interpretation of results (use of assessment data)
- reported psychometric properties (validity, reliability, sensitivity, specificity, positive predictive values)
- integrity of administration (who administered assessment, who interpreted the data)

5. Data analysis:

Due to the broad scope of our review question, we predict the generation of a large data set of resulting studies that use assessments of hearing, vision or both. We will therefore take a descriptive approach in providing a quantitative summary of the research findings (Wittich et al., 2012; Squires et al., 2011), outlining the extent of research utility documented for each hearing and/or vision assessment in persons with dementia. These data will then be used to evaluate and summarise the sensibility of each instrument.

Sensibility is defined by Feinstein (1987) in terms of comprehensibility, replicability, suitability, ease of use, face/construct validity, content validity, and scale of purpose; and refers to an instrument's feasibility (or efficiency of purpose) in a specified assessment context and its acceptability (of content and interpretation) to its intended users (Yeung et al., 2015). The evaluation of sensibility is an important first step before looking at the reliability, validity and responsiveness of an instrument (Yeung et al., 2015; Rowe and Oxman, 1993), and critical to its acceptance and actual utility with the intended population (Bowen et al., 2009).

Once the review data have been summarised and grouped by assessments used, the charted information will be evaluated by the scoping team using a devised scoring sheet to rate the instrument's sensibility. Reviewers will score each test on a 7-point rating scale (1 = strongly disagree, 7 = strongly agree) to rate its qualities in terms of: **1)** appropriateness; **2)** objectivity; **3)** content; and **4)** discriminative power (Rowe and Oxman, 1993). The assessment will be considered sensible if a mean score equal to or above 5 has been rated on at least 80% of the questionnaire items, and if none of the questionnaire items receive a mean rating of 3 (Yeung et al., 2015).

6. Consultation:

To add rigor and ensure the continued involvement of stakeholders throughout the process, we are engaging in a consultation exercise with clinical and research experts in hearing, vision and dual sensory impairment (Arksey and O'Malley, 2005; Levac et al., 2010; Daudt et al., 2014). We have aligned our review process with this recommendation and will apply a multidimensional consultative approach in: **1)** employing a multidisciplinary scoping team in the main review process; **2)** engaging in investigative discussion with frontline professionals in the form of environmental scan interviews; and in **3)** reporting our review findings to an expert panel of content developers, who will carry out the development of a hearing and vision screening package with devised guidelines as part of a later stage in this larger project.

We will organise a meeting with this expert panel to discuss the results of the current review, and with these findings employ a consensus method of modified RAND/UCLA Appropriateness Method (RAM) and Delphi method (Fitch et al., 2001; Ludwig, 1997) to evaluate and help select the tests and procedures to be included in the screening package. Our panel will be comprised of experts in the fields of clinical neuropsychology, nursing, geriatrics, audiology, optometry, and software development. These experts will identify tests and procedures which they believe could be administered by frontline staff in LTC in a reasonable time period based on the strength of evidence provided by the results from the literature review and environmental scan interviews.

Immediately following the development of the package of sensory screening tools, a similar consensus method will also be used to guide the development of a scoring mechanism (if adaption of an assessment for this population requires modification of the original scoring instructions) and decision-making process to identify which assessments to use with a specific resident and the criteria for referral to relevant specialist. The panel members will reconvene in a final meeting to re-evaluate the screening tools in practice and make their final recommendations.

Future recommendations may also include best approaches staff can use to conduct the screening assessments to acquire the most representative data possible. A noteworthy concern for this population is the reported variability in the symptomatic manifestation of Alzheimer's disease and mixed dementia, in terms of "good days" associated with improved cognition and functioning and "bad days" involving poor memory and increased agitation (Rockwood et al., 2014). Such implications for assessment will be outlined in the narrative contextualisation of search results.

ETHICS AND DISSEMINATION:

The scoping review protocol presented in this paper will identify and describe the utility and validity of hearing and vision screening assessments used with persons who have dementia, both in research as well as in the clinical domain. We have chosen to use a scoping review methodology to allow for inclusion of all types of studies and policies that have targeted assessments of the older adult. The review will summarise the available evidence in what has been done to assess and screen for hearing and vision loss, as well as the sensitivity and sensibility of these tools in diagnosing this type of sensory impairment. Healthcare professionals have little guidance on how to assess for hearing and vision concerns in this population; thus, a comprehensive review of assessments will be a valuable resource and is a next important step for healthcare providers working in the primary healthcare setting. This type of review also allows us to include consultations with key stakeholders to identify gaps in the evidence and research that need to be addressed in future investigations.

Timely assessment of hearing and vision will: **a)** facilitate identifying those in need of referral to a hearing or vision professional; **b)** enable individually tailored care for residents, thus promoting the health and well-being of older adults with dementia by enabling this population to participate more fully in programs and care activities offered in LTC; **c)** identify sensory impairments and by addressing them to whatever extent possible, care plans can be adapted to accommodate for these impairments; and **d)** allow tests of cognitive function that factor in sensory loss to be used, thus yielding a much more accurate gauge of residents' true levels of dementia (Dupuis et al., 2015).

Ethical approval was granted by the Research Ethic Boards of the University Health Network and Baycrest Health Sciences for environmental scan interviews with LTC frontline staff. With these review findings, we envision a package of tools and a process for tool selection that considers the degree and nature of hearing and vision sensory loss. The anticipated result of this larger project will include: **i)** recommendations for screening hearing in LTC facilities; **ii)** recommendations for screening vision in LTC facilities; **iii)** instructions for administering each screening tool and generating a score; **iv)** instructions for interpreting these scores; and **v)** a

description of the psychometric properties of the tools including reliability and validity; thus facilitating the accurate assessment of hearing and vision in older adults with dementia living in LTC, and possibly contributing to improvements in quality of life for these residents.

Word count = 3,838

REFERENCES

Alzheimer Society of Canada (2012). A new way of looking at the impact of dementia in Canada. http://www.alzheimer.ca/~/media/Files/national/Media-releases/asc_factsheet_new_data_09272012_en.pdf

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International journal of social research methodology*, 8(1), 19-32. http://dx.doi.org/10.1080/1364557032000119616

Armstrong, R., Hall, B. J., Doyle, J., & Waters, E. (2011). 'Scoping the scope' of a cochrane review. *Journal of Public Health, 33*(1), 147-150. doi:10.1093/pubmed/fdr015

Bédard, E., Kergoat, H., Kergoat, M. J., & Leclerc, B. S. (2015). Systematic review of vision-related quality of life questionnaires for older institutionalised seniors with dementia. *Ophthalmic and Physiological Optics*, 35(4), 377-387. http://dx.doi.org/10.1111/opo.12215

Behrman, S., Chouliaras, L., & Ebmeier, K. P. (2014). Considering the senses in the diagnosis and management of dementia. *Maturitas*, 77(4), 305-310. http://dx.doi.org/10.1016/j.maturitas.2014.01.003

Bowen, D. J., Kreuter, M., Spring, B., Cofta-Woerpel, L., Linnan, L., Weiner, D., Bakken, S., Kaplan, C. P., Squiers, L., Fabrizio, C., & Fernandez, M. (2009). How we design feasibility studies. *American Journal of Preventive Medicine, 36*(5), 452-457. http://dx.doi.org/10.1016/j.amepre.2009.02.002

Burnip, L. G., & Erber, N. P. (1997). Staff knowledge regarding hearing loss and communication among nursing home residents. *Australian Journal on Ageing*, 16(1), 40-43. http://dx.doi.org/10.1111/j.1741-6612.1997.tb01022.x

Canadian Hearing Society (2013). Facts and Figures. Retrieved from: http://www.chs.ca/facts-and-figures

Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M. & Moher, D. (2014). Scoping reviews: time for clarity in definition, methods, and reporting. *Journal of clinical epidemiology*, 67(12), 1291-1294. http://dx.doi.org/10.1016/j.jclinepi.2014.03.013

Crews, J. E., & Campbell, V. A. (2004). Vision impairment and hearing loss among community-dwelling older Americans: Implications for health and functioning. *American Journal of Public Health*, 94(5), 823-829. http://dx.doi.org/10.2105/AJPH.94.5.823

Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., Klein, R., Mares-Perlman, J. A., & Nondahl, D. M. (1998). Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin the epidemiology of hearing loss study. *American Journal of Epidemiology*, 148(9), 879-886. http://dx.doi.org/10.1093/oxfordjournals.aje.a009713

Daudt, H. M. L., Van Mossel, C., & Scott, S. J. (2013). Enhancing the scoping study methodology: A large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology*, 13(1). http://dx.doi.org/10.1186/1471-2288-13-48

Dupuis, K., Pichora-Fuller, M. K., Chasteen, A. L., Marchuk, V., Singh, G., & Smith, S. L. (2015). Effects of hearing and vision impairments on the Montreal Cognitive Assessment. *Aging, Neuropsychology, and Cognition*, 22(4), 413-437. http://dx.doi.org/10.1080/13825585.2014.968084

Feinstein, A. R. The theory and evaluation of sensibility. In Feinstein, A. R. (ed.) *Clinimetrics*. New Haven, MA: Y.U. Press; 1987. p. 141 – 166.

Ferris 3rd, F. L., Kassoff, A., Bresnick, G. H., & Bailey, I. (1982). New visual acuity charts for clinical research. *American Journal of Ophthalmology*, 94(1), 91–96. http://dx.doi.org/10.1016/0002-9394(82)90197-0

Fitch, K., Bernstein, S. J., Aguilar, M. D., Burnand, B., & LaCalle, J. R. (2001). The RAND/UCLA appropriateness method user's manual (No. RAND/MR-1269-DG-XII/RE). Retrieved from: http://www.rand.org/pubs/monograph_reports/MR1269.html

Gallacher, J. (2004). Hearing, cognitive impairment and aging: A critical review. *Reviews in Clinical Gerontology*, 14(03), 199-209. http://dx.doi.org/10.1017/S095925980500153X

Garahan, M. B., Waller, J. A., Houghton, M., Tisdale, W. A., & Runge, C. F. (1992). Hearing loss prevalence and management in nursing home residents. *Journal of the American Geriatrics Society*, 40(2), 130-134.

Gold, M., Lightfoot, L. A., & Hnath-Chisolm, T. (1996). Hearing loss in a memory disorders clinic: A specially vulnerable population. *Archives of Neurology*, 53(9), 922-928. http://dx.doi.org/10.1001/archneur.1996.00550090134019

Heine, C., & Browning, C. (2015). Dual Sensory Loss in Older Adults: A Systematic Review. *The Gerontologist*, gnv074. http://dx.doi.org/10.1093/geront/gnv074

InterRAI (20160). Instruments: Long-Term Care Facilities. Retrieved from: http://www.interrai.org/long-term-care-facilities.html

Kim, E. S., & Bayles, K. A. (2007). Communication in late-stage Alzheimer's disease: Relation to functional markers of disease severity. *Alzheimer's Care Quarterly, 8*(1), 43-52.

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: advancing the methodology. *Implementation Science*, *5*(1), 1-9. http://dx.doi.org/10.1186/1748-5908-5-69

Lin, F. R., Yaffe, K., Xia, J., Xue, Q.L., Harris, T. B., Purchase-Helzner, E., Satterfield, S., Ayonayon,H. N., Ferrucci, L., & Simonsick, E. M. (2013). Hearing loss and cognitive decline in older adults. *JAMA Internal Medicine*, 173(4), 293-299. http://dx.doi.org/10.1001/jamainternmed.2013.1868

Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi methodology? *Journal of Extension, 35*(5), 93-96.

McGilton, K. S., Rochon, E., Sidani, S., Shaw, A., Ben-David, B., Saragosa, M., Boscart, V., Wilson, R., Galimidi-Epstein, K. K., Pichora-Fuller, M. K. (in preparation). An intervention to improve interactions between care providers and residents with dementia.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L.A. (2015) Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. *Systematic Reviews.* 4(1):1. doi: 10.1186/2046-4053-4-1

O'Malley, P. G. (2013). Evolving insights about the impact of sensory deficits in the elderly. *JAMA Internal Medicine, 173*(4), 299. http://dx.doi.org/10.1001/jamainternmed.2013.3760

Ortman, J. M., Velkoff, V. A. & Hogan, H. (2014). An Aging Nation: The Older Population in the United States, Current Population Reports, P25-1140. U.S. Census Bureau, Washington, DC. USA. Retrieved from: https://www.census.gov/prod/2014pubs/p25-1140.pdf

Owsley, C., McGwin, G., Scilley, K., Meek, G. C., Dyer, A., & Seker, D. (2007). The visual status of older persons residing in nursing homes. *Archives of Ophthalmology, 125*(7), 925-930. doi:10.1001/archopht.125.7.925

Pichora-Fuller, M. K., Dupuis, K., Reed, M., & Lemke, U. (2013). Helping older people with cognitive decline communicate: Hearing aids as part of a broader rehabilitation approach. *Seminars in Hearing*, 34(4), 308-330. http://dx.doi.org/10.1055/s-0033-1356643

Prince, M., Wimo, A., Guerchet, M., Ali, G.-C., Wu, Y.-T., Prina, M., & Alzheimer's Disease International (ADI) (2015). *World Alzheimer Report 2015: The Global Impact of Dementia. An analysis of prevalence, incidence, cost & trends.* London, UK: Alzheimer's Disease International (ADI). http://www.alz.co.uk/research/WorldAlzheimerReport2015.pdf

Reed, M. (2012) When the Brain Gets Hard of Hearing: Paying Attention to Cognition in Hearing Rehabilitation. *Seminars on Audition. Canadian Hearing Report,* 8(3): 42-45.

Rockwood, K., Fay, S., Hamilton, L., Ross, E., & Moorhouse, P. (2014). Good days and bad days in dementia: A qualitative chart review of variable symptom expression. *International Psychogeriatrics*, 26(8), 1239-1246. http://dx.doi.org/10.1017/S1041610214000222

Rowe, B. H., & Oxman, A. D. (1993). An assessment of the sensibility of a quality-of-life instrument. *American Journal of Emergency Medicine*, 11(4), 374-380. http://dx.doi.org/10.1016/0735-6757(93)90171-7

Schneider, J. M., Gopinath, B., McMahon, C. M., Leeder, S. R., Mitchell, P., & Wang, J. J. (2011). Dual sensory impairment in older age. *Journal of Aging and Health*, 23(8), 1309-1324. http://dx.doi.org/10.1177/0898264311408418

Schow, R. L., & Nerbonne, M. A. (1980). Hearing levels among elderly nursing home residents. *Journal of Speech and Hearing Disorders*, 45(1), 124-132. http://dx.doi.org/10.1044/jshd.4501.124

Seitz, D., Purandare, N., & Conn, D. (2010). Prevalence of psychiatric disorders among older adults in long-term care homes: A systematic review. *International Psychogeriatrics*, 22(7), 1025-1039. http://dx.doi.org/10.1017/S1041610210000608

Squires, J. E., Estabrooks, C. A., O'Rourke, H. M., Gustavsson, P., Newburn-Cook, C. V., & Wallin, L. (2011). A systematic review of the psychometric properties of self-report research utilization measures used in healthcare. *Implementation Science*, 6(1). http://dx.doi.org/10.1186/1748-5908-6-83

Statistics Canada (2012). The Canadian Population in 2011: Age and Sex. Age and Sex, Census, 2011. Minister of Industry. Catalogue no. 98-311-X2011001: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-311-x/98-311-x2011001-eng.pdf

Swanson, M. W., McGwin Jr., G., Elliott, A. F., & Owsley, C. (2009). The nursing home minimum data set for vision and its association with visual acuity and contrast sensitivity. *Journal of the*

American Geriatrics Society, 57(3), 486-491. http://dx.doi.org/10.1111/j.1532-5415.2008.02144.x

Swenor, B. K., Ramulu, P. Y., Willis, J. R., Friedman, D., & Lin, F. R. (2013). Research letters: The prevalence of concurrent hearing and vision impairment in the United States. *JAMA Internal Medicine*, 173(4), 312-313. http://dx.doi.org/10.1001/jamainternmed.2013.1880

The American Speech-Language-Hearing Association, ASHA (2016). Hearing Screening. Retrieved from: http://www.asha.org/public/hearing/Hearing-Screening

Tielsch, J. M., Javitt, J. C., Coleman, A., Katz, J., & Sommer, A. (1995). The prevalence of blindness and visual impairment among nursing home residents in Baltimore. *New England Journal of Medicine*, 332(18), 1205-1209. http://dx.doi.org/10.1056/NEJM199505043321806

Uhlmann, R. F., Larson, E. B., Koepsell, T. D., Rees, T. S., & Duckert, L. G. (1991). Visual impairment and cognitive dysfunction in Alzheimer's disease. *Journal of General Internal Medicine*, 6(2), 126-132. http://dx.doi.org/10.1007/BF02598307

Uhlmann, R. F., Larson, E. B., Rees, T. S., Koepsell, T. D., & Duckert, L. G. (1989). Relationship of hearing impairment to dementia and cognitive dysfunction in older adults. *JAMA - Journal of the American Medical Association*, 261(13), 1916-1919. http://dx.doi.org/10.1001/jama.1989.03420130084028

Weinstein, B. E. (2000). *Geriatric audiology*. Thieme: New York.

Weinstein, B. E., & Arnsel, L. (1986). Hearing loss and senile dementia in the institutionalized elderly. *Clinical Gerontologist*, 4(3), 3-15. http://dx.doi.org/10.1300/J018v04n03_02

Wittich, W., Murphy, C., & Mulrooney, D. (2014). An adapted adult day centre for older adults with sensory impairment. *British Journal of Visual Impairment*, 32(3), 249-262. http://dx.doi.org/10.1177/0264619614540162

Wittich, W., Sikora, L., Watanabe, D. H., & Martinez, M. (2012). Canadian research contributions to low vision rehabilitation: a quantitative systematic review. *Canadian Journal of Optometry*, 74, 30-7. http://opto.ca/sites/default/files/resources/documents/cjo_volume_74_no_3_canadian_research_contributions_to_low_vision_rehabilitation.pdf

Woodruff, M. E., & Pack, G. (1980). A survey of the prevalence of vision defects and ocular anomalies in 43 ontario residential and nursing homes. *Canadian Journal of Public Health,* 71(6), 413-423.

Yamada, Y., Vlachova, M., Richter, T., Finne-Soveri, H., Gindin, J., van der Roest, H., Denkinger, M. D., et al. (2014). Prevalence and Correlates of Hearing and Visual Impairments in European Nursing Homes: Results From the SHELTER Study. *Journal of the American Medical Directors Association*, 15(10), 738–743. Elsevier Ltd. http://dx.doi.org/10.1016/j.jamda.2014.05.012

Yeung, E., Woods, N., Dubrowski, A., Hodges, B., & Carnahan, H. (2015). Sensibility of a new instrument to assess clinical reasoning in post-graduate orthopaedic manual physical therapy education. *Manual Therapy*, 20(2), 303-312. http://dx.doi.org/10.1016/j.math.2014.10.001

Yueh, B., Shapiro, N., MacLean, C. H., & Shekelle, P. G. (2003). Screening and management of adult hearing loss in primary care: Scientific review. *Journal of the American Medical Association*, 289(15), 1976-1985. http://dx.doi.org/10.1001/jama.289.15.1976

Hearing and Vision Screening Tools for Long-term Care Residents with Dementia: Protocol for a Scoping Review

Katherine S. McGilton [1, 2], Fiona Höbler [1, 3], Jennifer Campos [1, 4], Kate Dupuis [4, 5], Tammy Labreche [6], Dawn M. Guthrie [7], Jonathan Jarry [8], Walter Wittich [8, 9, 10, 11]

Strengths and limitations of this study

- This scoping review takes a rigorous and systematic approach to a broad research question that brings together two traditionally standalone areas of research and clinical practice to answer the critical issue of how to most effectively assess both hearing and vision abilities in older adults with dementia, residing in a long-term care setting.
- The scoping team will also consolidate its expertise in areas of vision, hearing, cognition, gerontology and communication, which complement each other in further enhancing the development of a systematic team approach and interpreting a wide range of research data.
- We are using several data sources to comprehensively answer a clearly defined, yet broad research question. We will include all published literature with original research data from electronic databases and online search engines, in any language, and within any setting that has measured hearing and/or vision in older adults with any form of dementia, whether for research or clinical purposes. In addition, we will enhance these search results with information obtained from relevant healthcare professionals through environmental scan interviews; thus yielding a more comprehensive scope of applicable findings for both researchers and practitioners alike.
- This review will describe the psychometric properties of assessments found in the literature and those used in the field, and evaluate the acceptance and feasibility of their use with this population by providing a sensibility appraisal.
- However, a limitation of this scoping review may lie in the possibly very large scale of its findings, and, for reasons of feasibility, we may not be able to provide a more in-depth quality analysis of the individual studies reported therein.

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		
Identification	1a	Identify the report as a protocol of a systematic review
Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number
Authors:		
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments
Support:		
Sources	5a	Indicate sources of financial or other support for the review
Sponsor	5b	Provide name for the review funder and/or sponsor
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol
INTRODUCTION		
Rationale	6	Describe the rationale for the review in the context of what is already known
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)
METHODS		
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated
Study records:		
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review

Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

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Hearing and Vision Screening Tools for Long-term Care Residents with Dementia: Protocol for a Scoping Review

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Hearing and Vision Screening Tools for Long-term Care Residents with Dementia: Protocol for a Scoping Review

Katherine S. McGilton [1, 2], Fiona Höbler [1, 3], Jennifer Campos [1, 4], Kate Dupuis [4, 5], Tammy Labreche [6], Dawn M. Guthrie [7], Jonathan Jarry [8], Gurjit Singh [9, 3, 10, 1], Walter Wittich [8, 11, 12, 13]

1. Department of Research, Toronto Rehabilitation Institute-University Health Network, Toronto, ON, Canada.
2. Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, ON, Canada.
3. Department of Speech-Language Pathology, University of Toronto, Toronto, ON, Canada.
4. Department of Psychology, University of Toronto, Toronto, ON, Canada.
5. Department of Audiology, Baycrest Health Sciences, Toronto, ON, Canada.
6. Centre for Sight Enhancement, School of Optometry and Vision Science, University of Waterloo, Waterloo, ON, Ontario.
7. Department of Kinesiology & Physical Education and Health Sciences, Faculty of Science, Wilfrid Laurier University, ON, Canada.
8. School of Optometry, University of Montréal, Montréal, QC, Canada.
9. Phonak AG, Stäfa, Switzerland.
10. Department of Psychology, Ryerson University, Toronto, Ontario, Canada.
11. School of Physical and Occupational Therapy, McGill University, Montréal, QC, Canada.
12. CRIR/Centre de réadaptation MAB-Mackay du CIUSSS du Centre-Ouest-de-l'Île-de-Montréal. Montréal, QC. Canada.
13. CRIR/Institut Nazareth et Louis-Braille du CISSS de la Montérégie-Centre, Montréal, QC, Canada.

Corresponding author: Katherine S. McGilton, RN, PhD

Senior Scientist, Toronto Rehabilitation Institute – UHN

Lawrence S. Bloomberg, Faculty of Nursing, University of Toronto

130 Dunn Ave, Toronto, M6K 2R7.

Tel: +1 416 597-3422 (2500). Email: kathy.mcgilton@uhn.ca

Email contact for all authors: fiona.hobler@utoronto.ca, jennifer.campos@uhn.ca, kdupuis@baycrest.org, tammy.labreche@uwaterloo.ca, dguthrie@wlu.ca, jonathan.jarry@umontreal.ca, gurjit.singh@phonak.com, walter.wittich@umontreal.ca.

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Abstract (299 words)

Introduction: Hearing and vision loss amongst long-term care (LTC) residents with dementia frequently goes unnoticed and untreated. Despite negative consequences for these residents, there is little information available about their sensory abilities, and care assessments and practices seldom take these abilities or accessibility needs into account. Without adequate knowledge regarding such sensory loss, it is difficult for LTC staff to determine the level of an individual's residual basic competence for communication and independent functioning. We will conduct a scoping review to identify the screening measures used in research and clinical contexts that test hearing and vision in adults aged over 65 years with dementia, aiming to: 1) provide an overview of hearing and vision screening in older adults with dementia; and 2) evaluate the sensibility of the screening tools.

Methods and analysis: This scoping review will be conducted using the framework by Arksey and O'Malley and furthered by methodological enhancements from cited researchers. We will conduct electronic database searches in CENTRAL, CINAHL, Embase, MEDLINE, and PsycINFO. We will also carry out a "grey literature" search for studies or materials not formally published, both online and through interview discussions with healthcare professionals and research clinicians working in the field. Our aim is to find new and existing hearing and vision screening measures used in research and by clinical professionals of optometry and audiology. Abstracts will be independently reviewed twice for acceptance by a multidisciplinary team of researchers and research clinicians.

Ethics and dissemination: This review will inform health professionals working with this growing population. With the review findings, we aim to develop a tool kit and an algorithmic process to select the most appropriate hearing and vision screening assessments for LTC residents with dementia that will facilitate accurate testing and can inform care planning, thereby improving residents' quality of life.

Strengths and limitations of this study

- This scoping review takes a rigorous and systematic approach to a broad research question that brings together two traditionally standalone areas of research and clinical practice by professionals working in both fields, to answer the critical issue of how to most effectively screen both hearing and vision abilities in older adults with dementia, residing in a long-term care setting.
- We will include all published literature with original research data from electronic databases and online search engines, in any language, and within any setting that has measured hearing and/or vision in older adults with any form of dementia, whether for research or clinical purposes.
- This review will describe the psychometric properties of assessments found in the literature and those used in the field, and evaluate the acceptance and feasibility of their use with this population.
- A limitation of this scoping review may lie in the large scale of its aggregate findings for vision *or* hearing measures with populations who have cognitive impairment, and, for reasons of feasibility, we may not be able to provide a more in-depth quality analysis of the individual studies reported therein.

INTRODUCTION

Dementia affects a person's ability to understand explanations, follow directions, or correctly interpret interpersonal communication[1]. Indeed, language impairment is often seen as one of the first symptoms of dementia[2, 3]. The dementias, particularly in their moderate to severe staging, are characterized by deficits in memory and language processing attributed to the temporal lobe area, and is reflected in the individual's ability to recognise, generate and repeat words, organize information in conversation, as well as variable impairments of grammatical, semantic (related to meaning) and lexical (vocabulary) knowledge[4, 5, 6]. These problems can have profound implications for effective interactions in long-term care (LTC) facilities. The prevalence of dementia is 58% amongst residents in this setting[7], and there are increasing incidence rates of this disease in a rapidly aging population[8, 9]. When residents cannot articulate their needs or cannot be understood because of their dementia, they frequently become frustrated or agitated. Furthermore, LTC staff may not correctly attribute these behaviours to various causes, and often underestimate the prevalence of sensory loss and its effects on communication[10].

The challenges of the resulting communication difficulties in residents with dementia are compounded by hearing and vision problems that progress as people age[4]. Sensory loss is widespread among older adults, and is often overlooked in those living in residential settings. Nursing home residents tend to be older and have higher levels and more severe physical and cognitive impairment, than those living in the community[11].

Hearing loss is the third most prevalent chronic condition in older adults[12], estimated in up to 50% of those aged over 65 years[13]. Vision impairment (low vision with visual acuity < 20/70) is reported in 18% of individuals aged 70 years or over[14]. Dual sensory loss or deafblindness, was found to have the highest prevalence in older adults in LTC settings, at approximately 25%, compared to those non-institutionalised or dwelling in other settings[15]. Notably, the prevalence of such sensory loss amongst adults with dementia has been shown to be higher than in those who are cognitively intact[16, 17], with hearing loss alone found in more than 90% of cognitively impaired patients[18].

Although the mechanisms underlying the association between cognitive and sensory

impairment remain unknown, it has been suggested that this relationship may result from a common neuropathological origin in the brain underlying both sensory loss and cognitive decline, effects of social isolation caused by both sensory and cognitive loss, and/or increased cognitive/attentional load caused by sensory loss[19, 20].

This evidence suggests significant increases in the prevalence of, and association between sensory and cognitive decline in a population of older adults (above 65 years) that is rapidly increasing[21, 22]. Unsurprisingly, the incidence of sensory impairment is hi higher in the LTC setting, with approximately 80% of LTC residents experiencing at minimum mild hearing loss and approximately 50% having a moderate to severe impairment[23, 24, 25]. Visual impairment is twice as high in LTC as amongst the general population of the same age, with a reported prevalence of between 30% - 57%[26, 27, 28, 29]; and, ultimately, hearing and/or vision loss found in two thirds of residents and dual sensory loss affecting one third of LTC residents[26].

For these reasons, there is a pressing need to further investigate the relationship between hearing, vision and cognitive impairment, as well as to develop appropriate interdisciplinary interventions to moderate their effects on older and vulnerable persons, by herein employing a comprehensive interdisciplinary, collaborative approach[30, 31].We will adopt this approach in our search for sensitive hearing and vision screening tools that appropriately identify sensory impairment as the first step in this rehabilitation process.

Pilot Project in Training Resident Centered Communication

In a recent pilot project funded by the Alzheimer Society of Canada (ASC), our research team investigated the effects of enhancing interactions between staff and LTC residents through training in a Resident Centered Communication Intervention, RCCI[32]. This study took place in a 128-bed, for-profit, LTC home in Ontario, Canada with 12 residents who had a diagnosis of dementia and 20 caregiving staff. The aim of the study was to determine if a Resident Communication Centred Intervention could influence caregiver and residents' outcomes. The RCCI involved a dementia care workshop, the development of individualised resident communication care plans by a Speech-Language Pathologist (SLP), with staff supported at the bedside by an advanced practice nurse to implement the care plans. Individualised

communication care plans were tailored according to the cognitive, sensory and linguistic abilities of the residents. Comparing post intervention to baseline results, residents experienced a significant improvement in their mood and staff experienced reduced burden, shown by use of multilevel mixed effects linear regression.

In order to address concerns raised in the literature and by LTC staff, sensory assessments, as well as linguistic and cognitive testing, was undertaken to better understand each resident's current linguistic and cognitive abilities from the outset[33, 34, 35]. Two major problems were identified:

1) **Usual screening in LTC Facilities:** Only residents who are flagged by staff or family members as possibly having sensory problems are assessed by the relevant specialist. At other times, identification of sensory problems may arise through the standardised resident assessment (known as the MDS 2.0), which includes items on hearing and vision, and is completed at admission, quarterly, and with a change in the clinical status of the resident[36]. Nonetheless, these assessments rely heavily on observation and reporting, are not comprehensive, and have been shown to be frequently inadequate in identifying those in need of specialist referral[37].

2) **Standard test procedures:** The tests used to supplement information about hearing and vision acquired from patient records have been validated in a non-cognitively impaired population. There are no equivalent vision screening tests designed specifically for persons with dementia in LTC facilities, and no best practice protocols for audiological examination of this population[38]. Not surprisingly, in our pilot study, there was limited success in administering standardised tests (e.g., audiogram assessment and Functional Linguistic Communication Inventory - FLCI), as residents often had difficulty following instructions.

   For example, the following adaptations were made to the standardised testing procedures for hearing and vision: **a)** audiometric testing: two participants were unwilling to complete the test and some were unable to learn to respond consistently to pure-tone stimuli, thus live voice testing at a conversational level was improvised using simple tasks; **b)** vision testing: participants often demonstrated difficulty following test instructions and maintaining prolonged attention even though instructions were communicated using clear and simple speaking skills[39]. Therefore, when necessary, test procedures were modified;

e.g., for patients who had difficulty sustaining attention, only a subset of the Teller cards was show[32].

In the traditional research domains of vision and hearing, participants with severe cognitive impairment are often excluded from recruitment and data collection, as tests that are otherwise standardised in their administration would need to be adapted for this population. For example, the requirement of reading letters on an eye chart relies on the ability to identify and remember these letters, and then repeat them; making these test formats unsuitable for individuals with impaired memory and language abilities; thus having to be substituted with the spelling of familiar words (such as the person's name) or basic numbers chart. This resulting exclusion process results in the limited scope of recent publications on the topic of sensory and co-morbid cognitive loss.

Although previous literature reviews have been carried out in the area of dual sensory loss or deafblindness, reporting on its frequency and effects on functionality[40], comorbidities and impact on older adults above 65 years[41], as well as the sensory impact on dementia care[42], vision related quality of life in residents with dementia[43], and hearing loss with cognitive impairment[4, 44], a comprehensive review of hearing and vision assessments and their clinical utility in this growing population is not yet available. Researchers as well as health service providers in the field of deafblindness agree that the co-presentation of vision- and hearing loss is not simply additive but multiplicative, thereby creating a new and more complex type of sensory impairment[45, 46, 47].

This scoping review aims to address the need for adaptable and standardised screening by identifying suitable and validated hearing and vision measures for persons with dementia that can be used in LTC residencies. The main objective of our larger study is to address the reported problems of identifying adults in LTC facilities who are in need of referral to a hearing or vision specialist for second level assessment, and thereby enable more specialised care and treatment for hearing and vision loss in this vulnerable population, which in turn will serve to promote their participation, engagement and improve quality of care.

Methods and analysis

1. Methodology:

Our scoping team of reviewers will be multidisciplinary, comprising of clinician scientists[1], researchers and clinicians specialising in the fields of nursing, audiology, optometry, cognitive and perceptual psychology, clinical neuropsychology, and speech-language pathology. Consistent with the broad scope of our areas of interest, we will adopt the methodological framework set out by Arksey and O'Malley[48], employing a scoping approach to review existing literature and to examine the extent, range and nature of research activity, identify research gaps in this literature, and then summarise and disseminate research findings, as outlined in Appendix 1.

We will further adhere to the methodological enhancements based on previously published scoping reviews by providing transparency, reproducibility and utility with the presentation of this protocol[49]. We aim for consistency in labelling and definition of scoping terms[50], and maintaining a broad search strategy with clearly defined concepts and their continuous refinement[51]. Additionally, we will use multidisciplinary expertise and group consultation within the scoping team to inform and guide the definition of the search criteria and clinical applicability of data for extraction[51, 52], and to allow for post-hoc development of inclusion/exclusion criteria and data synthesis in terms of the value yielded by qualitative or quantitative analysis of results[49].

We will also conduct interviews with frontline practitioners and LTC staff to add more information, meaning and applicability to our search results. Finally, we will provide a summary of the current research activity and possible clinical implications of the evidence to further clinical research, practice and policy[51]. Encompassing the fields of hearing and vision, we bring together two standalone concepts using established guidelines[53, 50] to form the research question: Which hearing and vision screening measures and practices are effective in identifying hearing and vision impairments in older adults with dementia? Our aims are to: **1)** provide an overview of the use of hearing and/or vision screening tools in persons with

[1] For the purpose of our study, we consider researchers to be those individuals whose primary training is focused on research methodologies, techniques and skills to conduct research (e.g., PhD); whereas we consider practitioners as those individuals whose primary focus during their training was the acquisition of skills for the purpose of delivering a clinical service (e.g., RSW). We acknowledge that, in the case of clinician-scientists, there is a certain overlap between these two categories, likely beneficial to our purposes. We aim to have representation of all three groups on our team.

dementia; and **2)** evaluate the sensibility of these measures.

It has been argued that despite having evidenced reliability, validity and responsiveness to change, instruments can be underused due to numerous reasons including its practicality[54], and therefore, evaluating an instrument's sensibility (which includes face and content validity) should be an important first step to see if this will be acceptable in the research or clinical field. In this sense, sensibility should also be assessed before ecological validity, as completing the test successfully and acceptably with the intended population is most indicative of its feasibility, rather than real-world validity and applicability of results. The reliability and validity of the tools selected with consideration of sensibility will be carried out a later stage of the process in developing the screening package. Sensibility will be defined as the feasibility and acceptability of an instrument in a specified assessment context[55]. Finally, our scoping results will then be reported in partitioned reviews dedicated to: **a)** hearing; **b)** vision; and **c)** dual sensory assessment.

2. Search Methods:

In order to investigate the extent of screening literature available and to identify any gaps in research and clinical practice, we are defining screening measures as objective tests and instruments appropriate for use in the preliminary evaluation of hearing and/or visual ability (e.g., hearing threshold or visual acuity). These screening instruments are not necessarily used for the diagnosis of a hearing or vision problem, but rather a reliable, valid and sensitive tool for detecting when further evaluation is warranted by a hearing or vision specialist[56]. A broad definition of screening methods will be adopted that include paper-based tests, as well as technologies involving software solutions in the form of apps for mobile devices, and higher-tech devices such as portable ophthalmic or audiometric equipment.

Electronic database searches will be conducted in CENTRAL, CINAHL, Embase, MEDLINE, and PsycINFO by an Information Specialist at the Toronto Rehabilitation Institute-University Health Network. This will be augmented by web-based grey literature searches, for published and unpublished in books or journals, including conference proceedings and abstracts, dissertations or theses, project reports, and government documents, and test searches using Google Scholar and Opengrey, and the instrumental database for Health and Psychosocial Instruments (HAPI).

Trialed key search terms appropriate to each database will be used, with more narrow definitions of the terms utilised in the grey literature search as listed in Appendix 2.

The publication years will be limited to between 1995 and 2016, without any language restrictions applied, to capture the full variation of possible tests being used. Search results will be filtered with removal of duplicates. Both peer reviewed and non-peer reviewed publications will be considered, including quantitative and qualitative research articles, assessment and treatment studies, as well as conference proceedings and academic dissertations that involve the reporting of original data.

Further to the grey literature search of online databases, information on available assessments and published research will also be gathered through interviews with frontline LTC staff and experts in optometry and audiology, and used to identify screening methods currently employed in the field, ultimately enriching the scoping results. Ten optometrists and audiologists, along with a convenience sample of twenty frontline nursing staff working in LTC with residents who have dementia, and who are responsible for completing the MDS 2.0, (including sensory screening items), will be invited to participate in these interviews. The information collected from environmental scan interviews will be analysed by means of thematic content analysis to identify the important points regarding screening approaches and materials used by healthcare professionals. These professionals will be interviewed by a member of the research team and asked about: **1)** their experiences of working with persons who have dementia, as well as hearing and vision loss; **2)** how they identify which residents have sensory impairments; **3)** ways in which sensory screening could be improved; and **4)** which key elements should be included in a screening package. This will also mark the first step in continuous engagement and consultation with hearing and vision specialists throughout this study[51].

3. Study selection

Consistent with recommendations by Levac et al.[51], the selection of studies: **1)** will involve searching the literature, refining the search strategy based on the scope of the initial results and judged feasibility of reviewing all articles for study inclusion; **2)** will require the scoping

team to convene by teleconference at the beginning of this process to discuss decisions surrounding study inclusion and exclusion, for a second time after a trial run of the search strategy for possible refinement of procedures, and after all reviews have been completed for discussion of the full process; and **3)** will employ at least two reviewers to independently read and rate each abstract for possible inclusion, with final arbitration by a third reviewer if consensus is not reached.

The resulting studies will be screened by this team of reviewers based on the title and abstract.

Two reviewers will independently make a decision to exclude articles from the review based on the agreed-upon exclusion criteria, which are listed in Appendix 2.

Further in line with guidelines by Levac et al.[51], each scoping team member will be briefed by advance conference call on the exclusion criteria, their rationale and the coding system, providing the facility to raise any concerns and offer clarification where needed. Exclusion criteria and coding procedures will be trialed by reviewers on the first 50 citations before the team reconvenes by phone to discuss and resolve any issues with the coding guidelines, with the objective of reaching 100% consensus on the scoring procedures. Our scoping team will have expertise in areas of gerontology, vision, hearing or cognitive evaluation; however, examples of hearing and vision assessments will be provided to reviewers as reference points prior to the review process to facilitate clarification where expertise is not established e.g., the *ETDRS Chart*[57] or *Cardiff Acuity Test (CAT)* for visual acuity, or Otoacoustic emissions and pure-tone audiometry for hearing abilities.

Finally, as with the screening of abstracts, the full articles will be reviewed by two independent reviewers to confirm inclusion, with disagreements arbitrated by a third reviewer[51]. Nevertheless, this process will remain iterative with each step continuously assessed for feasibility based on the search results and the analytical resources available within the scoping team.

4. Data extraction

After being approved for inclusion, research data will be extracted independently by two

reviewers, with final confirmation by a third reviewer[48]. The data collection form will be developed in collaboration with and following the approval of all members of the scoping team and charted in a standardised Excel spreadsheet, again approved by all collaborators. All reviewers will be provided with a sample extraction therein to guide them through this process. The spreadsheet will chart relevant data that will attempt to answer the research questions, as well as satisfy study objectives for the evaluation of test sensibility[49], whilst also providing information required by content experts in the final stage of the consultation exercise, including:

- authors
- year of publication
- country
- testing environment (e.g., clinic, research lab, care home, LTC facility)
- study design
- sampling method
- participant demographics (age, gender, dementia type, comorbidities)
- name of tool
- areas of testing (vision or hearing)
- testing duration (time required to complete)
- successful completion of test (including number of incomplete tests)
- adaptations made for this clinical population (instructions provided)
- measurement outcomes
- interpretation of results (use of assessment data)
- reported psychometric properties (validity, reliability, sensitivity, specificity, positive predictive values)
- integrity of administration (who administered test, who interpreted the data)

5. Data analysis:

Due to the broad scope of our review question, we predict the generation of a large data set of

resulting studies that use assessments of hearing, vision or both. We will therefore take a descriptive approach in providing a quantitative summary of the research findings[58, 59], outlining the extent of research utility documented for each hearing and/or vision assessment in persons with dementia. These data will then be used to evaluate and summarise the sensibility of each instrument.

Sensibility is defined by Feinstein[60] in terms of comprehensibility, replicability, suitability, ease of use, face/construct validity, content validity, and scale of purpose; and refers to an instrument's feasibility (or efficiency of purpose) in a specified screening context and its acceptability (of content and interpretation) to its intended users[55]. The evaluation of sensibility is an important first step before looking at the reliability, validity and responsiveness of an instrument[54, 55], and critical to its acceptance and actual utility with the intended population[61].

Once the review data have been summarised and grouped by measures used, the charted information will be evaluated by the scoping team using a devised scoring sheet to rate the instrument's sensibility. Reviewers will score each test on a 7-point rating scale (1 = strongly disagree, 7 = strongly agree) to rate its qualities in terms of: **1)** appropriateness; **2)** objectivity; **3)** content; and **4)** discriminative power[54]. The screening tool will be considered sensible if a mean score equal to or above 5 has been rated on at least 80% of the questionnaire items, and if none of the questionnaire items receive a mean rating of 3[55].

6. Consultation:

To add rigor and ensure the continued involvement of stakeholders throughout the process, we are engaging in a consultation exercise with clinical and research experts in hearing, vision and dual sensory impairment[48, 51, 52]. We have aligned our review process with this recommendation and will apply a multidimensional consultative approach in: **1)** employing a multidisciplinary scoping team in the main review process; **2)** engaging in investigative discussion with frontline professionals in the form of environmental scan interviews; and in **3)** reporting our review findings to an expert panel of content developers, who will carry out the development of a hearing and vision screening package with devised guidelines as part of a later stage in this larger project.

We will organise a meeting with this expert panel to discuss the results of the current review, and with these findings employ a consensus method of modified RAND/UCLA Appropriateness Method (RAM) and Delphi method[62, 63] to evaluate and help select the tests and procedures to be included in the screening package. Our panel will be comprised of experts with specialised clinical and/or research experience in the fields of clinical neuropsychology, nursing, geriatrics, audiology, optometry, and software development, recruited from the professional networks of the members of the study team. Given the highly specialized nature of this field of research, the network of specialists is tight-knit and many of the pertinent players are known to each other, making this identification and recruitment process relatively speedy. These experts will identify tests and procedures which they believe could be administered by frontline staff in LTC in a reasonable time period based on the strength of evidence provided by the results from the literature review and environmental scan interviews. A workflow of this first phase is charted in Appendix 3.

Immediately following the development of the package of sensory screening tools, a similar consensus method will also be used to guide the development of a scoring mechanism (if adaption of a screening tool for this population requires modification of the original scoring instructions) and decision-making process to identify which assessments to use with a specific resident and the criteria for referral to relevant specialist. The panel members will reconvene in a final meeting to re-evaluate the screening tools in practice and make their final recommendations.

Future recommendations may also include best approaches staff can use to conduct the screening assessments to acquire the most representative data possible. A noteworthy concern for this population is the reported variability in the symptomatic manifestation of Alzheimer's disease and mixed dementia, in terms of "good days" associated with improved cognition and functioning and "bad days" involving poor memory and increased agitation[64]. Such implications for assessment will be outlined in the narrative contextualisation of search results.

ETHICS AND DISSEMINATION:

The scoping review protocol presented in this paper will identify and describe the feasibility and acceptability of hearing and vision screening tools used with persons who have dementia, both

in research as well as in the clinical domain. We have chosen to use a scoping review methodology to allow for inclusion of all types of studies and policies that have targeted screening of the older adult. The review will summarise the available evidence in what has been done to screen for hearing and vision loss, as well as the sensitivity and sensibility of these tools in diagnosing this type of sensory impairment. Healthcare professionals have little guidance on how to assess for hearing and vision concerns in this population; thus, a comprehensive review of screening techniques will be a valuable resource and is a next important step for healthcare providers working in the primary healthcare setting. This type of review also allows us to include consultations with key stakeholders to identify gaps in the evidence and research that need to be addressed in future investigations.

Timely screening of hearing and vision will: **1)** facilitate identifying those in need of referral to a hearing or vision professional; **2)** enable individually tailored care for residents, thus promoting the health and well-being of older adults with dementia by enabling this population to participate more fully in programs and care activities offered in LTC; **3)** identify sensory impairments and by addressing them to whatever extent possible, care plans can be adapted to accommodate for these impairments; and **4)** allow tests of cognitive function that factor in sensory loss to be used, thus yielding a much more accurate gauge of residents' true levels of dementia[33].

Ethical approval was granted by the Research Ethic Boards of the University Health Network and Baycrest Health Sciences for environmental scan interviews with LTC frontline staff. With these review findings, we envision a package of tools and a process for tool selection that considers the degree and nature of hearing and vision sensory loss. The anticipated result of this larger project will include: **1)** recommendations for screening hearing in LTC facilities; **2)** recommendations for screening vision in LTC facilities; **3)** instructions for administering each screening tool and generating a score; **4)** instructions for interpreting these scores; and **5)** a description of the psychometric properties of the tools including reliability and validity; to facilitate the accurate screening of hearing and vision in older adults with dementia living in LTC, resulting in better personalised care, and thus possibly contributing to improvements in social participation, clinical interaction and in overall quality of life for these residents[65].

Word count = 4,235

REFERENCES

1. Kim, E. S., & Bayles, K. A. (2007). Communication in late-stage Alzheimer's disease: Relation to functional markers of disease severity. *Alzheimer's Care Quarterly, 8*(1), 43-52.
2. Klimova, B., Maresova, P., Valis, M., Hort, J., & Kuca, K. (2015). Alzheimer's disease and language impairments: Social intervention and medical treatment. *Clinical Interventions in Aging, 10*, 1401-1408. doi:10.2147/CIA.S89714
3. Tang-Wai, D. F., & Graham, N. L. (2008). Assessment of language function in dementia. *Geriatrics and Aging, 11*(2), 103-110.
4. Pichora-Fuller, M. K., Dupuis, K., Reed, M., & Lemke, U. (2013). Helping older people with cognitive decline communicate: Hearing aids as part of a broader rehabilitation approach. *Seminars in Hearing*, 34(4), 308-330. http://dx.doi.org/10.1055/s-0033-1356643
5. Mansur, L. L. (2011). Language alterations in alzheimer's disease and other dementias. *Language disturbances in adulthood: New advances from the neurolinguistics perspective* (pp. 59-70) doi:10.2174/978160805108311101010059
6. Vuorinen, E., Laine, M., & Rinne, J. (2000). Common pattern of language impairment in vascular dementia and in alzheimer disease. *Alzheimer Disease and Associated Disorders, 14*(2), 81-86. doi:10.1097/00002093-200004000-00005
7. Seitz, D., Purandare, N., & Conn, D. (2010). Prevalence of psychiatric disorders among older adults in long-term care homes: A systematic review. *International Psychogeriatrics*, 22(7), 1025-1039. http://dx.doi.org/10.1017/S1041610210000608
8. Prince, M., Wimo, A., Guerchet, M., Ali, G.-C., Wu, Y.-T., Prina, M., & Alzheimer's Disease International (ADI) (2015). *World Alzheimer Report 2015: The Global Impact of Dementia. An analysis of prevalence, incidence, cost & trends.* London, UK: Alzheimer's Disease International (ADI). http://www.alz.co.uk/research/WorldAlzheimerReport2015.pdf
9. Alzheimer Society of Canada (2012). A new way of looking at the impact of dementia in Canada. http://www.alzheimer.ca/~/media/Files/national/Media-releases/asc_factsheet_new_data_09272012_en.pdf
10. Burnip, L. G., & Erber, N. P. (1997). Staff knowledge regarding hearing loss and

communication among nursing home residents. *Australian Journal on Ageing*, 16(1), 40-43. http://dx.doi.org/10.1111/j.1741-6612.1997.tb01022.x

11. Carpenter, I., & Hirdes, J. P. (2013). Using interRAI assessment systems to measure and maintain quality of long-term care. In *A Good Life in Old Age? Monitoring and Improving Quality in Long-term Care*. OECD/European Commission. doi:10.1787/9789264194564-en
12. Yueh, B., Shapiro, N., MacLean, C. H., & Shekelle, P. G. (2003). Screening and management of adult hearing loss in primary care: Scientific review. *Journal of the American Medical Association*, 289(15), 1976-1985. http://dx.doi.org/10.1001/jama .289.15.1976
13. Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., Klein, R., Mares-Perlman, J. A., & Nondahl, D. M. (1998). Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin the epidemiology of hearing loss study. *American Journal of Epidemiology*, 148(9), 879-886. http://dx.doi.org/10.1093/oxfordjournals.aje.a009713
14. Crews, J. E., & Campbell, V. A. (2004). Vision impairment and hearing loss among community-dwelling older Americans: Implications for health and functioning. *American Journal of Public Health*, 94(5), 823-829. http://dx.doi.org/10.2105/AJPH.94.5.823
15. Vaal, J., Gussekloo, J., De Klerk, M. M. Y., Frijters, D. H. M., Evenhuis, H. M., Van Beek, A. P. A., Van Nispen, R. M. A., Smits, C., & Deeg, D. J. H. (2007). Acquired dual sensory impairment: In an estimated 30,000-35,000 people aged 55 years or over in the netherlands. [Gecombineerde visus- en gehoorbeperking: Naar schatting bij 30.000-35.000 55-plussers in Nederland] *Nederlands Tijdschrift Voor Geneeskunde, 151*(26), 1459-1463
16. Uhlmann, R. F., Larson, E. B., Koepsell, T. D., Rees, T. S., & Duckert, L. G. (1991). Visual impairment and cognitive dysfunction in Alzheimer's disease. *Journal of General Internal Medicine*, 6(2), 126-132. http://dx.doi.org/10.1007/BF02598307
17. Uhlmann, R. F., Larson, E. B., Rees, T. S., Koepsell, T. D., & Duckert, L. G. (1989). Relationship of hearing impairment to dementia and cognitive dysfunction in older adults. *JAMA - Journal of the American Medical Association*, 261(13), 1916-1919. http://dx.doi.org/10.1001/jama.1989.03420130084028
18. Gold, M., Lightfoot, L. A., & Hnath-Chisolm, T. (1996). Hearing loss in a memory disorders clinic: A specially vulnerable population. *Archives of Neurology*, 53(9), 922-928.

http://dx.doi.org/10.1001/archneur.1996.00550090134019

19. Albers, M. W., Gilmore, G. C., Kaye, J., Murphy, C., Wingfield, A., Bennett, D. A., . . . Zhang, L. I. (2015). At the interface of sensory and motor dysfunctions and alzheimer's disease. *Alzheimer's and Dementia, 11*(1), 70-98. doi:10.1016/j.jalz.2014.04.514
20. Lin, F. R., Yaffe, K., Xia, J., Xue, Q.L., Harris, T. B., Purchase-Helzner, E., Satterfield, S., Ayonayon,H. N., Ferrucci, L., & Simonsick, E. M. (2013). Hearing loss and cognitive decline in older adults. *JAMA Internal Medicine*, 173(4), 293-299. http://dx.doi.org/10.1001/jamainternmed.2013.1868
21. Ortman, J. M., Velkoff, V. A. & Hogan, H. (2014). An Aging Nation: The Older Population in the United States, Current Population Reports, P25-1140. U.S. Census Bureau, Washington, DC. USA. Retrieved from: https://www.census.gov/prod/2014pubs/p25-1140.pdf
22. Statistics Canada (2012). The Canadian Population in 2011: Age and Sex. Age and Sex, Census, 2011. Minister of Industry. Catalogue no. 98-311-X2011001: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-311-x/98-311-x2011001-eng.pdf
23. Weinstein, B. E. (2000). *Geriatric audiology*. Thieme: New York.
24. Garahan, M. B., Waller, J. A., Houghton, M., Tisdale, W. A., & Runge, C. F. (1992). Hearing loss prevalence and management in nursing home residents. *Journal of the American Geriatrics Society*, 40(2), 130-134.
25. Schow, R. L., & Nerbonne, M. A. (1980). Hearing levels among elderly nursing home residents. *Journal of Speech and Hearing Disorders*, 45(1), 124-132. http://dx.doi.org/10.1044/jshd.4501.124
26. Yamada, Y., Vlachova, M., Richter, T., Finne-Soveri, H., Gindin, J., van der Roest, H., Denkinger, M. D., et al. (2014). Prevalence and Correlates of Hearing and Visual Impairments in European Nursing Homes: Results From the SHELTER Study. *Journal of the American Medical Directors Association*, 15(10), 738–743. Elsevier Ltd. http://dx.doi.org/10.1016/j.jamda.2014.05.012
27. Owsley, C., McGwin, G., Scilley, K., Meek, G. C., Dyer, A., & Seker, D. (2007). The visual status of older persons residing in nursing homes. *Archives of Ophthalmology, 125*(7), 925-

930. doi:10.1001/archopht.125.7.925

28. Tielsch, J. M., Javitt, J. C., Coleman, A., Katz, J., & Sommer, A. (1995). The prevalence of blindness and visual impairment among nursing home residents in Baltimore. *New England Journal of Medicine*, 332(18), 1205-1209. http://dx.doi.org/10.1056/NEJM199505043321806
29. Woodruff, M. E., & Pack, G. (1980). A survey of the prevalence of vision defects and ocular anomalies in 43 ontario residential and nursing homes. *Canadian Journal of Public Health,* 71(6), 413-423.
30. O'Malley, P. G. (2013). Evolving insights about the impact of sensory deficits in the elderly. *JAMA Internal Medicine, 173*(4), 299. http://dx.doi.org/10.1001/jamainternmed.2013.3760
31. Swenor, B. K., Ramulu, P. Y., Willis, J. R., Friedman, D., & Lin, F. R. (2013). Research letters: The prevalence of concurrent hearing and vision impairment in the United States. *JAMA Internal Medicine*, 173(4), 312-313. http://dx.doi.org/10.1001/jamainternmed.2013.1880
32. Pichora-Fuller, M. K., Shaw, A., Saragosa, M., & McGilton, K. S. (in preparation). Screening assessments for persons with dementia: Trials and tribulations and lessons learned.
33. Dupuis, K., Pichora-Fuller, M. K., Chasteen, A. L., Marchuk, V., Singh, G., & Smith, S. L. (2015). Effects of hearing and vision impairments on the Montreal Cognitive Assessment. *Aging, Neuropsychology, and Cognition*, 22(4), 413-437. http://dx.doi.org/10.1080/13825585.2014.968084
34. Wittich, W., Murphy, C., & Mulrooney, D. (2014). An adapted adult day centre for older adults with sensory impairment. *British Journal of Visual Impairment*, 32(3), 249-262. http://dx.doi.org/10.1177/0264619614540162
35. Weinstein, B. E., & Arnsel, L. (1986). Hearing loss and senile dementia in the institutionalized elderly. *Clinical Gerontologist*, 4(3), 3-15. http://dx.doi.org/10.1300/J018v04n03_02
36. InterRAI (2016). Instruments: Long-Term Care Facilities. Retrieved from: http://www.interrai.org/long-term-care-facilities.html
37. Swanson, M. W., McGwin Jr., G., Elliott, A. F., & Owsley, C. (2009). The nursing home minimum data set for vision and its association with visual acuity and contrast sensitivity.

Journal of the American Geriatrics Society, 57(3), 486-491. http://dx.doi.org/10.1111/j.1532-5415.2008.02144.x

38. Reed, M. (2012) When the Brain Gets Hard of Hearing: Paying Attention to Cognition in Hearing Rehabilitation. *Seminars on Audition. Canadian Hearing Report,* 8(3): 42-45.
39. Young, T., & Manthorp, C. (2009). Towards a code of practice for effective communication with people with dementing illnesses. *Journal of Language and Social Psychology, 28*(2), 174-189. doi:10.1177/0261927X08330611
40. Schneider, J. M., Gopinath, B., McMahon, C. M., Leeder, S. R., Mitchell, P., & Wang, J. J. (2011). Dual sensory impairment in older age. *Journal of Aging and Health*, 23(8), 1309-1324. http://dx.doi.org/10.1177/0898264311408418
41. Heine, C., & Browning, C. (2015). Dual Sensory Loss in Older Adults: A Systematic Review. *The Gerontologist*, gnv074. http://dx.doi.org/10.1093/geront/gnv074
42. Behrman, S., Chouliaras, L., & Ebmeier, K. P. (2014). Considering the senses in the diagnosis and management of dementia. *Maturitas*, 77(4), 305-310. http://dx.doi.org/10.1016/j.maturitas.2014.01.003
43. Bédard, E., Kergoat, H., Kergoat, M. J., & Leclerc, B. S. (2015). Systematic review of vision-related quality of life questionnaires for older institutionalised seniors with dementia. *Ophthalmic and Physiological Optics*, 35(4), 377-387. http://dx.doi.org/10.1111/opo.12215
44. Gallacher, J. (2004). Hearing, cognitive impairment and aging: A critical review. *Reviews in Clinical Gerontology*, 14(03), 199-209. http://dx.doi.org/10.1017/S095925980500153X
45. Dammeyer, J. (2014). Deafblindness: A review of the literature. *Scandinavian journal of public health*, *42*(7), 554–562. doi:10.1177/1403494814544399
46. Hersh, M. A. (2013). Deafblind people , stigma and the use of communication and mobility assistive devices. *Technology & Disability*, *25*, 245–261. doi: 10.3233/TAD-130394
47. Saunders, G. H., & Echt, K. V. (2007). An overview of dual sensory impairment in older adults: perspectives for rehabilitation. *Trends in Amplification*, *11*(4), 243–258. doi:10.1177/1084713807308365
48. Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International journal of social research methodology*, 8(1), 19-32.

http://dx.doi.org/10.1080/1364557032000119616

49. Armstrong, R., Hall, B. J., Doyle, J., & Waters, E. (2011). 'Scoping the scope' of a cochrane review. *Journal of Public Health, 33*(1), 147-150. doi:10.1093/pubmed/fdr015
50. Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M. & Moher, D. (2014). Scoping reviews: time for clarity in definition, methods, and reporting. *Journal of clinical epidemiology*, 67(12), 1291-1294. http://dx.doi.org/10.1016/j.jclinepi.2014.03.013
51. Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: advancing the methodology. *Implementation Science*, *5*(1), 1-9. http://dx.doi.org/10.1186/1748-5908-5-69
52. Daudt, H. M. L., Van Mossel, C., & Scott, S. J. (2013). Enhancing the scoping study methodology: A large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology*, 13(1). http://dx.doi.org/10.1186/1471-2288-13-48
53. Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L.A. (2015) Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. *Systematic Reviews.* 4(1):1. doi: 10.1186/2046-4053-4-1
54. Rowe, B. H., & Oxman, A. D. (1993). An assessment of the sensibility of a quality-of-life instrument. *American Journal of Emergency Medicine*, 11(4), 374-380. http://dx.doi.org/10.1016/0735-6757(93)90171-7
55. Yeung, E., Woods, N., Dubrowski, A., Hodges, B., & Carnahan, H. (2015). Sensibility of a new instrument to assess clinical reasoning in post-graduate orthopaedic manual physical therapy education. *Manual Therapy*, 20(2), 303-312. http://dx.doi.org/10.1016/j.math.2014.10.001
56. The American Speech-Language-Hearing Association, ASHA (2016). Hearing Screening. Retrieved from: http://www.asha.org/public/hearing/Hearing-Screening
57. Ferris 3rd, F. L., Kassoff, A., Bresnick, G. H., & Bailey, I. (1982). New visual acuity charts for clinical research. *American Journal of Ophthalmology*, 94(1), 91–96. http://dx.doi.org/10.1016/0002-9394(82)90197-0

58. Wittich, W., Sikora, L., Watanabe, D. H., & Martinez, M. (2012). Canadian research contributions to low vision rehabilitation: a quantitative systematic review. *Canadian Journal of Optometry*, 74, 30-7. http://opto.ca/sites/default/files/resources/documents/cjo_volume_74_no_3_canadian_research_contributions_to_low_vision_rehabilitation.pdf

59. Squires, J. E., Estabrooks, C. A., O'Rourke, H. M., Gustavsson, P., Newburn-Cook, C. V., & Wallin, L. (2011). A systematic review of the psychometric properties of self-report research utilization measures used in healthcare. *Implementation Science*, 6(1). http://dx.doi.org/10.1186/1748-5908-6-83

60. Feinstein, A. R. The theory and evaluation of sensibility. In Feinstein, A. R. (ed.) *Clinimetrics*. New Haven, MA: Y.U. Press; 1987. p. 141 – 166.

61. Bowen, D. J., Kreuter, M., Spring, B., Cofta-Woerpel, L., Linnan, L., Weiner, D., Bakken, S., Kaplan, C. P., Squiers, L., Fabrizio, C., & Fernandez, M. (2009). How we design feasibility studies. *American Journal of Preventive Medicine, 36*(5), 452-457. http://dx.doi.org/10.1016/j.amepre.2009.02.002

62. Fitch, K., Bernstein, S. J., Aguilar, M. D., Burnand, B., & LaCalle, J. R. (2001). The RAND/UCLA appropriateness method user's manual (No. RAND/MR-1269-DG-XII/RE). Retrieved from: http://www.rand.org/pubs/monograph_reports/MR1269.html

63. Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi methodology? *Journal of Extension, 35*(5), 93-96.

64. Rockwood, K., Fay, S., Hamilton, L., Ross, E., & Moorhouse, P. (2014). Good days and bad days in dementia: A qualitative chart review of variable symptom expression. *International Psychogeriatrics*, 26(8), 1239-1246. http://dx.doi.org/10.1017/S1041610214000222

65. Dullard, B., & Saunders, G. H. (2016). Documentation of dual sensory impairment in electronic medical records. *Gerontologist, 56*(2), 313-317. doi:10.1093/geront/gnu032

Appendix 1: Methodological Framework (Arksey & O'Malley, 2005)

Through the following stages we will employ a scoping approach to review existing literature, and to examine the extent, range and nature of research activities, to identify research gaps, and to summarise and disseminate research findings:

1. **Identifying the research question:** starting with wide definitions for study population, interventions or outcomes, to ensure breadth of coverage in the search, and then setting parameters based on the scope and volume of references generated.
   - Levac et al., (2010): maintaining a broad search strategy with clearly defined concepts and their continuous refinement

2. **Identifying relevant studies:** as comprehensively as possible identifying primary studies (published and unpublished) and reviews suitable for answering the central research question. To achieve this, we adopted a strategy that involved searching for research evidence via different sources.
   - Armstrong et al., (2011): From a practical point of view, decisions have to be made at the outset about the coverage of the review in terms of time span and languages.

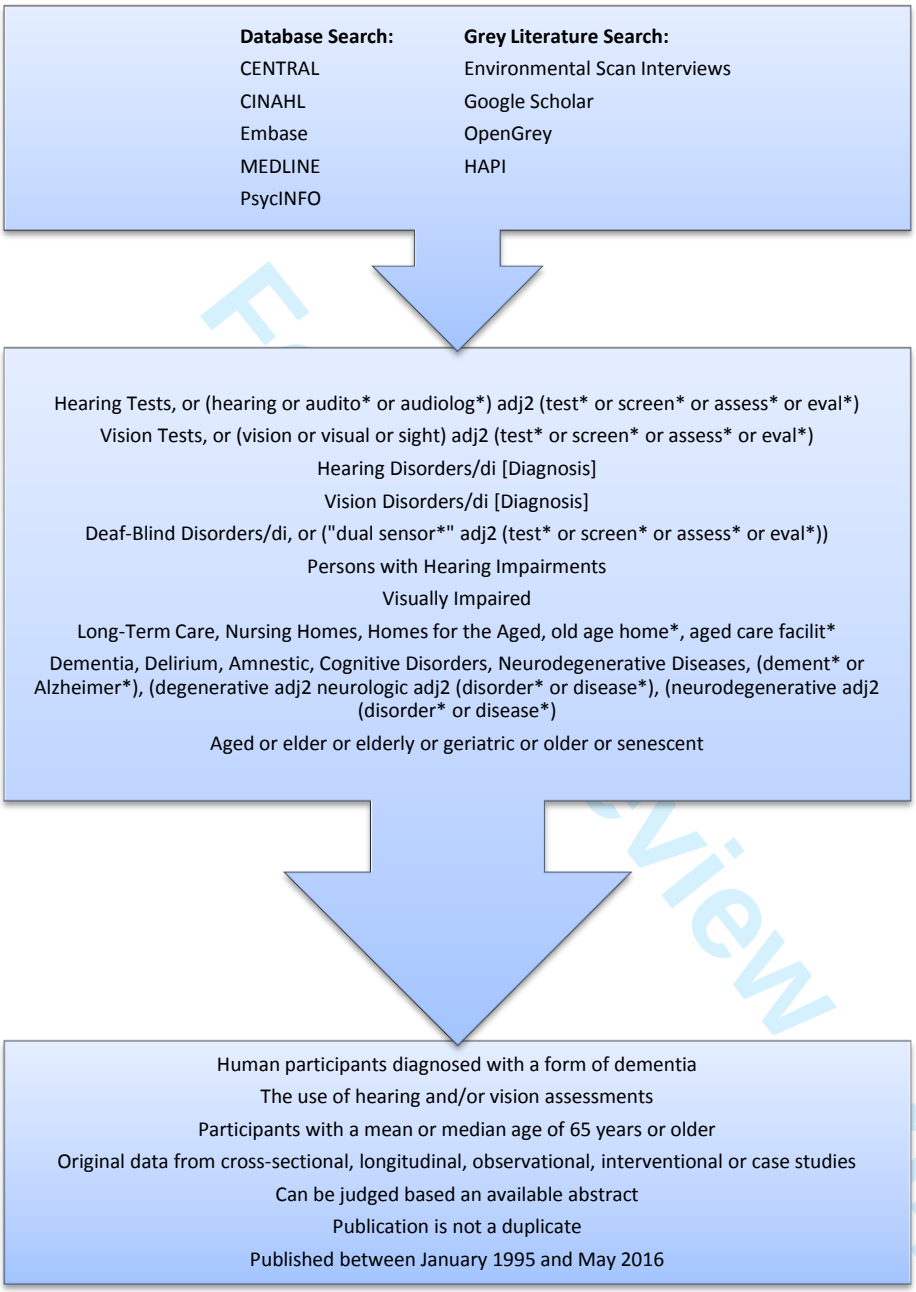
3. **Study selection:** unlike systematic reviews, inclusion and exclusion criteria are developed post hoc, once familiarity with the literature has been gained
   - Daudt et al., (2013); Levac et al., (2010): using multidisciplinary expertise and group consultation within the scoping team to inform and guide the definition of the search criteria and clinical applicability of data for extraction

4. **Charting the data:** data synthesis and interpretation may adopt a narrative or descriptive approach in place of a more systematic data extraction or analytic method.
   - Armstrong et al., (2011): allowing for post-hoc development of inclusion/exclusion criteria and data synthesis in terms of the value yielded by qualitative or quantitative analysis of results.

5. **Collating, summarising and reporting the results:** emphasis is not placed on the "weight of evidence" nor on evaluating the quality of evidence, but an analytic or thematic framework to guide the narrative account of existing literature is recommended.

6. **Consultation exercise:** although this is an optional step, this is recommended as a useful contribution, where "contributors to the consultation provided additional references about potential studies to include in the review as well as valuable insights about issues relating to the effectiveness and cost-effectiveness of services that the scoping review alone would not have alerted us to".
   - Daudt et al., (2013): An additional, parallel element is also described regarding the use of a 'consultation exercise' to inform and validate findings from the main scoping review. Whilst consultation might be viewed as an optional component of the scoping study framework, it greatly enhanced our work, a view confirmed by other researchers.

Appendix 2: Scoping Review Search Strategy



Appendix 3: Development of the sensory screening package – Phase 1