Ontario Health Technology Assessment Series 2008; Vol. 8, Nos. 1–6

Aging in the Community

This document is a compilation of 6 reports related to aging in the community, which were published individually in October 2008. Each report retains its original pagination, table of contents, and reference list. The compilation contains the following titles:

1. Summary of Evidence-Based Analyses
2. Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis
3. Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis
4. Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis
5. Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis
6. The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)

October 2008

Ontario

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 1

Aging in the Community

Summary of Evidence-Based Analyses

October 2008

Ontario

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. Aging in the community: summary of evidence-based analyses. *Ontario Health Technology Assessment Series* 2008;8(1).

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to MASinfo.moh@ontario.ca.

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-8014-7 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee (OHTAC).

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

Abbreviations

ADL	Activities of daily living
CCAC	Community Care Access Centre
CI	Confidence interval
HR	Hazard ratio
HRT	Hormone replacement therapy
IADL	Instrumental activities of daily living
LTC	Long-term care
NCA	Nurse continence advisor
OR	Odds ratio
PFMT	Pelvic floor muscle training
RCT	Randomized controlled trial
RR	Relative risk
UI	Urinary incontinence

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective

To identify interventions (e.g., devices and programs) that are effective at enabling seniors to live healthily and independently in the community.

Clinical Need: Target Population and Condition

Between 1981 and 2005, the proportion of elderly persons (aged 65+) in Ontario grew from 9.9% to 12.8%, and by 2031, more than 1 in 5 people in Ontario are expected to be over the age of 65. (1) Due to the longer life expectancy of women, the majority of seniors in Ontario are women. (1;2) This trend increases with age, with women accounting for over 75% of seniors aged 90 or older in 2006. (1) Dwelling type and whether or not an elderly person lives alone can have a large impact on his or her ability to remain living independently in the community. Although the majority of seniors in Canada (70.1%) live in an urban area with a population of 50,000 or more, 22.6% live in rural settings that often have less access to community-based services for the elderly. (2) In Ontario, 9% of seniors live in rural

areas with moderate, weak, or no metropolitan influence. (1)

Several sociodemographic factors can lead to the decision for a senior to move to a long-term care (LTC) home, including intrinsic characteristics such as gender, age, or medical conditions. (3) Furthermore, increased caregiver burden and a lack of social support and community-based services further increase the probability that a senior living in the community will move to a LTC home. (4) As a result, it is important to consider both medical and social determinants of LTC home admission, as well as the impact of informal and formal caregivers on the decision-making process.

The following is a summary of evidence-based analyses of the literature surrounding 4 areas associated with LTC home admission and healthy aging in the community.

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Project Scope

Research Questions

- What are the main *modifiable* predictors of admission to an LTC home in Ontario?
- What interventions (e.g., devices and program) are effective at targeting these predictors, and thus potentially delaying the transition from community-based living to LTC home admission?

Search Strategy

A preliminary literature search in OVID Medline was conducted to identify studies investigating common predictors of LTC home admission (Appendix 1).

Inclusion Criteria

- English-language;
- published between January 1950 and October 2007;
- population: seniors (aged 65+); and
- related to patient admission or institutionalization.

Abstracts were reviewed, and studies meeting the inclusion criteria outlined above were obtained. Significant predictors of LTC home admission were identified and compared across all studies.

Predictors of Long-Term Care Home Admission

Ten studies were identified that investigated general predictors of LTC home admission. These studies described several population characteristics that are significantly associated with LTC home admission. (3;5-13) Table 1 summarizes the most commonly identified factors in these 10 studies.

Table 1: Predictors Associated With Increased Odds of Admission to a Long-Term Care Home

Predictor	Banaszak-Holl et al. (8)	Bharucha et al. (9)	Coughlin et al. (10)	Gaugler et al. (3)	Jette et al. (11)	Lachs et al. (12)	Mustard et al. (5)	Oura et al. (7)	Rockwood et al. (6)	Trottier et al. (13)
Age	Y	Y	–	Y	–	Y	Y	N†	Y	Y
Gender (male)	Y	N	–	N†	–	N†	Y	Y‡	N	N
Not married	Y	N		Y	–	–	Y	N†	Y	Y
Lives alone	–	N	N†	Y	–	–	–	–	–	–
ADL dependency	Y	–	N†	Y	Y	Y	Y	–	Y	Y
Dementia	Y	Y	N†	Y	Y	–	–	N†	Y	Y
No available informal caregiver	–	–	–	Y‡	–	–	–	N†	Y	–
Diabetes	Y§	–	–	Y	–	–	–	–	Y	–
Falls	Y§	–	–	Y	–	–	–	–	–	–
Urinary incontinence	Y§	–	–	N†	–	N†	–	–	N†	Y

*– refers to predictor not reported; ADL, activities of daily living; N, no association; Y, a statistically significant association.
†Positive effect, but not statistically significant
‡Opposite effect
§After adjusting for activities of daily living and instrumental activities of daily living, no longer significant

Furthermore, a study was published by Tinetti and Williams in 1997 (14) that investigated the effects of falls and fall-related injuries on LTC home admission. This study found that after controlling for demographic, psychosocial, cognitive, health-related and functional characteristics, the hazard of being admitted to a LTC home was more than 3 times higher after a fall without serious injury and more than 10 times higher after a fall with serious injury. (14)

Similarly, several large cohort studies have examined the association between urinary incontinence (UI) and admission to a LTC home. (15-17) These studies found that, overall, UI is a significant predictor of LTC home admission, even after adjusting for age, dementia, cardiovascular disease and renal disease. (16)

Based on the above results, as well as through consultation with experts in the area, 4 key predictors were identified for further research in this area. These were

1. falls and fall-related injuries,
2. urinary incontinence,
3. dementia, and
4. social isolation.

Summary of Analyses

Assessment of Quality of Evidence

In all analyses, the quality of the evidence was assessed as high, moderate, low or very low according to the GRADE methodology and GRADE Working Group (Appendix 2). (18) As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence.

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of

	effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Budget Impact Analysis

The analyses for each of the 4 key predictors of LTC home admission are summarized below. See Tables 2 and 3 for a summary of effective interventions and the budget impact analysis.

Table 2: Summary of Characteristics of Effective Exercise Interventions and Budget Impact Analysis Per 100,000 Population

Intervention	Target Population* (Ontario)	Risk Estimate	Staffing Requirement	GRADE Quality of Evidence	Cost Impact per 100,000 Population $ million (Cdn)†
Falls & Fall-Related Injuries: Community Exercise Programs: Untargeted, long duration	Mobile seniors N = 476,992	RR, 0.76; 95% CI, 0.64–0.91	PT	Moderate	1.5
Urinary Incontinence: Patient directed behavioural techniques (PFMT only) (home and clinic)	Seniors with UI N = 196,011	No. incontinent episodes/wk: WMD, 10.50; 95% CI, 4.30–16.70	PT	Moderate	2.1
Dementia: Patient directed exercise program (in home visit)	Seniors with mild/moderate dementia N = 38,696	Effect size, 0.62; 95% CI, 0.55–0.70	OT, PT, PSW or RT	Moderate	OT: 8.8 PT: 8.0 PSW: 2.2 RT: 1.9
Social Isolation: Community exercise and education programs		Mean loneliness score change, 0.3 (P < .01) Activity change score, 2.0 (P < .01)	RT, OT or PT	Moderate	RT: 2.1 OT: 2.4 PT: 1.5

*CI refers to confidence interval; GP, general practitioner; N, number; NCA, nurse continence advisor; OT, occupational therapist; PFMT, pelvic floor muscle training; PSW, personal support worker; PT, physiotherapist; RR, relative risk; RT, recreational therapist; UI, urinary incontinence; WMD, weighted mean difference.
†The budget impact analyses were calculated for the first year after introducing the interventions from the Ministry of Health and Long-Term Care perspective using prevalence data only. Incidence and mortality rates were not factored in. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the Province, and assumptions on costs. Impacted numbers refer to patients likely to access these interventions in Ontario based on assumptions from the literature. These numbers are not comparable between domains as the assumptions come from heterogeneous different trials with different patient populations and different resource utilization. Resource consumption was confirmed by expert panel.

Table 3: Summary of Characteristics of Effective Interventions (Excluding Exercise) and Budget Impact Analysis Per 100,000 Population

Intervention	Target Population (Ontario)	Risk Estimate	Staffing Requirement	GRADE Quality of Evidence	Cost Impact per 100,000 Population $ million (Cdn) †
Falls & Fall-Related Injuries: Environmental Modifications (high-risk seniors)	High-risk seniors N = 271,980	RR, 0.66; 95% CI, 0.54–0.81	OT	High	4.7
Falls & Fall-Related Injuries: Vitamin D + Calcium Supplementation	Women at risk for osteopenia N = 477,662	RR, 0.83; 95% CI, 0.73–0.95	None	Moderate	0.7
Urinary Incontinence: Patient directed multicomponent behavioural techniques	Mobile, motivated seniors with UI N = 196,011	No. incontinent episodes/wk: WMD, 3.63; 95% CI, 2.07–5.19	NCA	Moderate	1.5
Dementia: Caregiver-directed behavioural techniques	Caregivers of seniors with dementia N = 56,629	Not estimable	OT or Nurse	Moderate	OT: 4.8 Nurse: 3.3
Dementia: Caregiver- and patient-directed behavioural techniques	Seniors with dementia and their caregivers N = 56,629	Caregiver burden: NNT, 2.5; 95% CI, 2.3–2.7 Patient (motor/ process skills): NNT, 1.3; 95% CI, 1.2–1.4 Patient (deterioration in ADLs): NNT, 1.5; 95% CI, 1.4–1.6	OT or nurse	Moderate	OT: 4.0 Nurse: 2.8

*ADL refers to activities of daily living; CI, confidence interval; GP, general practitioner; N, number; NCA, nurse continence advisor; NNT, number needed to treat; OT, occupational therapist; PT, physiotherapist; PSW, personal support worker; RR, relative risk; RT, recreational therapist.

†The budget impact analyses were calculated for the first year after introducing the interventions from the Ministry of Health and Long-Term Care perspective using prevalence data only. Incidence and mortality rates were not factored in. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the Province, and assumptions on costs. Impacted numbers refer to patients likely to access these interventions in Ontario based on assumptions from the literature. These numbers are not comparable between domains as the assumptions come from heterogeneous different trials with different patient populations and different resource utilization. Resource consumption was confirmed by expert panel.

1. Falls and Fall-Related Injuries

Objective

To identify interventions that may be effective in reducing the probability of an elderly person's falling and/or sustaining a fall-related injury.

Clinical Need: Target Population and Condition

Although estimates of fall rates vary widely based on the location, age, and living arrangements of the elderly population, it is estimated that each year approximately 30% of community-dwelling individuals aged 65 and older, and 50% of those aged 85 and older will fall. Of those individuals who fall, 12% to 42% will have a fall-related injury.

Several meta-analyses and cohort studies have identified falls and fall-related injuries as a strong predictor of admission to a long-term care (LTC) home. It has been shown that the risk of LTC home admission is over 5 times higher in seniors who experienced 2 or more falls without injury, and over 10 times higher in seniors who experienced a fall causing serious injury.

Falls result from the interaction of a variety of risk factors that can be both intrinsic and extrinsic. Intrinsic factors are those that pertain to the physical, demographic, and health status of the individual, while extrinsic factors relate to the physical and socio-economic environment. Intrinsic risk factors can be further grouped into psychosocial/demographic risks, medical risks, risks associated with activity level and dependence, and medication risks. Commonly described extrinsic risks are tripping hazards, balance and slip hazards, and vision hazards.

Evidence-Based Analysis Methods

Research Question

Since many risk factors for falls are modifiable, what interventions (devices, systems, programs) exist that reduce the risk of falls and/or fall-related injuries for community-dwelling seniors?

Inclusion and Exclusion Criteria

Inclusion Criteria

- English Language;
- published between January 2000 and September 2007;
- population of community-dwelling seniors (majority aged 65+);
- randomized controlled trials (RCTs), quasi-experimental trials, systematic reviews, or meta-analyses

Exclusion Criteria:

- Special populations (e.g., stroke or osteoporosis);
- studies only reporting surrogate outcomes;
- studies where outcome cannot be extracted for meta-analysis

Outcomes of Interest

Number of fallers and number of falls resulting in injury/fracture

Search Strategy

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), The Cochrane Library, and the International Agency for Health Technology Assessment (INAHTA) for studies published between January 2000 and September 2007. Furthermore, all studies included in a 2003 Cochrane review were considered for inclusion in this analysis. Abstracts were reviewed by a single author, and studies meeting the inclusion criteria outlined above were obtained. Studies were grouped based on intervention type, and data on population characteristics, fall outcomes, and study design were extracted. Reference lists were also checked for relevant studies. The quality of the evidence was assessed as high, moderate, low, or very low according to the GRADE methodology.

Summary of Findings

The following 11 interventions were identified in the literature search: exercise programs, vision assessment and referral, cataract surgery, environmental modifications, vitamin D supplementation, vitamin D plus calcium supplementation, hormone replacement therapy (HRT), medication withdrawal, gait-stabilizing devices, hip protectors, and multifactorial interventions.

Exercise programs were stratified into targeted programs where the exercise routine was tailored to the individuals' needs, and untargeted programs that were identical among subjects. Furthermore, analyses were stratified by exercise program duration (<6 months and ≥6 months) and fall risk of study participants. Similarly, the analyses on the environmental modification studies were stratified by risk. Low-risk study participants had had no fall in the year prior to study entry, while high-risk participants had had at least one fall in the previous year.

A total of 17 studies investigating multifactorial interventions were identified in the literature search. Of these studies, 10 reported results for a high-risk population with previous falls, while 6 reported results for study participants representative of the general population. One study provided stratified results by fall risk, and therefore results from this study were included in each stratified analysis.

Table 4: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Falls in Community-Dwelling Seniors*

Intervention	RR [95% CI]	GRADE
Exercise programs		
1. Targeted programs		
General population	0.81 [0.67–0.98]	Low
High-risk population	0.93 [0.82–1.06]	High
Short duration	0.91 [0.73–1.13]	High
Long duration	0.89 [0.79–1.01]	Moderate
2. Untargeted programs		
General population	0.78 [0.66–0.91]	Moderate
High-risk population	0.89 [0.72–1.10]	Very low
Short duration	0.85 [0.71–1.01]	Low
Long duration	0.76 [0.64–0.91]	Moderate
3. Combined targeted vs. untargeted programs		
General population	N/A	N/A
High-risk population	0.87 [0.57–1.34]	Moderate
Short duration	1.11 [0.73–1.70]	High
Long duration	0.73 [0.57–0.95]	High
Vision intervention		
Assessment/referral	1.12 [0.82–1.53]	Moderate
Cataract surgery	1.11 [0.92–1.35]	Moderate
Environmental modifications		
Low-risk population	1.03 [0.75–1.41]	High
High-risk population	0.66 [0.54–0.81]	High
General population	0.85 [0.75–0.97]	High
Drugs/Nutritional supplements		
Vitamin D (men and women)	0.94 [0.77–1.14]	High
Vitamin D (women only)	0.55 [0.29–1.08]	Moderate
Vitamin D and calcium (men and women)	0.89 [0.74–1.07]	Moderate
Vitamin D and calcium (women only)	0.83 [0.73–0.95]	Moderate
Hormone replacement therapy	0.98 [0.80–1.20]	Low
Medication withdrawal	0.34 [0.16–0.74]†	Low
Gait-stabilizing device	0.43 [0.29–0.64]	Moderate
Multifactorial intervention		
Geriatric screening (general population)	0.87 [0.69–1.10]	Very low
High-risk population	0.86 [0.75–0.98]	Low

*CI refers to confidence interval; RR, relative risk.
†Hazard ratio is reported, because RR was not available.

Table 5: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Fall-Related Injuries in Community-Dwelling Seniors*

Intervention	RR [95% CI]	GRADE
Exercise programs		
Targeted programs	0.67 [0.51–0.89]	Moderate
Untargeted programs	0.57 [0.38–0.86]	Low
Combined targeted vs untargeted programs	0.31 [0.13–0.74]	High
Drugs/nutritional supplements		
Vitamin D plus calcium (women only)	0.77 [0.49–1.21]	Moderate
Gait-stabilizing device	0.10 [0.01–0.74]	Moderate
Hip protectors	3.49 [0.68–17.97] †	Low
Multifactorial intervention		
Geriatric screening (general population)	0.90 [0.53–1.51]	Low
High-risk population	0.86 [0.66–1.11]	Moderate

*CI refers to confidence interval; RR, relative risk.
†Odds ratio is reported, because RR was not available.

2. Urinary Incontinence

Objective

To assess the effectiveness of behavioural interventions for the treatment and management of urinary incontinence (UI) in community-dwelling seniors.

Clinical Need: Target Population and Condition

Urinary incontinence defined as "the complaint of any involuntary leakage of urine" was identified as 1 of the key predictors in a senior's transition from independent community living to admission to a long-term care (LTC) home. Urinary incontinence is a health problem that affects a substantial proportion of Ontario's community-dwelling seniors (and indirectly affects caregivers), impacting their health, functioning, well-being and quality of life. Based on Canadian studies, prevalence estimates range from 9% to 30% for senior men and nearly double from 19% to 55% for senior women. The direct and indirect costs associated with UI are substantial. It is estimated that the total annual costs in Canada are $1.5 billion (Cdn), and that each year a senior living at home will spend $1,000 to $1,500 on incontinence supplies.

Interventions to treat and manage UI can be classified into broad categories which include lifestyle modification, behavioural techniques, medications, devices (e.g., continence pessaries), surgical interventions and adjunctive measures (e.g., absorbent products).

The focus of this review is behavioural interventions, since they are commonly the first line of treatment considered in seniors given that they are the least invasive options with no reported side effects, do not limit future treatment options, and can be applied in combination with other therapies. In addition, many seniors would not be ideal candidates for other types of interventions involving more risk, such as surgical measures.

Description of Technology/Therapy

Behavioural interventions can be divided into 2 categories according to the target population: caregiver-dependent techniques and patient-directed techniques. Caregiver-dependent techniques (also known as toileting assistance) are targeted at medically complex, frail individuals living at home with the assistance of a caregiver, who tends to be a family member. These seniors may also have cognitive deficits and/or motor deficits. A health care professional trains the senior's caregiver to deliver an intervention such as prompted voiding, habit retraining, or timed voiding. The health care professional who trains the caregiver is commonly a nurse or a nurse with advanced training in the management of UI, such as a nurse continence advisor (NCA) or a clinical nurse specialist (CNS).

The second category of behavioural interventions consists of patient-directed techniques targeted towards mobile, motivated seniors. Seniors in this population are cognitively able, free from any major physical deficits, and motivated to regain and/or improve their continence. A nurse or a nurse with advanced training in UI management, such as an NCA or CNS, delivers the patient-directed techniques. These are often provided as multicomponent interventions including a combination of bladder training techniques, pelvic floor muscle training (PFMT), education on bladder control strategies, and self-monitoring. Pelvic floor muscle training, defined as a program of repeated pelvic floor muscle contractions taught and

supervised by a health care professional, may be employed as part of a multicomponent intervention or in isolation.

Education is a large component of both caregiver-dependent and patient-directed behavioural interventions, and patient and/or caregiver involvement as well as continued practice strongly affect the success of treatment. Incontinence products, which include a large variety of pads and devices for effective containment of urine, may be used in conjunction with behavioural techniques at any point in the patient's management.

Evidence-Based Analysis Methods

A comprehensive search strategy was used to identify systematic reviews and randomized controlled trials that examined the effectiveness, safety, and cost-effectiveness of caregiver-dependent and patient-directed behavioural interventions for the treatment of UI in community-dwelling seniors (see Appendix 1).

Research Questions

1. Are caregiver-dependent behavioural interventions effective in improving UI in medically complex, frail community-dwelling seniors with/without cognitive deficits and/or motor deficits?
2. Are patient-directed behavioural interventions effective in improving UI in mobile, motivated community-dwelling seniors?
3. Are behavioural interventions delivered by NCAs or CNSs in a clinic setting effective in improving incontinence outcomes in community-dwelling seniors?

Summary of Findings

Table 6 summarizes the results of the analysis.

The available evidence was limited by considerable variation in study populations and in the type and severity of UI for studies examining both caregiver-directed and patient-directed interventions. The UI literature frequently is limited to reporting subjective outcome measures such as patient observations and symptoms. The primary outcome of interest, admission to a LTC home, was not reported in the UI literature. The number of eligible studies was low, and there were limited data on long-term follow-up.

Table 6: Summary of Evidence on Behavioural Interventions for the Treatment of Urinary Incontinence in Community-Dwelling Seniors

Intervention	Target Population	Interventions	Conclusions	GRADE quality of the evidence
1. Caregiver-dependent techniques (toileting assistance)	Medically complex, frail individuals at home with/without cognitive deficits and/or motor deficits Delivered by informal caregivers who are trained by a nurse or a nurse with specialized UI training (NCA/CNS)	• Prompted voiding • Habit retraining • Timed voiding	There is no evidence of effectiveness for habit retraining (n=1 study) and timed voiding (n=1 study). Prompted voiding may be effective, but effectiveness is difficult to substantiate because of an inadequately powered study (n=1 study). Resource implications and caregiver burden (usually on an informal caregiver) should be considered.	Low
2. Patient-directed techniques	Mobile, motivated seniors Delivered by a nurse or a nurse with specialized UI training (NCA/CNS)	Multicomponent behavioural interventions Include a combination of • Bladder training • PFMT (with or without biofeedback) • Bladder control strategies • Education • Self-monitoring	Significant reduction in the mean number of incontinent episodes per week (n=5 studies, WMD 3.63, 95% CI, 2.07–5.19) Significant improvement in patient's perception of UI (n=3 studies, OR 4.15, 95% CI, 2.70–6.37) Suggestive beneficial impact on patient's health-related quality of life	Moderate
		PFMT alone	Significant reduction in the mean number of incontinent episodes per week (n=1 study, WMD 10.50, 95% CI, 4.30–16.70)	Moderate
3. Behavioural interventions led by an NCA/CNS in a clinic setting	Community-dwelling seniors	Behavioural interventions led by NCA/CNS	Overall, effective in improving incontinence outcomes (n=3 RCTs + 1 Ontario-based before/after study)	Moderate

*CI refers to confidence interval; CNS, clinical nurse specialist; NCA, nurse continence advisor; PFMT, pelvic floor muscle training; RCT, randomized controlled trial; WMD, weighted mean difference; UI, urinary incontinence.

3A. Dementia: Caregiver-Directed Interventions

Objective

To identify interventions that may be effective in supporting the well-being of unpaid caregivers of seniors with dementia living in the community.

Clinical Need: Target Population and Condition

Dementia is a progressive and largely irreversible syndrome that is characterized by a loss of cognitive function severe enough to impact social or occupational functioning. The components of cognitive function affected include memory and learning, attention, concentration and orientation, problem-solving, calculation, language, and geographic orientation. Dementia was identified as one of the key predictors in a senior's transition from independent community living to admission to a long-term care (LTC) home, in that approximately 90% of individuals diagnosed with dementia will be institutionalized before death. In addition, cognitive decline linked to dementia is one of the most commonly cited reasons for institutionalization.

Prevalence estimates of dementia in the Ontario population have largely been extrapolated from the Canadian Study of Health and Aging conducted in 1991. Based on these estimates, it is projected that there will be approximately 165,000 dementia cases in Ontario in the year 2008, and by 2010 the number of cases will increase by nearly 17% over 2005 levels. By 2020 the number of cases is expected to increase by nearly 55%, due to a rise in the number of people in the age categories with the highest prevalence (85+). With the increase in the aging population, dementia will continue to have a significant economic impact on the Canadian health care system. In 1991, the total costs associated with dementia in Canada were $3.9 billion (Cdn) with $2.18 billion coming from LTC.

Caregivers play a crucial role in the management of individuals with dementia because of the high level of dependency and morbidity associated with the condition. It has been documented that a greater demand is faced by dementia caregivers compared with caregivers of persons with other chronic diseases. The increased burden of caregiving contributes to a host of chronic health problems seen among many informal caregivers of persons with dementia. Much of this burden results from managing the behavioural and psychological symptoms of dementia (BPSD), which have been established as a predictor of institutionalization for elderly patients with dementia.

It is recognized that for some patients with dementia, an LTC facility can provide the most appropriate care; however, many patients move into LTC unnecessarily. For individuals with dementia to remain in the community longer, caregivers require many types of formal and informal support services to alleviate the stress of caregiving. These include both respite care and psychosocial interventions. Psychosocial interventions encompass a broad range of interventions such as psychoeducational interventions, counseling, supportive therapy, and behavioural interventions.

Assuming that 50% of persons with dementia live in the community, a conservative estimate of the number of informal caregivers in Ontario is 82,500. Accounting for the fact that 29% of people with dementia live alone, this leaves a remaining estimate of 58,575 Ontarians providing care for a person with dementia with whom they reside.

Description of Interventions

The 2 main categories of caregiver-directed interventions examined in this review are respite care and psychosocial interventions. Respite care is defined as a break or relief for the caregiver. In most cases, respite is provided in the home, through day programs, or at institutions (usually 30 days or less). Depending on a caregiver's needs, respite services will vary in delivery and duration. Respite care is carried out by a variety of individuals, including paid staff, volunteers, family, or friends.

Psychosocial interventions encompass a broad range of interventions and have been classified in various ways in the literature. This review will examine educational, behavioural, dementia-specific, supportive, and coping interventions. The analysis focuses on behavioural interventions, that is, those designed to help the caregiver manage BPSD. As described earlier, BPSD are one of the most challenging aspects of caring for a senior with dementia, causing an increase in caregiver burden. The analysis also examines multicomponent interventions, which include at least 2 of the above-mentioned interventions.

Methods of Evidence-Based Analysis

A comprehensive search strategy was used to identify systematic reviews and randomized controlled trials (RCTs) that examined the effectiveness of interventions for caregivers of dementia patients.

Research Questions

- Are respite care services effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Do respite care services impact on rates of institutionalization of these seniors?
- Which psychosocial interventions are effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Which interventions reduce the risk for institutionalization of seniors with dementia?

Outcomes of Interest

- any quantitative measure of caregiver psychological health, including caregiver burden, depression, quality of life, well-being, strain, mastery (taking control of one's situation), reactivity to behaviour problems, etc.;
- rate of institutionalization; and
- cost-effectiveness.

Summary of Findings

Conclusions in Table 7 are drawn from Sections 2.1 and 2.2 of the report Caregiver- and Patient-Directed Interventions for Dementia in this series.

Table 7: Summary of Conclusions on Caregiver-Directed Interventions for Dementia

Section	Intervention	Conclusion
2.1	Respite care for dementia caregivers	Assessing the efficacy of respite care services using standard evidence-based approaches is difficult. ▪ There is limited evidence from RCTs that respite care is effective in improving outcomes for those caring for seniors with dementia. ▪ There is considerable qualitative evidence of the perceived benefits of respite care. ▪ Respite care is known as one of the key formal support services for alleviating caregiver burden in those caring for dementia patients. ▪ Respite care services need to be tailored to individual caregiver needs as there are vast differences among caregivers and patients with dementia (severity, type of dementia, amount of informal/formal support available, housing situation, etc.)
2.2a	Behavioural interventions (individual ≥ 6 sessions)	▪ There is moderate- to high-quality evidence that individual behavioural interventions (≥ 6 sessions), directed towards the caregiver (or combined with the patient) are effective in improving psychological health in dementia caregivers.
2.2b	Multicomponent interventions	▪ There is moderate- to high-quality evidence that multicomponent interventions improve caregiver psychosocial health and may affect rates of institutionalization of dementia patients.

RCT indicates randomized controlled trial.

3B. Dementia: Patient-Directed Interventions

Clinical Need: Target Population and Condition

Secondary Prevention[1]

Exercise

Physical deterioration is linked to dementia. This is thought to be due to reduced muscle mass leading to decreased activity levels and muscle atrophy, increasing the potential for unsafe mobility while performing basic ADLs such as eating, bathing, toileting, and functional ability.

Improved physical conditioning for seniors with dementia may extend their independent mobility and maintain performance of ADL.

Nonpharmacologic and Nonexercise Interventions

Cognitive impairments, including memory problems, are a defining feature of dementia. These impairments can lead to anxiety, depression, and withdrawal from activities. The impact of these cognitive problems on daily activities increases pressure on caregivers.

Cognitive interventions aim to improve these impairments in people with mild to moderate dementia.

[1] Secondary prevention covers all activities to take care of early symptoms of a disease and to preclude the development of possible irreparable medical conditions.

Primary Prevention[2]

Exercise

Various vascular risk factors have been found to contribute to the development of dementia (e.g., hypertension, hypercholesterolemia, diabetes, overweight).

Physical exercise is important in promoting overall and vascular health. However, it is unclear whether physical exercise can decrease the risk of cognitive decline/dementia.

Nonpharmacologic and Nonexercise Interventions

Having more years of education (i.e., a higher cognitive reserve) is associated with a lower prevalence of dementia in crossectional population-based studies and a lower incidence of dementia in cohorts followed longitudinally. However, it is unclear whether cognitive training can increase cognitive reserve or decrease the risk of cognitive impairment, prevent or delay deterioration in the performance of ADLs or IADLs or reduce the incidence of dementia.

Description of Interventions

Physical exercise and nonpharmacologic/nonexercise interventions (e.g., cognitive training) for the primary and secondary prevention of dementia are assessed in this review.

Methods of Evidence-Based Analysis

A comprehensive search strategy was used to identify systematic reviews and RCTs that examined the effectiveness, safety and cost effectiveness of exercise and cognitive interventions for the primary and secondary prevention of dementia.

Research Questions

- What is the effectiveness of physical exercise for the improvement or maintenance of ADLs in seniors with mild to moderate dementia?
- What is the effectiveness of nonpharmacologic/nonexercise interventions to improve cognitive functioning in seniors with mild to moderate dementia?
- Can exercise decrease the risk of subsequent cognitive decline/dementia?
- Does cognitive training decrease the risk of cognitive impairment, prevent or delay deterioration in the performance of ADLs or IADLs, or reduce the incidence of dementia in seniors with good cognitive and physical functioning?

Summary of Findings

Table 8 summarizes the conclusions from Sections 3.1 through 3.4 of the report on dementia.

[2] Primary prevention covers all activities designed to preclude the development of a disease.

Table 8: Summary of Conclusions on Patient-Directed Interventions for Dementia*

Section	Intervention	1° or 2° Prevention	Conclusion
3.1	Physical exercise for seniors with dementia	2° Prevention	Physical exercise is effective for improving physical functioning in patients with dementia.
3.2	Nonpharmacologic and nonexercise interventions to improve cognitive functioning in seniors with dementia	2° Prevention	▪ Previous systematic review indicated that "cognitive training" is not effective in patients with dementia. ▪ A recent RCT suggests that CST (up to 7 weeks) is effective for improving cognitive function and quality of life in patients with dementia.
3.3	Physical exercise for delaying onset of dementia	1° Prevention	Long-term outcomes ▪ Regular leisure time physical activity in midlife is associated with a reduced risk of dementia in later life (mean follow-up 21 years). Short-term 0utcomes ▪ Regular physical activity in seniors is associated with a reduced risk of cognitive decline (mean follow-up 2 years). ▪ Regular physical activity in seniors is associated with a reduced risk of dementia (mean follow-up 6–7 years).
3.4	Nonpharmacologic and nonexercise interventions for delaying onset of dementia	1° Prevention	For seniors with good cognitive and physical functioning: ▪ Evidence that cognitive training for specific functions (memory, reasoning, and speed of processing) produces improvements in these specific domains. ▪ Limited inconclusive evidence that cognitive training can offset deterioration in the performance of self-reported IADL scores and performance assessments.

*1° indicates primary; 2°, secondary; CST, cognitive stimulation therapy; IADL, instrumental activities of daily living; RCT, randomized controlled trial.

Benefit/Risk Analysis

As per the GRADE Working Group, the overall recommendations consider 4 main factors:

- the trade-offs, taking into account the estimated size of the effect for the main outcome, the confidence limits around those estimates, and the relative value placed on the outcome;
- the quality of the evidence;
- translation of the evidence into practice in a specific setting, taking into consideration important factors that could be expected to modify the size of the expected effects such as proximity to a hospital or availability of necessary expertise; and
- uncertainty about the baseline risk for the population of interest.

The GRADE Working Group also recommends that incremental costs of health care alternatives should be considered explicitly alongside the expected health benefits and harms. Recommendations rely on judgments about the value of the incremental health benefits in relation to the incremental costs. The last column in Table 9 reflects the overall trade-off between benefits and harms (adverse events) and incorporates any risk/uncertainty (cost-effectiveness).

Table 9: Overall Summary Statement of the Benefit and Risk for Patient-Directed Interventions for Dementia*

	Intervention	Quality	Benefits	Risks/Burden	Overall Strength of Recom-mendation
Section 3.1: Physical Exercise for Seniors with Dementia – Secondary Prevention	Exercise – mix	Moderate	Improvement in functional, cognitive and behavioural outcomes	Short-term follow-up and heterogeneity in studies Unclear if leads to delayed institutionalization	Moderate
Section 3.2. Nonpharmacologic & Nonexercise Interventions to Improve Cognitive Functioning in Seniors with Dementia – Secondary Prevention	Cognitive training	Very low	None	Intervention does not offer significant benefit (possible type 2 error) Unclear if leads to delayed institutionalization	Very low
	Cognitive stimulation therapy (CST)	Moderate/Low	Increased cognition and quality of life	Unclear how CST compares with past terminologies and methodologies. Short-term results. Role and extent of maintenance CST. Unclear how CST may impact functional dependence. Unclear if leads to delayed institutionalization.	Low
Section 3.3. Physical Exercise for Delaying the Onset of Dementia – Primary Prevention	Exercise – walking only	High/Moderate	Short-term decreased incidence of dementia	Unknown if leads to delayed institutionalization.	High/Moderate
	Exercise – mix	High/Moderate	Short-term reduced risk of subsequent cognitive decline	Unknown if leads to delayed diagnosis of dementia or institutionalization.	High/Moderate
	Exercise – mix	Moderate	Long-term decreased incidence of dementia	Unknown if leads to delayed institutionalization.	Moderate
Section 3.4. Nonpharmacologic & Nonexercise Interventions for Delaying the Onset of Dementia – Primary Prevention	Cognitive interventions	Low	Cognitive improvements sustained after 5 years *(however, none of these improvements had effects beyond the specific cognitive domains of the intervention)*	Results addressing functional outcomes unclear. Need more than 5-year follow-up. No evidence to determine if cognitive training leads to: 1) delayed diagnosis of dementia 2) delayed institutionalization	Very low

4. Social Isolation

Objective

The objective was to systematically review interventions aimed at preventing or reducing social isolation and loneliness in community-dwelling seniors, that is, persons ≥ 65 years of age who are not living in long-term care institutions. The analyses focused on the following questions:

- Are interventions to reduce social isolation and/or loneliness effective?
- Do these interventions improve health, well-being, and/or quality of life?
- Do these interventions impact on independent community living by delaying or preventing functional decline or disability?
- Do the interventions impact on health care utilization, such as physician visits, emergency visits, hospitalization, or admission to long-term care?

Target Population and Condition

Social and family relationships are a core element of quality of life for seniors, and these relationships have been ranked second, next to health, as the most important area of life. Several related concepts—reduced social contact, being alone, isolation, and feelings of loneliness—have all been associated with a reduced quality of life in older people. Social isolation and loneliness have also been associated with a number of negative outcomes such as poor health, maladaptive behaviour, and depressed mood. Higher levels of loneliness have also been associated with increased likelihood of institutionalization.

Evidence-Based Analysis Methods

The scientific evidence base was evaluated through a systematic literature review. The literature searches were conducted with several computerized bibliographic databases for literature published between January 1980 and February 2008. The search was restricted to English-language reports on human studies and excluded letters, comments and editorials, and case reports. Journal articles eligible for inclusion in the review included those that reported on single, focused interventions directed towards or evaluating social isolation or loneliness; included, in whole or in part, community-dwelling seniors (≥ 65 years); included some quantitative outcome measure on social isolation or loneliness; and included a comparative group. Assessments of current practices were obtained through consultations with various individuals and agencies including the Ontario Community Care Access Centres and the Ontario Assistive Devices Program. An Ontario-based budget impact was also assessed for the identified effective interventions for social isolation.

Summary of Findings

A systematic review of the published literature focusing on interventions for social isolation and loneliness in community-dwelling seniors identified 11 quantitative studies. The studies involved European or American populations with diverse recruitment strategies, intervention objectives, and limited follow-up, with cohorts from 10 to 15 years ago involving mainly elderly women less than 75 years of age. The studies involved 2 classes of interventions: in-person group support activities and technology-assisted interventions. These were delivered to diverse targeted groups of seniors such as those with mental distress, physically inactive seniors, low-income groups, and informal caregivers. The interventions were primarily focused on behaviour-based change. Modifying factors (client attitude or

preference) and process issues (targeting methods of at-risk subjects, delivery methods, and settings) influenced intervention participation and outcomes.

Both classes of interventions were found to reduce social isolation and loneliness in seniors. Social support groups were found to effectively decrease social isolation for seniors on wait lists for senior apartments and those living in senior citizen apartments. Community-based exercise programs featuring health and wellness for physically inactive community-dwelling seniors also effectively reduced loneliness. Rehabilitation for mild/moderate hearing loss was effective in improving communication disabilities and reducing loneliness in seniors. Interventions evaluated for informal caregivers of seniors with dementia, however, had limited effectiveness for social isolation or loneliness.

Research into interventions for social isolation in seniors has not been broadly based, relative to the diverse personal, social, health, economic, and environmentally interrelated factors potentially affecting isolation. Although rehabilitation for hearing-related disability was evaluated, the systematic review did not locate research on interventions for other common causes of aging-related disability and loneliness, such as vision loss or mobility declines. Despite recent technological advances in e-health or telehealth, controlled studies evaluating technology-assisted interventions for social isolation have examined only basic technologies such as phone- or computer-mediated support groups.

Table 10: Effectiveness of Diverse Interventions for Social Isolation, Loneliness, and Depression in Heterogenous Populations of Community-Dwelling Seniors*

	Population	Country, Year	Intervention Type	N	Findings
1.	Wait list for senior apartments	Sweden, 1985	Social worker–led self-help groups	108	↓ Isolation†
2.	Residents of senior apartments	Sweden, 1983	Support groups	60	↓ Isolation†
3.	Physically inactive seniors	Netherlands, 2002	Group exercise programs	382	↓ Isolation‡ ↓ Loneliness‡
4.	Physically inactive seniors	United States, 2000	Group exercise programs	174	↓ Loneliness†
5.	Bereaved seniors	United States, 1993	Peer- and professional- led self-help support groups	339	NS
6.	Users of mental health services at senior centres	United States, 1982	Social worker–led self-help groups	68	↓ Isolation‡ ↓ Loneliness§
7.	Seniors experiencing mental health crisis	United States, 1998	Social worker crisis phone line	61	↓ Isolation‡ ↓ Depression†
8.	Seniors with low income and low perceived social support	United States, 1991	Telephone friendships	291	NS
9.	Hearing-impaired seniors	Germany, 1997	Hearing aids	148	↓ Loneliness†
10.	Informal caregivers of persons with Alzheimer's disease	United States, 1995	Nurse moderated computer link	102	NS
11.	Informal caregivers of persons with dementia	United States, 2007	Social worker–led telephone-based support	103	↓ Depression† (subgroup > 65 y)

↓ indicates decrease; NS, not significant , $P > .05$.
†$P < .05$; ‡$P < .01$; §$P < .001$.

Economic Analyses

Disclaimer: The Medical Advisory Secretariat uses a standardized costing methodology for all of its economic analyses of technologies. The main cost categories and the associated methods from the province's perspective are as follows:

Hospital: Ontario Case Costing Initiative cost data are used for all in-hospital stay costs for the designated International Classification of Diseases-10 (ICD-10) diagnosis codes and Canadian Classification of Health Interventions procedure codes. Adjustments may need to be made to ensure the relevant case mix group is reflective of the diagnosis and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, the secretariat normally defaults to considering direct treatment costs only.

Nonhospital: These include physician services costs obtained from the Ontario Schedule of Benefits for physician fees, laboratory fees from the Ontario Laboratory Schedule of Fees, device costs from the perspective of local health care institutions, and drug costs from the Ontario Drug Benefit formulary list price.

Discounting: For all cost-effectiveness analyses, a discount rate of 5% is used as per the Canadian Agency for Drugs and Technologies in Health.

Downstream costs: All costs reported are based on assumptions of utilization, care patterns, funding, and other factors. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature. In cases where a deviation from this standard is used, an explanation has been given as to the reasons, the assumptions, and the revised approach. The economic analysis represents an estimate only, based on assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied for the purpose of developing implementation plans for the technology.

Falls and Fall-Related Injuries

A separate report in this series presents an economic model to predict long-term costs and effects and assess the cost-effectiveness of interventions that prevent falls and fall-related injuries and that thereby keep seniors in the community.

Urinary Incontinence

A budget impact analysis was conducted to forecast costs for caregiver-dependent and patient-directed multicomponent behavioural techniques delivered by NCAs, and PFMT alone delivered by physiotherapists. All costs are reported in 2008 Canadian dollars. Based on epidemiological data, published medical literature and clinical expert opinion, the annual cost of caregiver-dependent behavioural techniques was estimated to be $9.2 M, while the annual costs of patient-directed behavioural techniques delivered by either an NCA or physiotherapist were estimated to be $25.5 M and $36.1 M, respectively. Estimates will vary if the underlying assumptions are changed.

Currently, the province of Ontario absorbs the cost of NCAs (available through the 42 Community Care Access Centres across the province) in the home setting. The 2007 *Incontinence Care in the Community Report* estimated that the total cost being absorbed by the public system of providing continence care in

the home is $19.5 M in Ontario. This cost estimate included resources such as personnel, communication with physicians, record keeping and product costs. Clinic costs were not included in this estimation because currently these come out of the global budget of the respective hospital and very few continence clinics actually exist in the province. The budget impact analysis factored in a cost for the clinic setting, assuming that the public system would absorb the cost with this new model of community care.

Dementia

Caregiver-directed behavioural techniques and patient-directed exercise programs were found to be effective when assessing mild to moderate dementia outcomes in seniors living in the community. Therefore, an annual budget impact was calculated based on eligible seniors in the community with mild and moderate dementia and their respective caregivers who were willing to participate in interventional home sessions. Table 11 below describes the annual budget impact for these interventions.

Social Isolation

Community exercise programs were found to be effective in reducing social isolation outcomes in seniors living in the community. Therefore, an economic analysis to project total cost to implement the program in the first year based on eligible seniors in the community willing to participate in a community exercise program was calculated. Table 12 describes the cost to implement the program in the first year for these interventions.

This economic analysis was calculated for the first year after an introduction of the interventions, from the Ministry of Health and Long-Term Care perspective, using prevalence data only. Incidence and mortality rates were not factored in. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the province, and assumptions on costs. Number refers to patients likely to access these interventions in Ontario based on assumptions from the literature. Resource consumption was confirmed by an expert panel.

As a result of these assumptions, and due to the limited data available in the literature, uncertainty could become an issue. If and when new evidence is presented, these results may change and may better predict program resources over time, allowing for a more accurate analysis.

Table 11: Annual Budget Impact of Effective Interventions for Dementia

Parameter	Unit Cost ($ Cdn)	Unit	Annual Cost ($ Cdn)	Population*	No. of Patients	Annual Impact ($ Cdn)
Caregiver-Directed Behavioural Techniques†						
Occupational Therapist	120.22	1 hour session - 12 total	1,442.64	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	81,695,125
Nurse	82.12	1 hour session - 12 total	985.44	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	55,804,389
Patient-Directed Exercise Program‡						
Occupational Therapist	120.22	1 hour session - 32 total	3,847.04	Seniors with mild to moderate dementia who are willing to participate	38,696	148,866,672
Physiotherapist	108.49	1 hour session - 32 total	3,471.68	Seniors with mild to moderate dementia who are willing to participate	38,696	134,341,585
Personal Support Worker	30.48	1 hour session - 32 total	975.36	Seniors with mild to moderate dementia who are willing to participate	38,696	37,742,939
Recreation Therapist	25.85	1 hour session - 32 total	827.20	Seniors with mild to moderate dementia who are willing to participate	38,696	32,009,678
Caregiver- and Patient-Directed Behavioural Techniques§						
Occupational Therapist	120.22	1 hour session - 10 total	1,202.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	68,079,271
Nurse	82.12	1 hour session - 10 total	821.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	46,503,658

*Assumed 7% prevalence of dementia aged 65+ in Ontario.
†Assumed 8 weekly sessions plus 4 monthly phone calls.
‡Assumed 12 weekly sessions plus biweekly sessions thereafter (total of 20).
§Assumed 2 sessions per week for first 5 weeks. Assumed 90% of seniors in the community with dementia have mild to moderate disease. Assumed 4.5% of seniors 65+ are in long-term care, and the remainder are in the community. Assumed a rate of participation of 60% for both patients and caregivers and of 41% for patient-directed exercise. Assumed 100% compliance since intervention administered at the home. Cost for trained staff from Ministry of Health and Long-Term Care data source. Assumed cost of personal support worker to be equivalent to in-home support. Cost for recreation therapist from Alberta government Website.
Note: This budget impact analysis was calculated for the first year after introducing the interventions from the Ministry of Health and Long-Term Care perspective using prevalence data only. Prevalence estimates are for seniors in the community with mild to moderate dementia and their respective caregivers who are willing to participate in an interventional session administered at the home setting. Incidence and mortality rates were not factored in. Current expenditures in the province are unknown and therefore were not included in the analysis. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the province, and assumptions on costs. The number of patients was based on patients likely to access these interventions in Ontario based on assumptions stated below from the literature. An expert panel confirmed resource consumption.

Table 12: Cost to Implement Community-Based Exercise Programs (2008 $Cdn)*

Type of Professional Delivering Program	Unit Cost, $	First Year Cost, $	Population	Number	First Year Total Cost, $
Recreation Therapist	25.85	74.68	Seniors in the community willing to participate in an exercise program	476,992	35,620,736
Occupational Therapist	29.68	85.74	Seniors in the community willing to participate in an exercise program	476,992	40,898,392
Physiotherapist	18.41	53.18	Seniors in the community willing to participate in an exercise program	476,992	25,368,578

*Assumed hourly exercise group sessions of 9 seniors per group once biweekly with either an occupational therapist, a physiotherapist, or a recreation therapist. Assumed 4.5% of seniors are in long-term care. Assumed 57% of seniors 65+ would participate in a community exercise program and 79% would be compliant. Assumed 65.8% of seniors in the community are mobile.

Feedback from Expert Panel

Experts in the field of aging, with specific focus on community-based services, were invited to take part in panel meetings between January and May 2008 (See Appendix 3 for a list of members of the expert panel). The objectives of this panel were

- to review and consolidate evidence on the effectiveness of devices, programs, and systems provided in the home to elderly individuals in Ontario;
- to assess the appropriateness of the evidence in the context of the Ontario health system; and
- to identify gaps in the evidence and opportunities for improvement in current practice.

The feedback from the expert panel for the key predictors is summarized below.

Falls and Fall-Related Injuries

Medication Withdrawal

- Medication withdrawal involves a fine balance between benefit and risk, and cannot be as accurately implemented as other initiatives.
- There are not enough best practice guidelines for medication withdrawal in seniors.
- As a general rule, psychotropic medications are not prescribed unless there are specific needs (such as wandering, inability to sleep, hitting, and other abusive behaviour). In these cases, it is difficult (and perhaps inappropriate) to withdraw this medication since doing so can greatly increase caregiver burden.
- A discussion followed that indicated that inadequate training of caregivers to deal with behaviours in seniors may increase the reliance on psychotropic medications. Perhaps if proper training were provided, medication withdrawal could be more successful.
- In a home setting, individual compliance with taking psychotropic medications can be low and requires caregiver support for reminders.

Causes of Falls and Injury in Seniors

- Many injurious falls occur around indoor stairs, and therefore the proper design of stairs and appropriate handrails (shape, diameter, and height) should be investigated.
- Injuries following falls from ladders frequently occur in seniors (largely due to cleaning of eavestroughs and windows). Ladders with hoops or services to clean eavestroughs and windows for seniors should be considered.
- Falls on sidewalks and road crossings are frequent, particularly in the winter. With the deteriorating condition of street clearing, this is becoming a larger issue.
- Fear of falling is another important cause of falls since it perpetuates a cycle of immobility, followed by deconditioning and falls.

Falls in the Winter

- In the winter, several factors reduce the likelihood that an elderly person will go outdoors:
  - Seniors are most likely to go out during daylight hours, which are fewer.
  - Fear of slipping on the ice and snow reduces the likelihood of an elderly person choosing to go outdoors unless it is absolutely necessary.
  - Poorly designed coats and boots make it difficult for seniors with difficulty moving or with lowered flexibility to dress for the outdoors.
- These factors can lead to lowered fitness levels, which in turn leads to an increased likelihood of falls both indoors and outdoors.
- Furthermore, in the colder months, people tend to walk faster when outdoors, which can increase the likelihood that an individual will fall.

Mobility Aids

- At both meetings, the issue of mobility aids was raised by experts on the panel. Regrettably it is very rare to find published trials investigating the effectiveness of mobility aids, and therefore it was not appropriate to include this as a section of this literature review. However, the panel felt that it was important to discuss these aids and their use in reducing falls and fall-related injuries in the elderly population, and that more work should be done to improve existing mobility devices.
- Mobility aids that were discussed as being effective included
  - wheeled walkers – while wheeled walkers can decrease the frequency of falls, the panel mentioned that walkers must be properly designed to ensure the best stability and that poorly designed walkers can actually increase the likelihood of falls.
  - handrails that are at an appropriate height, are cylindrical and are easy to see and grab
  - raised toilet seats to decrease falls that occur when sitting at and standing up from the toilet
  - grab bars, particularly in washrooms
- While mobility aids are an important tool to reduce falls in community-dwelling seniors, when renovations are not done to an appropriate standard, they can actually increase home hazards and risk of falling. Therefore, it was felt that elderly populations should be provided with access to affordable high-standard renovations.
- Emergency buttons that act as a lifeline after a fall were discussed. Because quick access to help can prevent long-term complications and disabilities, it was argued that these emergency buttons are highly effective in elderly populations, although it was suggested that uptake of the technology may be limited, based on reports that many people forget after a fall that they have access to these buttons.

Urinary Incontinence

- Services/interventions that currently exist in Ontario offering behavioural interventions to treat UI are not consistent. There is a lack of consistency in how seniors access services for treatment of UI, who manages patients and what treatment patients receive.
- Help-seeking behaviours are important to consider when designing optimal service delivery methods.
- There is considerable social stigma associated with UI and therefore there is a need for public education and an awareness campaign.
- The cost of incontinent supplies and the availability of NCAs were highlighted.

Dementia

Respite Care

Methodological and Quality Issues with Studies

- Respite care is difficult to define.
- Randomized controlled trials are very challenging to conduct in this population.
- Caregivers of seniors with dementia have complex and diverse needs.
- Patients differ greatly with respect to type of dementia, severity of disease, and limits in ADLs and IADLs.
- Caregivers differ greatly with respect to characteristics, age, health status, relationship to care recipient, amount of formal or informal support available, and use/access of other supportive services.
- Outcomes measured may not be sensitive/appropriate measures to detect effectiveness of respite.
- Interventions are heterogeneous (type of respite, duration, intensity).
- Study duration is typically short; therefore, it is difficult to assess medium- to long-term effects.
- There are many forms of respite that are effective but have not been studied (i.e., respite provided through religious groups). One must be careful with how the results of the respite care literature are reported.

Current Delivery

- Community Care Access Centres (CCACs) provide respite care in 3 ways:
  - informal in-home, 1-on-1 care for a couple of hours per day,
  - referral to community-support programs, and
  - referral to short-term nursing home stays.
- Hours of respite are coordinated by CCACs and delivered by personal support workers (PSWs).
- Informal agencies and religious groups provide some respite services (congregate driving, meals on wheels, and friendly visiting).
- What seems to be useful is someone taking the senior with dementia for a walk for 1 to 2 hours per day since this gives the caregiver free time. This is often organized by a PSW from a CCAC.
- In general, a short-term stay in a nursing home has less positive effects than other forms of respite since there is disruption of routine for the patient/ caregiver.

System Pressures

- Problem: not enough hours of respite provided by PSWs from CCACs.
- Other issues are: high turnaround of staff, lack of flexibility, lack of knowledge to manage behavioural challenges, inconsistency in delivery of services.
- Individuals with dementia need a familiar face and an individualized approach.

- Large issue in evaluating effectiveness of interventions in the dementia population.
- Often, informal arrangements are made (i.e., with neighbours/friends, etc.) to alleviate the burden of the caregiver.

Future Research/Direction

- There exist caregiver-support programs that define the number of hours in-home and flexibility benchmarks for caregiver-support interventions.
- In nursing homes, spouses of people with dementia support one another and help with the caregiving requirements, which is a form of respite for these caregivers.
- Not enough research is done into what happens to caregivers once the care receiver dies.

Behavioural Management Interventions

Current Delivery

- Two groups generally provide behavioural management interventions: community occupational therapists and psychogeriatric nurses.
- Psychogeriatric nurses counsel caregivers, and occupational therapists make environmental modifications to the home and provide case management.
- Physicians are reluctant to prescribe medications to seniors with dementia for problem behaviours; however, when caregivers have major difficulties with managing the care recipient (i.e., wandering, sleep disruptions), physicians will prescribe medication.

Systems Pressures

- Programs/tools are needed which will give caregivers the skills to manage and provide relief.
- It is difficult to co-ordinate funding of technology and of research.
- There are fundamental problems with studying caregiver interventions for dementia.

Future Research/Direction

- Examine the research being done at the occupational therapy department at the University of Toronto around family caregivers and outcome measures; identify which interventions are most effective.
- Field evaluations are required as different models and evaluations are needed.
- Technological interventions such as websites and online networking for care providers can be effective.
- It is important to focus on characteristics of people requiring services since response to interventions greatly differs according to type and severity.

Physical Exercise

- Community Care Access Centres can provide referrals for occupational therapists, physiotherapists, and personal support workers to go to homes.
- Community recreation centres – recreationalists can teach caregiver and client exercise programs.
- Community agencies and religious groups offer exercise programs – volunteer-led informal exercise groups (e.g., "mall walkers").
- Exercise programs often provided in/around supportive housing units.
- Exercise activities often organized outside of the formal health system.
- Municipality websites often list services available within the area.

Conclusions

Falls and Fall-Related Injuries

- High-quality evidence indicates that long-term exercise programs in mobile seniors and environmental modifications in the homes of frail elderly persons will effectively reduce falls and possibly fall-related injuries in Ontario's elderly population.
- A combination of vitamin D and calcium supplementation in elderly women will help reduce the risk of falls by more than 40%.
- The use of outdoor gait-stabilizing devices for mobile seniors during the winter in Ontario may reduce falls and fall-related injuries; however, evidence is limited and more research is required in this area.
- While psychotropic medication withdrawal may be an effective method for reducing falls, evidence is limited and long-term compliance has been demonstrated to be difficult to achieve.
- Multifactorial interventions in high-risk populations may be effective; however, the effect is only marginally significant, and the quality of evidence is low.

Urinary Incontinence

There is moderate-quality evidence that the following interventions are effective in improving UI in mobile motivated seniors:

- Multicomponent behavioural interventions including a combination of bladder training techniques, PFMT (with or without biofeedback), education on bladder control strategies and self-monitoring techniques.
- Pelvic floor muscle training alone.

There is moderate quality evidence that when behavioural interventions are led by NCAs or CNSs in a clinic setting, they are effective in improving UI in seniors.

There is limited low-quality evidence that prompted voiding may be effective in medically complex, frail seniors with motivated caregivers.

There is insufficient evidence for the following interventions in medically complex, frail seniors with motivated caregivers:

- habit retraining, and
- timed voiding.

Dementia

Caregiver Interventions for Seniors with Dementia

- There is limited evidence from RCTs that respite care is effective in improving caregiver outcomes for those caring for seniors with dementia.
- There is moderate- to high-quality evidence that individual behavioural interventions (≥ 6 sessions), directed at the caregiver (or combined with the patient) are effective in improving psychological health in dementia caregivers.
- There is moderate- to high-quality evidence that multicomponent interventions improve caregiver psychosocial health and may impact rates of institutionalization of dementia patients.

Patient-Directed Interventions

Secondary Prevention

- Physical exercise is effective for improving physical functioning in patients with dementia.
- Previous systematic review indicated that "cognitive training" is not effective in patients with dementia.
- A recent RCT suggests cognitive stimulation therapy (up to 7 weeks) is effective for improving cognitive function and quality of life in patients with dementia.

Primary Prevention (Delaying the Onset of Dementia)

- Regular leisure time physical activity in midlife is associated with a reduced risk of dementia in later life (mean follow-up 21 years).
- Regular physical activity in seniors is associated with a reduced risk of cognitive decline (mean follow-up 2 years).
- Regular physical activity in seniors is associated with a reduced risk of dementia (mean follow-up 6–7 years).

For seniors with good cognitive and physical functioning, there is:

- evidence that cognitive training for specific functions (memory, reasoning, and speed of processing) produces improvements in these specific domains, and
- limited inconclusive evidence that cognitive training can offset deterioration in the performance of self-reported IADL scores and performance assessments.

Social Isolation

Although effective interventions were identified for social isolation and loneliness in community-dwelling seniors, they were directed at specifically targeted groups and involved only a few of the many potential causes of social isolation. Little research has been directed at identifying effective interventions that influence the social isolation and other burdens imposed upon caregivers, in spite of the key role that caregivers assume in caring for seniors. The evidence on technology-assisted interventions and their effects on the social health and well-being of seniors and their caregivers is limited, but increasing demand for home health care and the need for efficiencies warrant further exploration. Interventions for social isolation in community-dwelling seniors need to be researched more broadly in order to develop effective, appropriate, and comprehensive strategies for at-risk populations.

Overall Conclusions

- There is moderate- to high-quality evidence that interventions that treat or reduce the risk of falls, UI, dementia or social isolation can improve health outcomes in community-dwelling seniors.
- There is moderate- to high-quality evidence that regular exercise can significantly improve health outcomes in community-dwelling seniors through the primary or secondary prevention of falls, UI (using PFMT), dementia, and social isolation.
- Low-quality or limited evidence is available and therefore no conclusions as to the effectiveness of the following interventions in the Ontario senior population can be made:
  - psychotropic medication withdrawal to prevent falls,
  - multicomponent interventions to prevent falls and fall-related injuries in high-risk seniors,
  - gait-stabilizing devices to prevent outdoor falls,

- caregiver-dependent behavioural techniques for UI (prompted voiding),
- rehabilitation for hearing loss (hearing aids),
- respite care for caregivers of seniors with dementia,
- cognitive stimulation therapy for seniors with dementia,
- cognitive training for seniors with good cognitive function, and
- focus/support group activities for seniors on wait lists for senior apartments.

Appendices

Appendix 1: Search Strategy

Database: Ovid MEDLINE(R) <1950 to October Week 1 2007>
Search Strategy:

1	exp Institutionalization/ (6846)
2	institutionalization.mp. (5403)
3	1 or 2 (8192)
4	exp Patient Admission/ (13250)
5	exp Nursing Homes/ or exp Homes for the Aged/ (28869)
6	4 and 5 (676)
7	(nursing home$ adj2 (entry or placement$ or admission$)).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (909)
8	3 or 6 or 7 (9429)
9	exp Aged/ or elderly.mp. or senior$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (1684396)
10	8 and 9 (4258)
11	limit 10 to (humans and english language and yr="1990 - 2007") (2584)
12	limit 11 to (controlled clinical trial or meta analysis or randomized controlled trial) (187)
13	(meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (65450)
14	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (514505)
15	exp Double-Blind Method/ (94064)
16	exp Control Groups/ (805)
17	exp Placebos/ (26800)
18	RCT.mp. (2437)
19	or/12-18 (587909)
20	11 and 19 (350)

Appendix 2: Grade Score for the Body of Evidence

Number of Studies	Study Design	Quality of Studies	Consistency	Directness	Other Modifying Factors
N	RCT=High Observational =Low Any other evidence =Very Low	Serious limitation to study quality (−1) Very serious limitation to study quality (−2)	Important inconsistency (−1)	Some uncertainty about directness (−1) Major uncertainty about directness (−2)	Association strong (+1) Association very strong (+2) Dose response gradient (+1) All plausible confounders would have reduced the effect (+1) Imprecise or sparse data (−1) High probability of reporting bias (−1)

Source: Atkins D et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454): 1490. (18)

Appendix 3: Expert Panel Membership

Members of the Expert Panel were as follows:

Dr. Shirlee Sharkey (Chair)	President and CEO, St. Elizabeth Health Care
Ms. Trish Barbato	President and CEO, COTA Health
Dr. Ed Brown	Executive Director, North network
Dr. Geoff Fernie	Vice President Research, Toronto Rehabilitation Institute
Ms. Malini Hall	Resource Occupational Therapist, St. Elizabeth Health Care
Mr. Eric Hong	Director of Corporate Development, Yee Hong Centre for Geriatric Care
Ms. Kay McGarvey	Clinical Resource Nurse, St. Elizabeth Health Care
Dr. Alex Mihailidis	Department of Occupational Therapy and Director of Intelligent Assistive Technology and Systems Lab
Ms. Nancy Murray	Manager, Staff Education & Training, Waterloo Wellington CCAC
Dr. Sandy Nuttall	Director, Emerging Innovation Investment Strategy Branch, MOHLTC
Ms. Susan Paetkau	Director, Health Program Policy and Standards Branch, MOHLTC
Dr. David Ryan	Director of Education, Regional Geriatric Program of Toronto
Ms. Loretta Ryan	Manager, Policy and Communications; Ontario Professional Planners Institute
Dr. Jennifer Skelly	Associate Professor at McMaster University and the Director of the Continence Program at St. Joseph's Healthcare Hamilton
Ms. Joan Stevens	Program Manager, Assistive Devices Program
Dr. Paul Williams	Professor, HPME, University of Toronto
Dr. Maria Zorzitto	Head of Geriatrics, St. Michael's Hospital

References

(1) Turcotte M, Schellenberg G. A portrait of seniors in Canada [Internet]. Statistics Canada; [updated 2006; cited 2008 Apr 15]. Available from: http://www.statcan.ca/english/freepub/89-519-XIE/89-519-XIE2006001.pdf

(2) Canada's aging population [Internet]. Ottawa, Ontario: Minister of Public Works and Government Services Canada; [updated 2002; cited 2008 May 15]. Available from: http://dsp-psd.pwgsc.gc.ca/Collection/H39-608-2002E.pdf

(3) Gaugler JE, Duval S, Anderson KA, Kane RL. Predicting nursing home admission in the U.S: a meta-analysis. BMC Geriatr 2007; 7:13.

(4) Jette AM, Tennstedt S, Crawford S. How does formal and informal community care affect nursing home use? J Gerontol B Psychol Sci Soc Sci 1995; 50(1):S4-S12.

(5) Mustard C, Finlayson M, Derksen S, Berthelot JM. What determines the need for nursing home admission in a universally insured population? J Health Serv Res Policy 1999; 4(4):197-203.

(6) Rockwood K, Stolee P, McDowell I. Factors associated with institutionalization of older people in Canada: testing a multifactorial definition of frailty. J Am Geriatr Soc 1996; 44(5):578-82.

(7) Oura A, Washio M, Wada J, Arai Y, Mori M. Factors related to institutionalization among the frail elderly with home-visiting nursing service in Japan. Gerontology 2006; 52(1):66-8.

(8) Banaszak-Holl J, Fendrick AM, Foster NL, Herzog AR, Kabeto MU, Kent DM et al. Predicting nursing home admission: estimates from a 7-year follow-up of a nationally representative sample of older Americans. Alzheimer Dis Assoc Disord 2004; 18(2):83-9.

(9) Bharucha AJ, Pandav R, Shen C, Dodge HH, Ganguli M. Predictors of nursing facility admission: a 12-year epidemiological study in the United States. J Am Geriatr Soc 2004; 52(3):434-9.

(10) Coughlin TA, McBride TD, Liu K. Determinants of transitory and permanent nursing home admissions. Med Care 1990; 28(7):616-31.

(11) Jette AM, Branch LG, Sleeper LA, Feldman H, Sullivan LM. High-risk profiles for nursing home admission. Gerontologist 1992; 32(5):634-40.

(12) Lachs MS, Williams CS, O'Brien S, Pillemer KA. Adult protective service use and nursing home placement. Gerontologist 2002; 42(6):734-9.

(13) Trottier H, Martel L, Houle C, Berthelot J, Légare J. Living at home or in an institution: what makes the difference for seniors? Health Rep 2000; 11(4):49-61.

(14) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(15) Nuotio M, Tammela TL, Luukkaala T, Jylha M. Predictors of institutionalization in an older population during a 13-year period: the effect of urge incontinence. J Gerontol A Biol Sci Med

Sci 2003; 58(8):756-62.

(16) Thom DH, Haan MN, VanDenElden SK. Medically recognized urinary incontinence and risks of hospitalization, nursing home admission and mortality. Age Ageing 1997; 26(5):367-74.

(17) Andel R, Hyer K, Slack A. Risk factors for nursing home placement in older adults with and without dementia. J Aging Health 2007; 19(2):213-28.

(18) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490.

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 2

Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors

An Evidence-Based Analysis

October 2008

Ontario

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. Prevention of falls and fall-related injuries in community-dwelling seniors: an evidence-based analysis. *Ontario Health Technology Assessment Series* 2008;8(2).

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to MASinfo.moh@ontario.ca.

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-8015-4 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee (OHTAC).

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

Abbreviations

ADL	Activity of daily living
ALOS	Average length of stay
CI	Confidence interval
ED	Emergency department
FY	Fiscal year
HR	Hazard ratio
ICES	Institute of Clinical Evaluative Science
IRR	Incidence rate ratio
IU	International units
LOS	Length of stay
LTC	Long-term care
NNP	Number needed to prevent
OR	Odds ratio
OT	Occupational therapist
PT	Physical therapist
QoL	Quality of life
OR	Odds ratio
RCT	Randomized controlled trial
RR	Relative risk
UI	Urinary incontinence

Executive Summary

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective

To identify interventions that may be effective in reducing the probability of an elderly person's falling and/or sustaining a fall-related injury.

Background

Although estimates of fall rates vary widely based on the location, age, and living arrangements of the elderly population, it is estimated that each year approximately 30% of community-dwelling individuals aged 65 and older, and 50% of those aged 85 and older will fall. Of those individuals who fall, 12% to 42% will have a fall-related injury.

Several meta-analyses and cohort studies have identified falls and fall-related injuries as a strong predictor of admission to a long-term care (LTC) home. It has been shown that the risk of LTC home admission is over 5 times higher in seniors who experienced 2 or more falls without injury, and over 10

times higher in seniors who experienced a fall causing serious injury.

Falls result from the interaction of a variety of risk factors that can be both intrinsic and extrinsic. Intrinsic factors are those that pertain to the physical, demographic, and health status of the individual, while extrinsic factors relate to the physical and socio-economic environment. Intrinsic risk factors can be further grouped into psychosocial/demographic risks, medical risks, risks associated with activity level and dependence, and medication risks. Commonly described extrinsic risks are tripping hazards, balance and slip hazards, and vision hazards.

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Evidence-Based Analysis of Effectiveness

Research Question

Since many risk factors for falls are modifiable, what interventions (devices, systems, programs) exist that reduce the risk of falls and/or fall-related injuries for community-dwelling seniors?

Inclusion and Exclusion Criteria

Inclusion Criteria

- English language;
- published between January 2000 and September 2007;
- population of community-dwelling seniors (majority aged 65+); and
- randomized controlled trials (RCTs), quasi-experimental trials, systematic reviews, or meta-analyses.

Exclusion Criteria

- special populations (e.g., stroke or osteoporosis; however, studies restricted only to women were included);
- studies only reporting surrogate outcomes; or
- studies whose outcome cannot be extracted for meta-analysis.

Outcomes of Interest

- number of fallers, and
- number of falls resulting in injury/fracture.

Search Strategy

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), The Cochrane Library, and the International Agency for Health Technology Assessment (INAHTA) for studies published between January 2000 and September 2007. Furthermore, all studies included in a 2003 Cochrane review were considered for inclusion in this analysis. Abstracts were reviewed by a single author, and studies meeting the inclusion criteria outlined above were obtained. Studies were grouped

based on intervention type, and data on population characteristics, fall outcomes, and study design were extracted. Reference lists were also checked for relevant studies. The quality of the evidence was assessed as high, moderate, low, or very low according to the GRADE methodology.

Summary of Findings

The following 11 interventions were identified in the literature search: exercise programs, vision assessment and referral, cataract surgery, environmental modifications, vitamin D supplementation, vitamin D plus calcium supplementation, hormone replacement therapy (HRT), medication withdrawal, gait-stabilizing devices, hip protectors, and multifactorial interventions.

Exercise programs were stratified into targeted programs where the exercise routine was tailored to the individuals' needs, and untargeted programs that were identical among subjects. Furthermore, analyses were stratified by exercise program duration (<6 months and ≥6 months) and fall risk of study participants. Similarly, the analyses on the environmental modification studies were stratified by risk. Low-risk study participants had had no fall in the year prior to study entry, while high-risk participants had had at least one fall in the previous year.

A total of 17 studies investigating multifactorial interventions were identified in the literature search. Of these studies, 10 reported results for a high-risk population with previous falls, while 6 reported results for study participants representative of the general population. One study provided stratified results by fall risk, and therefore results from this study were included in each stratified analysis.

Executive Summary Table 1: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Falls in Community-Dwelling Seniors*

Intervention	RR [95% CI]	GRADE
Exercise programs		
1. Targeted programs		
General population	0.81 [0.67–0.98]	Low
High-risk population	0.93 [0.82–1.06]	High
Short duration	0.91 [0.73–1.13]	High
Long duration	0.89 [0.79–1.01]	Moderate
2. Untargeted programs		
General population	0.78 [0.66–0.91]	Moderate
High-risk population	0.89 [0.72–1.10]	Very low
Short duration	0.85 [0.71–1.01]	Low
Long duration	0.76 [0.64–0.91]	Moderate
3. Combined targeted vs. untargeted programs		
General population	N/A	N/A
High-risk population	0.87 [0.57–1.34]	Moderate
Short duration	1.11 [0.73–1.70]	High
Long duration	0.73 [0.57–0.95]	High
Vision intervention		
Assessment/referral	1.12 [0.82–1.53]	Moderate
Cataract surgery	1.11 [0.92–1.35]	Moderate
Environmental modifications		
Low-risk population	1.03 [0.75–1.41]	High
High-risk population	0.66 [0.54–0.81]	High
General population	0.85 [0.75–0.97]	High
Drugs/Nutritional supplements		
Vitamin D (men and women)	0.94 [0.77–1.14]	High
Vitamin D (women only)	0.55 [0.29–1.08]	Moderate
Vitamin D and calcium (men and women)	0.89 [0.74–1.07]	Moderate
Vitamin D and calcium (women only)	0.83 [0.73–0.95]	Moderate
Hormone replacement therapy	0.98 [0.80–1.20]	Low
Medication withdrawal	0.34 [0.16–0.74]†	Low
Gait-stabilizing device	0.43 [0.29–0.64]	Moderate
Multifactorial intervention		
Geriatric screening (general population)	0.87 [0.69–1.10]	Very low
High-risk population	0.86 [0.75–0.98]	Low

*CI refers to confidence interval; RR, relative risk.
†Hazard ratio is reported, because RR was not available.

Executive Summary Table 2: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Fall-Related Injuries in Community-Dwelling Seniors*

Intervention	RR [95% CI]	GRADE
Exercise programs		
Targeted programs	0.67 [0.51–0.89]	Moderate
Untargeted programs	0.57 [0.38–0.86]	Low
Combined targeted vs untargeted programs	0.31 [0.13–0.74]	High
Drugs/nutritional supplements		
Vitamin D plus calcium (women only)	0.77 [0.49–1.21]	Moderate
Gait-stabilizing device	0.10 [0.01–0.74]	Moderate
Hip protectors	3.49 [0.68–17.97] †	Low
Multifactorial intervention		
Geriatric screening (general population)	0.90 [0.53–1.51]	Low
High-risk population	0.86 [0.66–1.11]	Moderate

*CI refers to confidence interval; RR, relative risk.
†Odds ratio is reported, because RR was not available.

Conclusions

1. High-quality evidence indicates that long-term exercise programs in mobile seniors and environmental modifications in the homes of frail elderly persons will effectively reduce falls and possibly fall-related injuries in Ontario's elderly population.
2. A combination of vitamin D and calcium supplementation in elderly women will help reduce the risk of falls by more than 40%.
3. The use of outdoor gait-stabilizing devices for mobile seniors during the winter in Ontario may reduce falls and fall-related injuries; however, evidence is limited and more research is required in this area.
4. While psychotropic medication withdrawal may be an effective method for reducing falls, evidence is limited and long-term compliance has been demonstrated to be difficult to achieve.
5. Multifactorial interventions in high-risk populations may be effective; however, the effect is only marginally significant, and the quality of evidence is low.

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective

To identify interventions that may be effective in reducing the probability of an elderly person's falling and/or sustaining a fall-related injury.

Clinical Need: Target Population and Condition

Definition of a Fall

Several definitions for falls exist in the literature; however, a recently published consensus statement suggested that a fall be defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level." (1)

Target Population and Prevalence of Falls

Although estimates of fall rates vary widely based on the location, age, and living arrangements of the elderly population, it is estimated that approximately 30% of community-dwelling individuals aged 65 and older, and 50% of those aged 85 and older will fall each year. (2-4) Of those individuals who fall, 12% to 42% will have a fall-related injury. (5;6) Elderly women living independently in the community are more likely to experience a fall than men, (6;7) and a study by Campbell et al. (8) found that the risk of falling for women was more than 1.5 times higher than for men, even after controlling for physical and sociological variables associated with increased fall risk.

In 2005, 12.8% of Ontario's population was aged 65 or older, a figure that is expected to increase by almost 65% by 2031. (9) With more than 1 in 5 Ontarians being 65 or older in 2031, the number of community-dwelling seniors at risk for encountering a fall will dramatically increase, thus increasing the demand for community-based services and the burden on Ontario's health system.

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Fall Outcomes and Burden

Minor injuries such as bruises, abrasions, lacerations and sprains occur after 44% of falls (10), while major injuries such as hip and wrist fractures occur after approximately 4% to 5% of falls. (11;12) As an individual ages, their ability to use their hands to break a fall and protect their hip is reduced, and therefore wrist fractures are more common than hip fractures between the ages of 65 and 75, while hip fractures become more prevalent after the age of 75. (13)

Injuries due to falls place a significant burden on the Ontario health system and are the leading cause of injury-related hospital visits (1,201/100,000 population) and emergency department visits (4,821/100,000 population) in Ontarians aged 65 and older. (14) Furthermore, once an individual is admitted into an acute hospital following a fall, their average length of stay (ALOS) is approximately 40% longer than that for all-cause hospitalizations. (15) This highlights not only the severity of injuries due to falls, but also the need for community-based services that will allow a more expedient discharge of elderly individuals back to their homes following a fall-related hospitalization.

Difficulties exist in measuring mortality directly associated with falls; however, it is estimated that up to 40% of injury-related deaths, and 1% of total deaths in those aged 65 and over, are due to falls. (16)

Falls as a Predictor of Long-Term Care Home Admission

A prospective cohort study was conducted in 1997 by Tinetti and Williams (17) to assess the risk of admission to a LTC home following falls and fall-related injuries. A cohort of 1,103 community-dwelling seniors aged 71 and older were followed for a median of 12 months. The outcome of interest in this study was the number of days from initial assessment to a first long-term admission to a skilled-nursing facility. The results of this study showed that after adjusting for demographic, psychosocial, cognitive, health-related and functional characteristics, there was a significant increase in the hazard of LTC home admission following falls (Table 1).

A meta-analysis published by Gaugler et al. in 2007 (18) investigated predictors of LTC home admission in community-dwelling elderly populations. This analysis was based on two large cohort studies in the United States, and found that the hazard of LTC home admission was approximately 16% higher in seniors with a history of falls than in those without (hazard ratio [HR], 1.16, [95% confidence interval (CI), 1.02–1.30]). The smaller effect size in this study as compared with the Tinetti and Williams study is likely due to the fact that fall status was based on annual recall in the studies included in the Gaugler et al. review, while the Tinetti and Williams study measured falls based on monthly calendars. While evidence regarding the most valid method of falls-outcome collection is limited, the use of monthly falls calendars is generally accepted to be a more rigorous and sensitive method of measuring fall status in elderly individuals. (19)

Table 1: Hazard Ratios for Admission to a Long-term Care Home Following Falls and Fall-related Injuries*

Fall Severity	HR [95% CI]	Population Attributable Risk (%)
1 fall without serious injury	3.1 [1.9–4.9]	13%
2 or more falls without serious injury	5.5 [2.1–14.2]	3%
At least one fall causing serious injury	10.2 [5.8–17.9]	10%

*CI refers to confidence interval; HR, hazard ratio.
Tinetti and Williams (20)

Fall Risks for Community-Dwelling Seniors

Falls result from the interaction of a variety of risk factors that can be both intrinsic and extrinsic. Intrinsic factors are those that pertain to the physical, demographic, and health status of the individual, while extrinsic factors relate to the physical and socio-economic environment. (21;22) Intrinsic risk factors can be further grouped into psychosocial/demographic risks, medical risks, risks associated with activity level and dependence, and medication risks.

Intrinsic Risk Factors

Psychosocial and Demographic Risks

As mentioned earlier in this report, increasing age and gender are both strong risk factors for falls. (6;23;24) Two psychosocial risk factors that have also been studied extensively are previous history of falls and fear of falling. A previous history of falls has been demonstrated as one of the strongest predictors of future falls and injurious falls. (25) This may be due to a loss of mobility and balance, or because of increased fear of falling, which can in turn lead to activity restrictions, loss of strength, and social isolation. (26;27)

Medical Risk Factors

In general, the risk of falling and sustaining a fall-related injury increases with the number of chronic health problems, with individuals having 5 to 7 chronic illnesses having more than 2.5 times the risk of

falling and 4.5 times the risk of having an injurious fall as someone without chronic conditions. (28) More specifically, chronic medical problems that have been shown to be associated with an increased risk of falls are a history of stroke, arthritis of the knee, foot problems, low systolic blood pressure, poor vision, cognitive impairment, Parkinson's disease, poor strength, muscle weakness, decreased reaction time, limited mobility and impaired balance and gait. (6;29-31)

Activity and Dependence

As individuals age, limited mobility, fear of falling, chronic illnesses and various other factors lead to decreased physical activity, which can result in decreased muscle strength and balance. Several studies have indicated that inactivity and decreased physical fitness in seniors are a major risk factor for falls and injurious falls. (32) However, some studies identify high physical activity as a risk factor for falls in older populations, indicating that the risks associated with increased physical activity for some elderly people must also be considered. (6) More research is needed in this area to determine the potential harm and benefit of various types and intensities of physical activity.

Medications

Research surrounding the risks of falls and fall-related injuries following medication use is extensive. Multiple prescriptions can lead to dizziness, and to problems with alertness, coordination, and balance. (33) As a result, studies have found that taking multiple medications leads to a significant increase in the risk of falls and injurious falls. (34-37) Furthermore, several drugs that are frequently prescribed to elderly individuals are independently associated with a high risk of falls. These include sedatives and hypnotics, psychotropic medications, benzodiazepines, and diuretics. (6;38;39) Some studies indicate that antihypertensive medications may also increase the risk of falls and fall-related injuries; however, results in this area are inconsistent. (40)

Extrinsic Risk Factors

There is very little evidence surrounding the level of risk associated with extrinsic risk factors. Commonly described extrinsic risks are tripping hazards, balance and slipping hazards, and vision hazards. (6;41-43)

Tripping hazards

- loose rugs,
- electrical cords,
- pets,
- uneven sidewalks, and
- inappropriate or ill-fitting footwear.

Balance and slipping hazards

- narrow or slippery stairs,
- no handrails on stairs,
- bathroom hazards (e.g., low toilets, unsafe or slippery bathtubs/showers),
- low furniture, and
- ice and snow.

Vision hazards

- cataracts,

- eyeglasses, and
- poor lighting.

Evidence-Based Analysis of Effectiveness

Objective

To identify interventions that may be effective in reducing the probability of an elderly person's falling and/or sustaining a fall-related injury.

Research Questions

- Since many risk factors for falls are modifiable, what interventions (devices, systems, programs) exist that reduce the risk of falls and/or fall-related injuries for community-dwelling elderly persons?
- Are there differences in the effectiveness of interventions in high-risk groups (e.g., frail, history of falling)?

Methods

Inclusion and Exclusion Criteria

Inclusion Criteria

- English language;
- published between January 2000 and September 2007;
- population of community-dwelling seniors (majority aged 65+); and
- randomized controlled trials (RCTs), quasi-experimental trials, systematic reviews, or meta-analyses.

Exclusion Criteria

- special populations (e.g., stroke or osteoporosis; however, studies restricted only to women were included);
- studies only reporting surrogate outcomes; or
- studies whose outcome cannot be extracted for meta-analysis.

Outcomes of Interest

- number of fallers, and
- number of falls resulting in injury/fracture.

Method of Review

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), The Cochrane Library, and the International Agency for Health Technology Assessment (INAHTA) for studies published between January 2000 and September 2007. The search strategy is detailed in Appendix 1.

Furthermore, all studies included in a 2003 Cochrane review published by Gillespie et al. (44) were considered for inclusion in this review.

Abstracts were reviewed, and studies meeting the inclusion criteria outlined above were obtained. Studies were grouped based on intervention type, and data on population characteristics, falls outcomes, and study design were extracted. Reference lists were also checked for relevant studies. Results for each outcome from individual studies were meta-analyzed using fixed-effects models.

Assessment of Quality of Evidence

The quality assigned to individual studies was determined using the Medical Advisory Secretariat's adaptation of the levels-of-evidence hierarchy proposed by Goodman. (45)

The overall quality of the evidence was examined according to the GRADE Working Group criteria (see Appendix 2). (46)

- Quality refers to criteria such as the adequacy of allocation concealment, blinding, and follow-up.
- Consistency refers to the similarity of estimates of effect across studies. If there is important unexplained inconsistency in the results, our confidence in the estimate of effect for that outcome decreases. Differences in the direction of effect, the size of the differences in effect, and the significance of the differences guide the decision about whether important inconsistency exists.
- Directness refers to the extent to which the interventions and outcome measures are similar to those of interest.

As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence.

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Results of Evidence-Based Analysis

The database search identified 507 citations published between January 2000 and September 2007. Of the 155 studies set in the community as opposed to a hospital or LTC home, 43 met the inclusion criteria described above. A further 17 studies were identified in the Cochrane review on falls in the elderly, 15 of which were published before the year 2000. (44) All studies identified were RCTs, and only one was defined as small (total sample size N=28) (Table 2).

Table 2: Quality of Evidence of Included Studies*

Study Design	Level of Evidence	Number of Eligible Studies
Large RCT, systematic review of RCTs	1	59
Large RCT unpublished but reported to an international scientific meeting	1(g)	0
Small RCT	2	1
Small RCT unpublished but reported to an international scientific meeting	2(g)	0
Non-RCT with contemporaneous controls	3a	0
Non-RCT with historical controls	3b	0
Non-RCT presented at international conference	3(g)	0
Surveillance (database or register)	4a	0
Case series (multisite)	4b	0
Case series (single site)	4c	0
Retrospective review, modeling	4d	0
Case series presented at international conference	4(g)	0

†For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. (45) An additional designation "g" was added for preliminary reports of studies that have been presented at international scientific meetings. Non-RCT, clinical trial that is not randomized, e.g., a cohort study; RCT, randomized controlled trial.
Adapted from the Oxford Centre for Evidence (45)

Summary of Existing Evidence

Interventions Identified in Literature

- physical exercise
- vision assessment and referral
- cataract surgery
- environmental modifications
- vitamin D supplements
- vitamin D and calcium supplements
- hormone replacement therapy (HRT)
- medication withdrawal
- gait-stabilizing devices
- hip protectors
- multifactorial interventions

Detailed study characteristics are provided in Appendix 3.

Exercise

There were 25 studies identified that described the effects of a physical exercise intervention on the proportion of people falling or experiencing a fall-related injury. The types of exercise programs provided to the intervention group varied considerably between trials. Most exercise programs contained a combination of exercises designed to improve balance, endurance, strength, coordination, and flexibility. Although most were conducted in a group setting, several programs incorporated a home-based exercise program to be completed between group sessions.

In general, the exercise interventions described in the literature can be grouped into 2 main categories:

targeted and untargeted. Targeted interventions are tailored exercise programs that are based on the individual's risk factors and needs, while untargeted interventions provide the same exercise program to all individuals enrolled. Eighteen studies investigated the effects of an untargeted intervention, 5 studies investigated the effects of a targeted intervention, and in 2 studies, the authors compared a combination of untargeted and targeted exercises against an untargeted exercise program. The meta-analysis of these studies indicated that there is a moderate reduction in the risk of falling following untargeted interventions (relative risk [RR], 0.82 [95% CI, 0.72–0.93]). Forest plots for all meta-analyses are presented in Appendix 4.

After evaluating the population and program characteristics found in the literature, two important stratifications were identified. The first stratification was by fall risk, where individuals were identified as high-risk if they were extremely frail or had a history of previous falls. Ten studies restricted the population of interest to frail elderly persons at high risk for falls, while the remaining 15 studies did not limit their population based on fall risk. The meta-analysis indicated that there was no statistically significant reduction in the number of high-risk individuals falling following an exercise program (Table 3). However, in studies that did not restrict the study population to those at high risk, both targeted and untargeted exercise programs significantly reduced an individual's risk of falling and having a fall-related injury (Tables 4 and 5).

Table 3: Summary of Evidence Surrounding the Risk of Falls After an Exercise Program: High-Risk Population*

	Untargeted Exercise vs. No Exercise	Targeted Exercise vs. No Exercise	Combination Exercise vs. Untargeted Exercise
Number of studies	6	2	2
Total N (case/control)	372/270	329/330	77/61
RR (95% CI)	0.89 (0.72–1.10)	0.93 (0.82–1.06)	0.87 (0.57–1.34)

*CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs.

Table 4: Summary of Evidence Surrounding the Risk of Falls After an Exercise Program: General Population*

	Untargeted Exercise vs. No Exercise	Targeted Exercise vs. No Exercise	Combination Exercise vs. Untargeted Exercise
Number of studies	12	3	0
Total N (case/control)	1250/1234	282/284	0/0
RR (95% CI)	0.78 (0.66–0.91)	0.81 (0.67–0.98)	N/A

* CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs.

Table 5: Summary of Evidence Surrounding the Risk of Fall-Related Injuries After an Exercise Program: General Population*

	Untargeted Exercise vs. No Exercise	Targeted Exercise vs. No Exercise	Combination Exercise vs. Untargeted Exercise
Number of studies	2	3	0
Total N (case/control)	239/187	269/277	0/0
RR (95% CI)	0.44 (0.27–0.72)	0.67 (0.51–0.89)	N/A

* CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs.

The second stratification considered was based on intervention duration. There was inconsistency in results of studies based on the duration of the exercise program, and therefore studies were stratified into those exercise programs lasting for less than 6 months, and those lasting 6 months or more. The results of this meta-analysis indicated that there was no statistically significant reduction in the risk of falling following a short exercise intervention of any kind (Table 6). Conversely, untargeted exercise interventions lasting 6 months or longer showed a statistically significant reduction in the risk of falling (Table 7). Only two studies investigating a short-term exercise intervention reported fall-related injuries as an outcome (47;48), and only one of these studies (49) reported any fall-related injuries during its follow-up period. The authors of this study reported a reduction in the risk of fall-related injuries following an untargeted exercise program; however, this reduction was not significant. A meta-analysis of the effectiveness of long-term exercise interventions on risk of fall-related injury indicated that targeted exercise programs moderately reduce the risk of fall-related injuries (Table 8).

Table 6: Summary of Evidence Surrounding the Risk of Falls After an Exercise Program: Short Intervention (<6 months)*

	Untargeted	Targeted	Combination* Versus Untargeted
Number of studies	10	2	1
Total N (case/control)	1160/1070	157/158	34/34
RR (95% CI)	0.85 (0.71–1.01)	0.91 (0.73–1.13)	1.11 (0.73–1.70)

*CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs.

Table 7: Summary of Evidence Surrounding the Risk of Falls After an Exercise Program: Long Intervention (≥6 months)*

	Untargeted	Targeted	Combination* Versus Untargeted
Number of studies	8	3	1
Total N (case/control)	462/434	454/456	43/27
RR (95% CI)	0.76 (0.64–0.91)	0.89 (0.79–1.01)	0.73 (0.57–0.95)

*CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs

Table 8: Summary of Evidence Surrounding the Risk of Fall-Related Injuries After an Exercise Program: Long Intervention (≥6 months)*

	Untargeted	Targeted	Combination* Versus Untargeted
Number of studies	2	2	1
Total N (case/control)	171/167	224/229	43/27
RR (95% CI)	0.61 (0.33–1.12)	0.68 (0.51–0.90)	0.31 (0.13–0.74)

*CI refers to confidence interval; RR, relative risk; combination refers to untargeted and targeted exercise programs

Vision Assessment and Referral

The literature search identified two studies that investigated the effects of vision assessment and referral on fall risk in a population of healthy elderly people aged 70 and over. (50;51) The intervention in the study by Day et al. (52) consisted of a visual acuity test by a trained assessor followed by referrals to an eye care provider, general practitioner, or optometrist where needed. In the study by Cumming et al. (53), the vision assessment was performed by an optometrist, and further referrals to an ophthalmologist or eye clinic were determined by the optometrist. A meta-analysis of these two studies showed that there was no significant reduction in the risk of falls following vision assessment and referral (Table 9).

Table 9: Summary of Evidence Surrounding the Risk of Falls After Vision Interventions*

	Vision Assessment and Referral	Cataract Surgery
Number of studies	2	2
Total N (case/control)	448/444	274/271
RR (95% CI)	1.12 (0.82–1.53)	1.11 (0.92–1.35)

*CI refers to confidence interval; RR, relative risk.

Cataract Surgery

Two studies have investigated the effects of cataract surgery in women aged 70 and over on risk of falling after 12 months of follow-up. (54;55) The intervention in the study by Harwood et al. (56) was small-incision cataract surgery and implantation of a folding silicone intraocular lens in women with cataracts and no previous ocular surgery. The study by Foss et al. (57) was a follow-up to this study and investigated the effects of cataract surgery on the second eye following successful cataract surgery in the study by Harwood et al. The results of a meta-analysis on these studies indicates that there is no reduction in risk of falls following cataract surgery in elderly women eligible for this procedure (Table 9).

Environmental Modifications

Environmental modifications are generally implemented in an elderly person's home to reduce the risk associated with many of the extrinsic risk factors such as loose rugs, poor lighting, and slippery floors. This literature search identified 4 studies that assessed the effectiveness of a home modification program in community-dwelling seniors. (58-61) The interventions consisted of one assessment visit in the elderly individual's home, followed by any necessary modifications such as the removal of floor coverings and loose electrical cords, changes to footwear, and the addition of hand rails, contrast edging to stairs, and non-slip bathmats. While the modifications available in each study were similar, the personnel responsible for the assessment and the cost of materials differed between programs. In two studies, an

occupational therapist was responsible for the home assessment, (58;62) while in the remaining two studies, the assessment was carried out by a trained assessor (63) and a team consisting of a physical medicine and rehabilitation doctor and ergotherapist. (64) Only 2 studies described the costs associated with the home modifications. In the trial by Cumming et al., (65) modifications were funded through the usual sources available in the Central Sydney Area Health Service, and in the study by Day et al., (66) labour and materials up to a value of $100 (Australian) ($54 US) were provided at no cost to the client.

Several of these studies investigated whether prior fall risk was associated with fall outcomes following an environmental modification program, and therefore the results are stratified by fall risk. High-risk populations are those with one or more falls in the previous year, and low-risk populations are those with no fall in the previous year. Three studies reported results on the risk of falling for high-risk populations, and 1 study reported outcomes for low-risk populations. The results of meta-analyses on these subgroups showed that environmental modifications effectively reduce the risk of falling in high-risk populations (RR, 0.66 [95% CI, 0.54–0.81]) but show no effect for seniors at low risk of falling (RR, 1.03 [95% CI, 0.65–1.41]) (Table 10). Three studies also reported results in a population that contained both high- and low-risk individuals. A meta-analysis of these studies showed that there was a slight reduction in risk of falling following a home modification program if the program was implemented in a population with mixed risk of falling (RR, 0.85 [95% CI, 0.75–0.97]) (Table 10). No studies reported fall-related injuries as an outcome.

Table 10: Summary of Evidence Surrounding the Risk of Falls After Environmental Modifications*

	High Risk (≥1 fall in previous year)	Low Risk (no fall in previous year)	High and Low Risk
Number of studies	3	1	3
Total N (case/control)	186/188	161/163	581/582
RR (95% CI)	0.66 (0.54–0.81)	1.03 (0.75–1.41)	0.85 (0.75–0.97)

*CI refers to confidence interval; RR, relative risk.

Vitamin D Supplements

Studies have shown that vitamin D deficiency may play a role in the development of osteoporosis and risk of fractures. (67;68) In 1999, two cross-sectional studies showed that vitamin D levels are associated with reduced muscle function and strength, (69;70) and as a result, several published studies have looked at the relationship between vitamin D supplementation and the risk of falls and fall-related injuries.

Four RCTs meeting the inclusion criteria were identified, one of which restricted the study population to women only. In two studies, a single dose of vitamin D was administered at study entry, after which participant fall outcomes were monitored for 6 months. (71;72) In the third study, participants received 1-µg capsules of alfacalcidol for 36 weeks, (73) and in the last study, participants were randomized to receive for 3 months either a 600-mg calcium carbonate supplement alone, or a combination supplement containing 600 mg calcium carbonate and 400 IU cholecalciferol (74). The results of the meta-analysis indicated that supplementation with vitamin D does not significantly reduce the risk of falling in the community-dwelling elderly population (Table 11). Similarly, in the study restricted to a population of elderly women, there was no evidence that vitamin D supplementation reduced the risk of falls (RR, 0.55 [95% CI, 0.29–1.08]) or fall-related injuries (RR, 0.48 [95% CI, 0.12–1.84]).

Table 11: Summary of Evidence Surrounding the Risk of Falls After Supplementation with Vitamin D*

	Men and Women	Women
Number of studies	3	1
Total N (case/control)	383/369	70/67
RR (95% CI)	0.94 (0.77–1.14)	0.55 (0.29–1.08)

*CI refers to confidence interval; RR, relative risk.

Vitamin D and Calcium Supplements

Supplementation with calcium has been shown to be effective in reducing bone loss by approximately 1% per year in post-menopausal women. (75) As a result, it has been hypothesized that the combination of vitamin D and calcium supplementation will reduce bone loss, body sway and loss of muscle strength, thus reducing the risk of falls and fractures in elderly individuals. Two studies were identified which investigated the joint effect of vitamin D and calcium supplementation in an elderly community-dwelling population. Both studies followed patients prospectively for 1 to 3 years; however, there were substantial differences in the intervention between the trials. A 3-year RCT conducted by Bischoff-Ferrari et al. (76) investigated the effects of a combination of 700 IU vitamin D_3 and 600 mg calcium citrate malate each day on risk of falling in elderly men and women, while Barr et al. (77) investigated a screening intervention where supplementation with vitamin D and calcium were only suggested for women at increased risk of hip fracture.

The results of the analyses indicated that supplementation with vitamin D and calcium can effectively reduce the risk of falls in women. Although the meta-analysis of two small studies investigating the effect of vitamin D alone on fall risk were not significant, the relative risk was small (RR, 0.55 [95% CI, 0.29–1.08]), and the meta-analysis may not have been adequately powered to detect a significant reduction. Therefore, it is not possible to draw from these analyses any conclusions regarding the *individual* effectiveness of vitamin D or calcium on fall risk in women. The evidence does not suggest a statistically significant reduction in falls in the study that included both men and women in their study population or in fall-related injuries in women (Tables 12 and 13).

Table 12: Summary of Evidence Surrounding the Risk of Falls After Supplementation with Vitamin D and Calcium

	Men and Women	Women
Number of studies	1	2
Total N (case/control)	219/226	720/1401
RR (95% CI)	0.89 (0.74–1.07)	0.83 (0.73–0.95)

*CI refers to confidence interval; RR, relative risk.

Table 13: Summary of Evidence Surrounding the Risk of Fall-Related Fractures After Supplementation with Vitamin D and Calcium*

	Men and Women	Women
Number of studies	0	2
Total N (case/control)	0/0	1313/2667
RR (95% CI)	N/A	0.77 (0.49–1.21)

*CI refers to confidence interval; RR, relative risk.

Hormone Replacement Therapy

The literature search identified one study that examined the effect of HRT on fall risk in elderly women. (78) In this study, women in the intervention group with a hysterectomy were given conjugated equine estrogen (0.625 mg/day), and women without a hysterectomy were given conjugated equine estrogen (0.625 mg/day) and medroxyprogesterone (2.5 mg/day). All women in the trial were given a calcium and vitamin D supplement. This study found no evidence of a reduction in the risk of falling following HRT (RR, 0.98 [95% CI, 0.80–1.20]).

Medication Withdrawal

As described earlier, the use of medications, particularly psychotropic medications, is frequently identified as a major risk factor for falls in the elderly. The literature search identified one study that investigated the effect of psychotropic medication withdrawal on the risk of falls in a community-dwelling elderly population. (79) Participants in the intervention arm of this study had the amount of active ingredient in their medication gradually reduced over 14 weeks. After 14 weeks, these individuals were taking capsules that contained inert substances only. Individuals in the control arm did not have any change in the active ingredients in their medication. After controlling for fall history and total number of medications taken, the relative hazard of falls was significantly lower in the medication withdrawal group than in the control group (HR, 0.34 [95% CI, 0.16–0.74]). However, a major limitation of this study was that compliance 1 month following study completion was very low, with 47% of the participants in the medication withdrawal group restarting psychotropic medications. Therefore, the acceptability of this intervention as a method of reducing falls in community-dwelling seniors is questionable.

Gait-stabilizing Devices

One study published in 2005 investigated the effects of a gait-stabilizing device on outdoor slips and falls in 109 community-dwelling seniors with a history of falls. (80) Study participants in the intervention arm were provided with a gait-stabilizing device (Yaktrax Walker) for use outdoors during the winter months. The Yaktrax Walker is an injection-molded thermal plastic elastomer netting with high-strength horizontal coils to provide forward and backward stability. (81) This study found that there was a significant reduction in the risks of outdoor falls and of injurious falls when using the gait-stabilizing device as compared with the controls (RR, 0.43 [95% CI, 0.29–0.64]; RR, 0.10 [95% CI, 0.01–0.74], respectively). This results in a number needed to prevent (NNP) of 3 to prevent one fall, and 6 to prevent one injurious fall. Furthermore, the compliance with this intervention was high, with 78% of study participants reporting the Yaktrax Walker as their primary winter footwear during the course of the study.

Hip Protectors

Most studies of the effectiveness of hip protectors on fall-related injury risk in the elderly are conducted

in an institutionalized elderly population, and due to different population characteristics and risk factors, the results of these studies are not generalizable to the community-dwelling elderly population. The literature search identified one study that investigated the effects of a hip protector on hip fracture risk in community-dwelling seniors with a previous hip fracture. (82) During a median follow-up of 14 months, 8 hip fractures were reported among the 279 study participants. There was no significant difference in the odds of a second hip fracture between those study participants wearing a hip protector and those in the control group (OR, 3.5 [95% CI, 0.7–18.0]). However, compliance in the intervention group was low (34%), and only one of the 6 individuals in the intervention arm who suffered a hip fracture was wearing the hip protector at the time of the fall. This woman reported falling backwards and not to the side.

Multifactorial Interventions

Several studies have investigated the effect of a combination of interventions whose purpose is to reduce the risk of falls for community-dwelling seniors. In this review, 17 studies provided an initial assessment followed by a multifactorial intervention to reduce falls and fall-related injuries. The components of the multifactorial interventions differed between trials; however, most included a combination of home hazard assessment and environmental modification, an exercise program, and medication review. Other interventions offered in some studies included vision assessment, podiatry, assessment of cognition, provision of assistive devices, and community safety education. In general, services were provided by an occupational therapist, physical therapist, or nurse.

The intervention duration and target population differed among studies. The majority of studies (83-88) had a follow-up of 1 year; however, there was a wide variation, with two studies following participants for only 3 months (89;90), and two studies with a 3-year follow-up period. (91;92) Furthermore, 6 studies restricted their population to the general elderly population ("geriatric screening"), while 10 studies considered a more targeted approach, restricting their inclusion criteria to seniors at high risk of falls. One study performed a stratified analysis, with results provided for both the general elderly population, and that at high risk of falls. (83)

Two studies (93;94) were excluded from the meta-analysis. The mean number of falls in the previous 6 months, and the percentage of recurrent fallers at baseline in the study by Whitehead et al. (93) were significantly higher in the intervention compared with the control group. Since these are important covariates to consider when assessing fall risk, it was not appropriate to include the unadjusted results of this study in the meta-analysis. The adjusted results of this study found no significant change in fall risk following the multifactorial intervention (OR, 1.7; 95% CI, 0.7–4.4). In the study by Mahoney et al. (95) raw data were not presented, and therefore data extraction for meta-analysis was not possible. Similarly, this study did not demonstrate a significant reduction in falls following a multifactorial intervention (RR, 0.81; 95% CI, 0.57–1.17).

The results of the meta-analysis indicated that multifactorial interventions do not significantly reduce the risk of falls among the general elderly population (RR, 0.87 [95% CI, 0.69–1.10]), but there is a marginally significant reduction in the risk of falls in high-risk populations following a multifactorial intervention (RR, 0.86 [95% CI, 0.75-0.98]; Table 14). Only 7 studies reported fall-related injuries as an outcome. The results of the meta-analyses of these trials did not indicate a significant reduction in the risk of fall-related injuries following a multifactorial intervention (Table 15).

Despite the lack of a large effect of multifactorial interventions on falls and fall-related injuries, it is important to note that the studies were all quite diverse in the composition of the multifactorial intervention. Furthermore, since studies did not generally describe the uptake of specific interventions within their study population, it is possible that the effects of effective interventions were diluted. Therefore, it is difficult to draw a strong conclusion as to whether appropriate, well-conducted

multifactorial interventions would be effective in the population of Ontario's seniors.

Four study protocols for multifactorial interventions were identified in the literature search. These studies are all investigating the effectiveness of multifactorial interventions in high-risk populations in preventing falls after 12 months of follow-up. (96-99)

Table 14: Summary of Evidence Surrounding the Risk of Falls After a Multifactorial Intervention*

	Geriatric Screening	High Risk	Total
Number of studies	6	10	16
Total N (case/control)	1430/1427	1301/1309	2731/2736
RR (95% CI)	0.87 (0.69–1.10)	0.86 (0.75–0.98)	0.87 (0.78–0.97)

*CI refers to confidence interval; RR, relative risk.

Table 15: Summary of Evidence Surrounding the Risk of Fall-Related Injuries After a Multifactorial Intervention*

	Geriatric Screening	High Risk	Total
Number of studies	2	5	7
Total N (case/control)	845/811	771/783	1616/1594
RR (95% CI)	0.90 (0.53–1.51)	0.86 (0.66–1.11)	0.87 (0.69–1.10)

*CI refers to confidence interval; RR, relative risk.

Summary of Findings of Literature Review

The results of the meta-analyses for the interventions identified in the literature search are summarized below in Tables 16 and 17.

Table 16: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Falls in Community-Dwelling Seniors*

Intervention	RR [95% CI]
Exercise programs	
1. Targeted programs	
General population	0.81 [0.67–0.98]
High-risk population	0.93 [0.82–1.06]
Short duration	0.91 [0.73–1.13]
Long duration	0.89 [0.79–1.01]
2. Untargeted programs	
General population	0.78 [0.66–0.91]
High risk population	0.89 [0.72–1.10]
Short duration	0.85 [0.71–1.01]
long duration	0.76 [0.64–0.91]
3. Combined targeted vs. untargeted programs	
General population	N/A
High-risk population	0.87 [0.57–1.34]
Short duration	1.11 [0.73–1.70]
Long duration	0.73 [0.57–0.95]
Vision intervention	
Assessment/referral	1.12 [0.82–1.53]
Cataract surgery	1.11 [0.92–1.35]
Environmental modifications	
Low-risk population	1.03 [0.75–1.41]
High-risk population	0.66 [0.54–0.81]
General population	0.85 [0.75–0.97]
Drugs/nutritional supplements	
Vitamin D (men and women)	0.94 [0.77–1.14]
Vitamin D (women only)	0.55 [0.29–1.08]
Vitamin D and calcium (men and women)	0.89 [0.74–1.07]
Vitamin D and calcium (women only)	0.83 [0.73–0.95]
Hormone replacement therapy	0.98 [0.80–1.20]
Medication withdrawal	0.34 [0.16–0.74]†
Gait-stabilizing device	0.43 [0.29–0.64]
Multifactorial intervention	
Geriatric screening (general population)	0.87 [0.69–1.10]
High-risk population	0.86 [0.75–0.98]

*CI refers to confidence interval; N/A, not applicable; RR relative risk.
†Hazard ratio is presented, because relative risk was not reported

Table 17: Summary of meta-analyses of studies investigating the effectiveness of interventions on the risk of fall-related injuries in community-dwelling seniors*

Intervention	RR [95% CI]
Exercise programs	
Targeted programs	0.67 [0.51–0.89]
Untargeted programs	0.57 [0.38–0.86]
Combined targeted vs untargeted programs	0.31 [0.13–0.74]
Drugs/nutritional supplements	
Vitamin D plus calcium (Women only)	0.77 [0.49–1.21]
Gait-stabilizing device	0.10 [0.01–0.74]
Hip protectors	3.49 [0.68–17.97]†
Multifactorial intervention	
Geriatric screening (general population)	0.90 [0.53–1.51]
High-risk population	0.86 [0.66–1.11]

*CI refers to confidence interval; RR relative risk
†Odds ratio is presented, because relative risk could not be calculated

Quality of the Evidence

Table 18: Summary of GRADE Quality Assessment for Exercise Interventions: Stratified by Intervention Length*

		Quality Assessment					Summary of Findings			
							No. of Patients		Effect	
Intervention	No. of Studies	Design	Quality	Consistency	Directness	Other	Interv	Control	(RR [95% CI])	Quality
Exercise (untargeted, long duration)	8	RCT	Serious limitations†	Consistent	Direct	None	462	434	0.76 [0.64–0.91]	Moderate
		High	Moderate	Moderate	Moderate	Moderate				
Long duration: targeted	3	RCT	No serious limitations	Consistent	Some uncertainty about directness‡	None	454	456	0.89 [0.79–1.01]	Moderate
		High	High	High	Moderate	Moderate				
Long duration: Combined	1	RCT	No serious limitations	Only 1 study	Direct	None	43	27	0.73 [0.57–0.95]	High
		High	High	High	High	High				
Short duration: Untargeted	10	RCT	Serious limitations§	Slightly inconsistent	Direct	None	1160	1070	0.85 [0.71–1.01]	Low
		High	Moderate	Low	Low	Low				
Short duration: Targeted	2	RCT	No serious limitations	Consistent	Direct	None	157	158	0.91 [0.73–1.13]	High
		High	High	High	High	High				
Short duration: Combined	1	RCT	No serious limitations	Only 1 study	Direct	None	34	34	1.11 [0.73–1.70]	High
		High	High	High	High	High				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial;
†Several studies (100-103) did not describe randomization process and by this omission might conceal biases in study allocation. Heterogeneity in exercise programs.
‡Two studies on older individuals aged 80+ and 85+ (104;105). Study by Campbell et al. on women only. (106)
§Five studies didn't have adequate blinding. (107-111) Two studies were not completely randomized (111;112)

Table 19: Summary of GRADE Quality Assessment for Exercise Interventions: Stratified by Target Population*

Intervention	No. of Studies	Quality Assessment					Summary of Findings			
							No. of Patients		Effect	
		Design	Quality	Consistency	Directness	Other	Interv	Control	(RR [95% CI])	Quality
General population: Untargeted	12	RCT	Serious limitations†	Consistent	Direct	None	1250	1234	0.78 [0.66–0.91]	Moderate
		High	Moderate	Moderate	Moderate	Moderate				
General population: Targeted	3	RCT	Serious limitations‡	Consistent	Some uncertainty about directness§	None	282	284	0.81 [0.66–0.98]	Low
		High	Moderate	Moderate	Low	Low				
High-risk population: Untargeted	6	RCT	Serious limitations‖	Some inconsistency	Some uncertainty about directness¶	None	372	270	0.89 [0.72–1.10]	Very low
		High	Moderate	Low	Very low	Very low				
High-risk population: Targeted	2	RCT	No serious limitations	Consistent	Direct	None	329	330	0.93 [0.82–1.06]	High
		High	High	High	High	High				
High-risk population: Combined	2	RCT	No serious limitations	Some inconsistency	Direct	None	77	61	0.87 [0.57–1.34]	Moderate
		High	High	Moderate	Moderate	Moderate				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial;
†Three studies (102) (100;113) did not describe randomization process, an omission which could conceal biases in study allocation; Exercise programs differed.
‡One study (114) only 19% randomized; Exercise programs differed.
§One study only on older (80+) women (115)
‖One study (116) did not describe randomization process; One study (111) not completely randomized; Three studies (111;117;118) not adequately blinded
¶One study in women only, (119) and one study in men only. (120)

Table 20: Summary of GRADE Quality Assessment for Nutritional Supplementation*

Intervention	No. of Studies	Quality Assessment					Summary of Findings			
							No. of Patients		Effect	
		Design	Quality	Consistency	Directness	Other	Interv	Control	(RR [95% CI])	Quality
Vitamin D: Men and women	3	RCT	No serious limitations	Consistent	Direct	None	383	369	0.94 [0.77–1.14]	High
		High	High	High	High	High				
Vitamin D: Women	1	RCT	Serious limitations†	Only 1 study	Direct	None	70	67	0.55 [0.29–1.08]	Moderate
		High	Moderate	Moderate	Moderate	Moderate				
Vitamin D plus calcium: Men and Women	1	RCT	Serious limitations†	Only 1 study	Direct	None	219	226	0.89 [0.74–1.07]	Moderate
		High	Moderate	Moderate	Moderate	Moderate				
Vitamin D plus calcium: Women	2	RCT	No serious limitations	Consistent	Direct	High probability of reporting bias‡	720	1401	0.83 [0.73–0.95]	Moderate
		High	High	High	High	Moderate				
Vitamin D plus calcium: Women Outcome: injurious Falls	2	RCT	No serious limitations	Consistent	Direct	High probability of reporting bias‡	1313	2667	0.77 [0.49–1.21]	Moderate
		High	High	High	High	Moderate				
Hormone replacement therapy	1	RCT	Serious limitations§	Only 1 study	Direct	None	187	186	0.09 [0.80–1.20]	Moderate
		High	Moderate	Moderate	Moderate	Moderate				
Medication withdrawal	1	RCT	No serious limitations	Only 1 study	Major uncertainty about directness§	Sparse data‖ Strong evidence of association	24	24	0.34 [0.16–0.74]¶	Low
		High	High	High	Low	Low				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial
†No description of randomization or blinding (although stated "double-blinded RCT") (74)
‡In one study, use of vitamin D and calcium by self-report only over a period of 1 to 3 years, and falls outcome reported as interval recall (falls in past year). (121)
§Study relied on long recall times (6 months) for falls outcome. (122)
‖Large amount of withdrawal (123-125)
¶Hazard Ratio

Table 21: Summary of GRADE Quality Assessment for Environmental Modifications*

Intervention	No. of Studies	Quality Assessment					Summary of Findings			
		Design	Quality	Consistency	Directness	Other	No. of Patients Interv	No. of Patients Control	Effect (RR [95% CI])	Quality
Environmental modification (low-risk seniors)	1	RCT	No serious limitations	Only 1 study	Direct	None	161	163	1.03 [0.75–1.41]	High
		High	High	High	High	High				
Environmental modification (high-risk seniors)	3	RCT	No serious limitations	Consistent	Direct	None	186	188	0.66 [0.54–0.81]	High
		High	High	High	High	High				
Environmental modification (all seniors)	3	RCT	No serious limitations	Consistent	Direct	None	581	582	0.85 [0.75–0.97]	High
		High	High	High	High	High				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial

Table 22: Summary of GRADE Quality Assessment for Vision Interventions*

Intervention	No. of Studies	Quality Assessment					Summary of Findings			
		Design	Quality	Consistency	Directness	Other	No. of Patients Interv	No. of Patients Control	Effect (RR [95% CI])	Quality
Vision assessment and referral	2	RCT	No serious limitations	Some inconsistency†	Direct	None	448	444	1.12 [0.82–1.53]	Moderate
		High	High	Moderate	Moderate	Moderate				
Cataract surgery	2	RCT	No serious limitations	Consistent	Some uncertainty about directness‡	None	274	271	1.11 [0.92–1.35]	Moderate
		High	High	High	Moderate	Moderate				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial
†One study shows positive effect, (126) and one shows negative. (127)
‡Only women included in studies. (128;129)

Table 23: Summary of GRADE Quality Assessment for Devices*

Intervention	No. of Studies	Quality Assessment					Summary of Findings			
							No. of Patients		Effect	
		Design	Quality	Consistency	Directness	Other	Interv	Control	(RR [95% CI])	Quality
Hip Protector	1	RCT	Serious limitations†	Only 1 study	Some uncertainty about directness‡	None	139	140	3.49 (0.68–17.97)	Low
		High	Moderate	Moderate	Low	Low				
Gait-stabilizing device	1	RCT	Serious limitations§	Only 1 study	Some uncertainty about directness‖	Strong evidence of association	55	54	0.43 [0.29–0.64]	Moderate
		High	Moderate	Moderate	Low	Moderate				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial
†High dropout in hip protector group; randomization technique not described. (82)
‡Study population of people with previous hip fracture, therefore may not be generalizable to all seniors. (82)
§No information as to whether groups comparable at study entry. (80)
‖No information on number of people excluded because they couldn't put on device. This may affect the generalizability and use in the general ambulatory, elderly population. (82)

Table 24: Summary of GRADE Quality Assessment for Multifactorial Interventions

Population and Outcome	No. of Studies	Quality Assessment					Summary of Findings			
							No. of Patients		Effect	
		Design	Quality	Consistency	Directness	Other	Interv	Control	(RR [95% CI])	Quality
Geriatric screening Falls	6	RCT	Very serious limitations†	Some Inconsistency	Direct	None	1430	1427	0.87 [0.69–1.10]	Very low
		High	Low	Very low	Very low	Very low				
Geriatric screening Injurious falls	2	RCT	Very serious limitations‡	Some Inconsistency	Direct	None	845	811	0.90 [0.53–1.51]	Low
		High	Moderate	Low	Low	Low				
High risk Falls	10	RCT	Serious limitations§	Some inconsistency	Direct	None	1301	1309	0.91 [0.75–0.98]	Low
		High	Moderate	Low	Low	Low				
High risk Injurious falls	4	RCT	Serious limitations‖	Consistent	Direct	None	624	639	0.85 (0.63–1.17)	Moderate
		High	Moderate	Moderate	Moderate	Moderate				

*RR refers to relative risk; CI, confidence interval; Interv, intervention; RCT, randomized controlled trial.

†No blinding of outcome assessors in 4 studies; (130-133) high dropout in 2 studies; (134;135) fall outcome based on recall at end of study for 4 studies; (133;136-138) randomization technique not described in study by Jitapunkul et al. (139)

‡Recall required for falls outcome and no blinding or intention-to-treat analysis in one study (133)

§No blinding of outcome assessors in 5 studies; (140-144) high dropout in 2 studies (145;146)

‖High loss to follow-up in two studies; (147;148) outcome assessors not blind in two studies (149;150)

Feedback from Expert Panel

The systematic review on falls and fall-related injuries was presented at two expert panel meetings (January 23, 2008, and May 16, 2008). The panel contextualized the evidence and identified several important issues to consider. The following is a summary of comments that were made:

Medication Withdrawal

- Medication withdrawal involves a fine balance between benefit and risk, and cannot be as accurately implemented as other initiatives.
- There are not enough best practice guidelines for medication withdrawal in seniors.
- As a general rule, psychotropic medications are not prescribed unless there are specific needs (such as wandering, inability to sleep, hitting, and other abusive behaviour). In these cases, it is difficult (and perhaps inappropriate) to withdraw this medication since doing so can greatly increase caregiver burden.
- A discussion followed that indicated that inadequate training of caregivers to deal with behaviours in seniors may increase the reliance on psychotropic medications. Perhaps if proper training were provided, medication withdrawal could be more successful.
- In a home setting, individual compliance with taking psychotropic medications can be low and requires caregiver support for reminders.

Causes of Falls and Injury in Seniors

- Many injurious falls occur around indoor stairs, and therefore the proper design of stairs and appropriate handrails (shape, diameter, and height) should be investigated.
- Injuries following falls from ladders frequently occur in seniors (largely due to cleaning of eavestroughs and windows). Ladders with hoops or services to clean eavestroughs and windows for seniors should be considered.
- Falls on sidewalks and road crossings are frequent, particularly in the winter. With the deteriorating condition of street clearing, this is becoming a larger issue.
- Fear of falling is another important cause of falls since it perpetuates a cycle of immobility, followed by deconditioning and falls.

Falls in the Winter

- In the winter, several factors reduce the likelihood that an elderly person will go outdoors:
  - Seniors are most likely to go out during daylight hours, which are fewer.
  - Fear of slipping on the ice and snow reduces the likelihood of an elderly person choosing to go outdoors unless it is absolutely necessary.
  - Poorly designed coats and boots make it difficult for seniors with difficulty moving or with lowered flexibility to dress for the outdoors.
- These factors can lead to lowered fitness levels, which in turn leads to an increased likelihood of falls both indoors and outdoors.
- Furthermore, in the colder months, people tend to walk faster when outdoors, which can increase the likelihood that an individual will fall.

Mobility Aids

- At both meetings, the issues of mobility aids was raised by experts on the panel. Regrettably it is very rare to find published trials investigating the effectiveness of mobility aids, and therefore it was not appropriate to include this as a section of this literature review. However, the panel felt that it was important to discuss these aids and their use in reducing falls and fall-related injuries in the elderly population, and that more work should be done to improve existing mobility devices.
- Mobility aids that were discussed as being effective included
  - wheeled walkers – while wheeled walkers can decrease the frequency of falls, the panel mentioned that walkers must be properly designed to ensure the best stability and that poorly designed walkers can actually increase the likelihood of falls.
  - handrails that are at an appropriate height, are cylindrical and are easy to see and grab
  - raised toilet seats to decrease falls that occur when sitting at and standing up from the toilet
  - grab bars, particularly in washrooms
- While mobility aids are an important tool to reduce falls in community-dwelling seniors, when renovations are not done to an appropriate standard, they can actually increase home hazards and risk of falling. Therefore, it was felt that elderly populations should be provided with access to affordable high-standard renovations.
- Emergency buttons that act as a lifeline after a fall were discussed. Because quick access to help can prevent long-term complications and disabilities, it was argued that these emergency buttons are highly effective in elderly populations, although it was suggested that uptake of the technology may be limited, based on reports that many people forget after a fall that they have access to these buttons.

Follow-Up to Comments Made by Expert Panel

Following the expert panel meeting, a literature search was performed to attempt to identify any literature surrounding the effectiveness of mobility devices. It was confirmed that there is very little evidence surrounding mobility devices in the published literature. One recent Canadian study was identified which described current fall-prevention interventions in seniors. (151) This paper described a handrail cueing system, balance-enhancing footwear inserts, and a modified walking aid. The results of these studies indicated that the balance-enhancing footwear inserts improved the ability to stabilize one's body and may reduce the number of falls, while more research is needed in an elderly population to determine whether an extended arched walker can increase stability in seniors. A study is currently underway to test the effectiveness of handrail cueing systems (both visual and combined visual and verbal cueing) on handrail use and reaching reactions.

In response to the discussion regarding the reasons for falls in the elderly population, the Medical Advisory Secretariat analyzed fall-related data for FY2006/07 on inpatient hospitalization of and emergency department use by elderly Ontarians. Hospitalizations with an external cause recorded as a fall were extracted for Ontarians aged 65 and over between April 1, 2006, and March 31, 2007. The resulting distribution of cause of falls appears in Table 25. This table indicates that mobility devices and furniture are frequently reported as the causes of falls in seniors going to the emergency department, and those admitted to hospital. Additionally, outdoor falls involving ice and snow, falls involving ladders, and falls involving stairs and steps explain 13.0% of hospitalizations for falls and 15.7% of emergency department visits for falls among Ontario's seniors.

Table 25: Distribution of the Cause of Falls in Hospitalizations for Elderly (Aged 65+) Ontarians (FY2006/2007)*

	ED Visits			Hospitalizations		
Type of Fall	**% of all falls**	**% of specified falls†**	**N‡**	**% of all falls**	**% of specified falls†**	**N‡**
Fall involving mobility devices						
Fall involving adult walker	1.55	2.13	1,410	2.10	2.88	518
Fall involving wheelchair	1.23	1.69	1,119	1.21	1.65	298
Fall involving other specified walking devices	0.09	0.12	79	0.13	0.17	31
Fall involving unspecified walking devices	0.01	0.02	12	–	–	≤5
Outdoor Fall						
Fall on same level involving ice and snow	3.69	5.08	3,359	2.72	3.73	671
Fall from tree	0.06	0.08	51	0.06	0.08	15
Fall from scaffolding	0.04	0.05	32	0.03	0.04	8
Fall involving playground equipment	0.01	0.01	9	–	–	≤5
Fall involving furniture						
Fall involving bed	3.87	5.32	3,520	5.00	6.85	1,233
Fall involving chair	2.08	2.86	1,892	2.09	2.86	515
Fall involving other furniture	0.59	0.81	537	0.52	0.71	128
Fall involving baby walker	–	–	≤5	–	–	≤5
Other Falls						
Fall on the same level from slip, trip, or stumble	32.44	44.66	29,540	32.72	44.81	8,070
Unspecified fall	27.36	N/A	24,907	26.99	N/A	6,658
Other fall on same level	13.31	18.32	12,118	14.85	20.35	3,664
Fall on and from stairs and steps	10.19	14.02	9,276	8.78	12.02	2,165
Fall on and from ladder	1.81	2.49	1,647	1.51	2.07	372
Other fall from one level to another	1.47	2.02	1,335	0.99	1.35	244
Fall out of/through building structure	0.22	0.31	203	0.29	0.39	71

*ED indicated emergency department; N, number.

†Excludes "Unspecified fall" from denominator

‡To maintain privacy, all cell sizes of 5 or less are suppressed

Source: The Ministry of Health and Long-Term Care, Provincial Health Planning Database

Conclusions

1. High-quality evidence indicates that long-term exercise programs in mobile seniors and environmental modifications in the homes of frail elderly persons will effectively reduce falls and possibly fall-related injuries in Ontario's elderly population.
2. A combination of vitamin D and calcium supplementation in elderly women will help reduce the risk of falls by more than 40%.
3. The use of outdoor gait-stabilizing devices for mobile seniors during the winter in Ontario may reduce falls and fall-related injuries; however, evidence is limited and more research is required in this area.
4. While psychotropic medication withdrawal may be an effective method for reducing falls, evidence is limited and long-term compliance has been demonstrated to be difficult to achieve.
5. A multifactorial intervention, including a combination of fall prevention interventions such as exercise, medication withdrawal, environmental modifications, vision and hearing interventions may reduce the risk of falls in high-risk populations. However, the quality of the evidence in this area is low, and included interventions are varied. Therefore more research is needed into the most appropriate and effective multifactorial intervention design.

Appendices

Appendix 1: Search Strategies

Search date: October 2, 2007
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, INAHTA/NHS EED

Database: Ovid MEDLINE(R) <1996 to September Week 3 2007>
Search Strategy:
---

1 exp Accidental Falls/pc [Prevention & Control] (2140)
2 exp Accidental Falls/ (6124)
3 exp Accident Prevention/ or exp Primary Prevention/ or exp risk reduction behavior/ or exp Preventive Health Services/ or exp Preventive Medicine/ (172856)
4 2 and 3 (718)
5 (fall$ adj4 prevent$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (1416)
6 1 or 4 or 5 (2961)
7 limit 6 to (humans and english language and yr="2000 - 2007") (1906)
8 limit 7 to "all aged (65 and over)" (1259)
9 (elder$ or senior$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (71440)
10 7 and (8 or 9) (1292)
11 limit 10 to (controlled clinical trial or meta analysis or randomized controlled trial) (200)
12 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (54569)
13 exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (326025)
14 exp Double-Blind Method/ (48004)
15 exp Control Groups/ (493)
16 exp Placebos/ (8371)
17 RCT.mp. (1998)
18 or/11-17 (366985)
19 10 and 18 (296)

Database: EMBASE <1980 to 2007 Week 39>
Search Strategy:
---

1 exp Falling/pc [Prevention] (2)
2 exp Falling/ (9062)
3 exp prevention/ or exp Preventive Health Service/ or exp Preventive Medicine/ or exp Risk Reduction/ (456395)
4 2 and 3 (1568)
5 (fall$ adj4 prevent$).mp. [mp=title, abstract, subject headings, heading word, drug trade name,

original title, device manufacturer, drug manufacturer name] (2198)
6 1 or 4 or 5 (2963)
7 limit 6 to (human and english language and yr="2000 - 2008") (1351)
8 limit 7 to aged <65+ years> (661)
9 (senior$ or elder$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (115074)
10 8 or 9 (115397)
11 7 and 10 (797)
12 Randomized Controlled Trial/ (149282)
13 exp Randomization/ (24000)
14 exp RANDOM SAMPLE/ (792)
15 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).ti,mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (76601)
16 Double Blind Procedure/ (66657)
17 exp Triple Blind Procedure/ (8)
18 exp Control Group/ (1007)
19 exp PLACEBO/ (104532)
20 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (386635)
21 or/12-20 (511379)
22 11 and 21 (238)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to September Week 4 2007>
Search Strategy:
---
1 exp Accidental Falls/pc [Prevention and Control] (2193)
2 exp Accidental Falls/ (4650)
3 exp "FALL PREVENTION (IOWA NIC)"/ (1)
4 exp Preventive Health Care/ (73373)
5 exp SAFETY/ (37546)
6 or/3-5 (109313)
7 2 and 6 (972)
8 1 or 7 (2510)
9 (fall$ adj4 prevent$).mp. [mp=title, subject heading word, abstract, instrumentation] (1057)
10 8 or 9 (2776)
11 limit 10 to (english and yr="2000 - 2007") (1916)
12 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (60536)
13 RCT.mp. (736)
14 exp Meta Analysis/ (5696)
15 exp "Systematic Review"/ (3320)
16 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (19960)
17 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (11524)
18 exp PLACEBOS/ (3799)
19 or/12-18 (78869)
20 11 and 19 (222)

Appendix 2: GRADE Score for the Body of Evidence

Number of Studies	Study Design	Quality of Studies	Consistency	Directness	Other Modifying Factors
N	RCT=High Observational =Low Any other evidence =Very Low	Serious limitation to study quality (−1) Very serious limitation to study quality (−2)	Important inconsistency (−1)	Some uncertainty about directness (−1) Major uncertainty about directness (−2)	Association strong (+1) Association very strong (+2) Dose response gradient (+1) All plausible confounders would have reduced the effect (+1) Imprecise or sparse data (−1) High probability of reporting bias (−1)

Source: Atkins D et al. Grading quality of evidence and strength of recommendations. BMJ 2004;328(7454):1490. (46)

Appendix 3: Study Characteristics

Exercise Interventions – Summary of Evidence*

Study	Population	Intervention and Referent Group	Intensity (No. Times/Week)	Targeted or Untargeted	Follow-Up	Outcomes Measured	Results
Gillespie: Cochrane Review (2003) (44)	• Elderly • RCTs • Community-dwelling	Exercise alone vs. control	Varied	1. Untargeted 2. Targeted (strength, balance, training) 3. Targeted (strength)	Varied	Number of falls	Meta-analysis results: 1. RR, 0.89 (0.79–1.01) 2. RR, 0.80 (0.66–0.98) 3. RR, 0.92 (0.73–1.16)
				1. Individually targeted	Varied	Number sustaining injury fall	Meta-analysis results: 1. RR, 0.67 (0.51–0.89)
				1. Untargeted 2. Targeted	Varied	Number sustaining 2 or more falls	Meta-analysis results: 1. RR, 0.78 (0.52–1.18) 2. RR, 0.76 (0.54–1.05)
Barnett (2003) (152)	• Aged 65+ • High risk	Exercise (balance, coordination, strength, tai chi) vs. control	37 classes over 1 year 1 h	Untargeted, Group and Home	12 months	Falls, fear of falling, fall injuries	No difference in fear of falling at 6 months Falls: • IRR, 0.60 (0.36–0.99) • ≥1 fall RR, 0.71 (0.49–1.04) • ≥2 fall RR, 0.44 (0.21–0.96) Fall injuries – no difference: • IRR, 0.66 (0.38–1.15) • ≥1 fall RR, 0.77 (0.48–1.21) • ≥2 fall RR, 0.58 (0.22–1.52)
Day (2002)† (153)	• Aged 70+	Strength and balance (n=135) vs. control (n=137)	1x/week for 15 weeks 1 h Daily home exercises	Untargeted, group and home	18 months	Number of falls	• RR, 0.82 (0.70–0.97) • % reduction in annual fall rate: 6.9 (1.1–12.8)
Freiberger (2007) (154)	• Aged 70+	Psychomotor intervention vs. fitness intervention (strength, endurance, flexibility) vs. control	2x/week for 16 weeks 1 h Practice at home daily	Untargeted, Group and home (unsupervised)	12 months	Number falls, fallers, multiple fallers	Fitness Intervention: • No. of fallers: RR, 0.77 (0.60–0.97) • Multiple fallers and number falls: RR, not significant Psychomotor intervention: • No outcomes significant Time to first fall: • Psychomotor: 281 ± 16 days

Study	Population	Intervention and Referent Group	Intensity (No. Times/Week)	Targeted or Untargeted	Follow-Up	Outcomes Measured	Results
							• Fitness: 337 ± 9 days • Control: 216 ± 15 days
Hauer (2001) (155)	• Women • Aged 75–90 • High risk • Past fall • Recruited from rehab ward	Resistance and balance training vs. placebo activity (flexibility, calisthenics, ball games, memory tasks)	3 days/week for 12 weeks 1.5 h resistance 45 min balance	Untargeted, Group	6 months	falls	• No difference: • RR, 0.75 (0.46–1.25)
Helbostad (2004) (156)	• Aged 75+ • High risk (fall or use of walking aid)	Home-based (HT) exercise vs. group exercise (CT)	HT: Daily home exercises + 3 group meetings CT: 2x/wk for 12 weeks (1hr) + same home exercises as HT group daily	Targeted vs. untargeted, Group vs. home	1 year	Number of falls	• No significant difference in number of falls (*P* = .78)
Latham (2003) (157)	• Frail • Mean age 79	Quadriceps exercise program (home) vs. regular home and telephone support	3/week for 10 weeks	Targeted, Home	10-week intervention plus 6-month follow-up	Falls, time to first fall	Falls outcome: • RR, 0.96 (0.67–1.36) Time to first fall: • HR, 0.97 (0.68–1.37)
Li (2005) (158)	• Aged 70+ • Inactive	Tai chi intervention vs. stretching control	3x/week for 6 months (both intervention and control)	Untargeted, Group	After intervention, and 6 months postintervention	Number of falls, injurious falls, fear of falling	After intervention • RR moderate injurious falls, 0.31 (0.12–0.84) • RR severe falls, 0.28 (0.09–0.86) • Significant increase in time to first fall (*P* = .007) • HR falls, 0.46 (0.26–0.80), *P* = .006 • HR multiple falls, 0.45 (0.30–0.70), *P* < .001 • Fear of falling significantly reduced (*P* = .05) • Improvements maintained during the postintervention follow-up
Luukinen (2006) (159)	• Aged 85+ • High risk (recurrent falls or other risk factor)	Individual exercise plan (could be home or group-based) based on risk factors (low-intensity) vs. control (no exercise plan)	Varied	Targeted, group, and home depending on assessment	Median 16 months' intervention	Falls	Entire group: • HR for first 4 falls and for all falls, not significant Subgroup: able to move outdoors: • HR first 4 falls, 0.72 (0.59–0.88)

Study	Population	Intervention and Referent Group	Intensity (No. Times/Week)	Targeted or Untargeted	Follow-Up	Outcomes Measured	Results
							• HR all falls, 0.83 (0.69–1.00)
Means (2005) (160)	• Mean aged 73.5 years	Balance training (stretching, postural control, endurance) vs. control (attended seminars on non-health-related topics)	1x/week 6 weeks	Untargeted, Group (6–8 people)	6 months post-intervention	Falls, fall-related injuries	• Pre/post analysis: • Exercise group had fewer falls and fall-related injuries (*P* = .002 and .034). • No difference in control group pre/post
Robertson (2001)† (161)	• Aged 75+	Exercise program vs. control	Exercise at least 3x/week, walk 2x/week; 30 min For 1 year	Targeted, home	1 year	Number of falls, number injuries from falls	• IRR for fall, 0.54 (0.32–0.90), *P* = .019 • RR serious injury due to fall (control vs. intervention), 4.6 (1.0–20.7), *P* = .033 • Age stratification: • 80+: significant fall reduction, *P* < .001 • 75–79: no significant reduction
Rubenstein (2000) †(162)	• Men • Aged 70+ • High risk	Exercise (strength, endurance and balance) vs. control	3x/week for 12 weeks 1.5 h	Untargeted, group	12 weeks	Falls, self-rated health	• Higher self-rated global health (*P* = .005) • 6 falls/1000 h of activity vs. 16.2 falls/1000 h of activity, *P* = .027
Skelton (2005) (163)	• Women • Aged 65+ • High risk (≥3 falls in past year)	Falls management exercise (group and home) vs. regular home exercises	36 weeks of class Group: 1/week for 1 h Home: 2/week for 30 minutes	Targeted, Group, and Home (unsupervised)	36-wk intervention plus mean 49.7-wk follow-up	Falls, injurious falls, died/LTC home/hospital	• Whole trial period: IRR, 0.69 (0.50–0.96), *P* = .029 • Follow-up only (after intervention completed: IRR, 0.46 (0.34–0.63) • No difference for injurious falls (possibly due to lack of power) • Significant difference in # deaths or LTC home admission or hospital admission: *P* = .017
Suzuki (2004) (100)	• Women • Aged 73–90 • Participants in Tokyo Metropolitan Institute of Gerontology Longitudinal Interdisciplina	Exercise (tai chi, strength, balance, resistance) vs. control	Group: 1 h every 2 weeks for 6 months Home: 3/wk for ~30 minutes	Untargeted, Group and Home (unsupervised)	8 and 20 months	falls	• Proportion with fall: 54.5% in controls vs. 13.6% in intervention group, *P* < .05 at 20-month follow-up • No difference at 8-month follow-up

Study	Population	Intervention and Referent Group	Intensity (No. Times/Week)	Targeted or Untargeted	Follow-Up	Outcomes Measured	Results
	ry Study on Aging						
Voukelatos (2007) (164)	• Aged 60+ • Recruited in community	Tai chi vs. control	1 time/week for 16 weeks 1 hour	Untargeted, Group	4 and 6 months	Falls, ≥1 fall, ≥2 falls	• IRR # falls, 0.67, *P* = .02 • HR ≥1 fall, 0.66, *P* = .02 • HR ≥2 falls, 0.27, *P* = .001
Weerdesteyn (2006) (111)	• Aged 65+ • High risk (history of falls)	Nijmegen Falls Prevention Program: low-intensity exercise vs. control	2x/week for 5 weeks 1.5 h	Untargeted, Group	Unclear	Falls	• IRR fall incidence rate, 0.54 (0.34–0.86) • IRR number falls, 1.26 (0.60–2.64) *note: not completely randomized
Woo (2007) (165)	• Aged 65–74 • Recruited in community	1) Tai chi 2) Resistance exercise 3) Control	3 times/week for 12 months	Untargeted, Group	6 and 12 months	Falls	• No difference

*HR refers to hazard ratio; IRR, incidence rate ratio; RCT, randomized controlled trial; RR, relative risk.
†Also identified in Cochrane review

Vision Interventions – Summary of Evidence*

Study	Population	Intervention	Follow-Up	Outcomes Measured	Results
Cumming (2007) (166)	• Aged 70+ • No cataract surgery or new eyeglass prescription in previous 3 months	• Intervention (N=309) vs. control (N=307) • Vision tests and eye examinations by optometrist • New eyeglasses dispensed if required • If ocular pathology requiring treatment, referred to ophthalmologist or public hospital eye clinic • If substantial impairment, referred to OT for home modifications/assistive devices	12 months	Falls, fallers, multiple fallers, fractures	• Falls: RR, 1.35 (1.18–1.55) • Fallers: RR, 1.54 (1.25–1.91) • Multiple fallers: RR, 1.24 (0.99–1.54) • Fractures: RR, 1.74 (0.97–3.11) not blinded
Day (2002) (167)	• Aged 70+ • Healthy	• Vision improvement: assessed at baseline using dual visual acuity chart • Referred to eye care provider, GP or local optometrist where needed	18 months	Number of fallers	• Fallers: RR, 0.95 (0.79–1.14)
Foss (2006) (168)	• Aged 70+ • Women • Following one successful cataract operation with second operable cataract • About half patients recruited from Harwood (2005) trial	• Expedited surgery (N=120) vs. routine surgery (N=119) • Small incision cataract surgery and implantation of a folding silicone intraocular lens under local anaesthetic.	12 months	Falls, ADLs, QoL, Rate of falling	• No statistically significant results • First fall: HR, 1.06 (0.69–1.61) • Multiple fallers: HR, 0.85 (0.49–1.56) • Rate of falling: Rate ratio, 0.68 (0.39–1.19)
Harwood (2005) (169)	• Aged 70+ • Women • With cataracts with no previous ocular surgery, who were suitable for surgery	• Expedited surgery (N=154) vs. routine surgery (N=152) • Small incision cataract surgery and implantation of a folding silicone intraocular lens under local anaesthetic.	12 months	Falls, ADLs, QoL, Rate of falling	• Any falls: HR, 0.95 (0.69–1.35) • Multiple fallers: HR, 0.60 (0.36–0.98) • Rate of falling: Rate ratio, 0.66 (0.45–0.96) • Improvement in QoL measured using Euroqol (*P* = .02)

* ADLs refers to activities of daily living; GP, general practitioner; HR, hazard ratio; OT, occupational therapist; QoL, quality of life; RR, relative risk.

Environmental Modifications: Summary of Evidence*

Study	Population	Intervention and Referent Group (N)	Number of Visits and Description of Intervention	Personnel (e.g., Nurse, OT)	Follow-Up	Outcomes Measured	Results
Gillespie: Cochrane Review (2003) (44)	• Elderly • RCTs • Community-dwelling Fallers in year prior (n=3 studies) No falls in year prior (n=1) Fallers and non-fallers in year prior (n=3)	Home safety intervention alone vs. control	• Varied	Varied	Varied	Number of people falling	Results from meta-analysis: Fallers in year prior RR: 0.66 (0.54–0.81) No falls in year prior, RR: 1.03 (0.75–1.41) Fallers and non-fallers in year prior RR: 0.85 (0.74–0.96)
Day (2002) †(170)	• Aged 70+	Home hazard intervention (n=135) vs. no intervention (n=137)	• One assessment visit, and one by home maintenance staff if labour and materials were required • Modifications included hand rails, modifications to floor coverings, contrast edging, and stair/ramp maintenance	Trained assessor	18 months	Number of falls, number of home hazards	• RR, 0.92 (0.78–1.08), *P* = .29 • % estimated reduction in annual fall rate, 3.1 (−2.0 to 9.7)
Nikolaus (2003)† (58)	• Mean age 81 • Recruited as inpatients in geriatric clinic	Home intervention team (N=140) vs. control (N=139)	• One home visit while inpatient to evaluate home and prescribe technical aids • After discharge, at least 1 more visit to inform patient of risks, give advice for modifications, facilitate modifications	Nurse, physiotherapist, occupational therapist, social worker	1 year	Death or nursing home placement, number of falls	• IRR falls, 0.69 (0.51–0.97), *P* = .032 • IRR falls in intervention group with at least 1 modification after 12 months, 0.64 (0.37–0.99, *P* = .047) • IRR falls in intervention group with no modification after 12 months, not significant • No difference between no. died vs. no. moved to LTC home
Pardessus (2002)† (171)	• Aged 65+ • Recruited after fall hospitalization	Home visit to assess environmental modifications (N=30) vs. control (N=30)	• Single home visit during hospitalization to assess home hazards and remove any with patient consent • Hospital social worker contacted to assess problems that were encountered	Physical medicine and rehabilitation doctor, ergotherapist and hospital social worker	Every month for 6 months, and at 12 months	Fall, hospital admission, LTC home admission, death	• No significant difference in recurring fall, number of recurring falls, LTC home admission or rehospitalization. • 40% controls rehospitalized, 23% cases. • May be a power problem because of small sample size

* IRR refers to incidence rate ratio; no., number; OT, occupational therapist; RCT, randomized controlled trial; RR, relative risk;
†Also identified in Cochrane review

Nutritional Supplementation: Summary of Evidence*

Study	Population	Intervention, dose	Follow-Up	Outcomes measured	Results
Gillespie: Cochrane Review (2003) (44)	• Elderly • RCTs • Community-dwelling	Vitamin D vs. control (2 studies)	Varied	Fallers, mean number of falls	Results from meta-analysis 1. Fallers: RR, 0.90 (0.71–1.13) 2. Mean falls: mean difference, 0.10 (−0.71 to 0.91)
Gillespie (2003): Cochrane Review	• Elderly • RCTs • Community-dwelling	Psychotropic medication withdrawal (1 study – Campbell 1999)	44 weeks	Fallers	1. Fallers: HR, 0.34 (0.16–0.74) 2. Note that one month after completion of study, 47% of medication withdrawal group had restarted taking psychotropic medication
Barr (2005) (172)	• Women • Aged 70+	• Intervention (screening + vitamin D/calcium) (N=726) vs. controls (N=1625) • In intervention group, screened for increased risk of hip fracture: broadband ultrasound attenuation (BUA) in lowest quartile of manufacturer normal range and/or presence of 2 or more clinical risk factors for hip fracture • Those with high risk were prescribed calcium and vitamin D supplement	1 to 3 years (median follow-up 28.9 months)	Fallers, number of people sustaining a fracture	1. Proportion of fallers in active group lower (25.3%) than in control group (29.7%), but not significant 2. Fracture: OR, 0.54 (0.33–0.87)
Bischoff (2006) (76)	• Aged 65+	• Intervention (vitamin D + calcium) (N=219) vs. placebo (N=226) • Intervention: cholecalciferol (vitamin D3; 700 IU/day) + calcium citrate malate (500 mg/day)	3 years	Faller (stratified by gender)	1. Total sample: OR, 0.77 (0.51–1.15) 2. Men: OR, 0.93 (0.50–1.72) 3. Women: OR, 0.54 (0.30–0.97)
Dhesi (2004) (173)	• Aged 65+ • At least 1 fall in last 8 weeks	• Intervention (N=70) vs. placebo (N=69) • Intervention included a single intramuscular injection of 600,000 IU of ergocalciferol (vitamin D) • Control: equivalent volume (2ml) of normal saline	6 months	Fallers, falls	1. No difference in mean number of falls (0.39 vs. 0.24, *P* = .28) 2. No difference in number of fallers (14 vs. 11, *P* = .52)
Dukas (2004) (174)	• Aged 70+	• Intervention (N=191) vs placebo (N=187) • Intervention received 1-µg capsules of alfacalcidol (vitamin D)	36 weeks	Fallers	1. Overall: OR, 0.69 (0.41–1.16) 2. Post-hoc subgroup of <512 mg and >512 mg daily calcium intake: <512 mg: OR, 1.00 (0.47–2.11) >512 mg: OR, 0.45 (0.21–0.97)

Greenspan (2005) (175)	• Women • Aged 65+	• HRT (N=187) vs. placebo (N=186) Intervention (HRT): • Women with hysterectomy given conjugated equine estrogen (0.625 mg/day) • Remaining women received conjugated equine estrogen 0.625 mg/day) and medroxyprogesterone (2.5 mg/day)	3 years	Falls	1. No difference in people who fell (50% intervention group vs. 51% in control), *P* = .92
Latham (2003) (176)	• Frail • Mean age 79	• Intervention (vitamin D) (N=108) vs. placebo (N=114) • Intervention: single oral dose of 6 1.25-mg calciferol (300,000 IU) or matching placebo tablets	6 months	Falls, time to first fall	Falls Outcome: • RR, 1.12 (0.79–1.59) Time to first fall: HR, 1.14 (0.80–1.62)
Porthouse (2005) (177)	• Women • Aged 70+ • At least one self-reported risk factor for fracture (low weight, previous fracture, maternal history of hip fracture, smoker, poor/fair health)	• Intervention (N=1321) vs. leaflet-only control (N=1993) • Intervention: nurse advice on reducing risk of fracture, 1000 mg calcium, 800 IU of vitamin D_3, leaflet • Control: leaflet only	Median follow-up 25 months	All fractures, hip fractures, falls, fear of falling	1. All fractures: OR, 1.01 (0.71–1.43) 2. Hip Fractures: OR, 0.75 (0.31–1.78) 3. Falls: OR, 0.98 (0.79–1.20)

* HR refers to hazard ratio; HRT, hormone replacement therapy; OR, odds ratio; RCT, randomized controlled trial; RR, relative risk.

Devices: Summary of Evidence*

Study	Device	Population	Intervention	Follow-Up	Outcomes Measured	Results
McKiernan (2005) (80)	Gait-stabilizing device (Yaktrax Walker®)	• Aged 65+ • Fall-prone people • Independently ambulatory	• Yaktrax Walker® (N=55) vs. usual winter footwear (N=54)	Winter 2003/2004: 10,724 observation-days	Number indoor and outdoor slip falls and injurious falls	• Footwear assignment did not influence indoor slip and fall rates All days: • outdoor slips: RR, 0.50 (P < .04) • outdoor falls: RR, 0.45 (P < .02) • non-serious injurious fall: RR, 0.10 (P < .02) Days walked on snow/ice: • outdoor slips: RR, 0.61 (P = .14) • outdoor falls: RR, 0.42 (P < .03) • non-serious injurious fall: RR, 0.13 (P < .02) • non-serious injurious fall: NNP, 6 outdoor fall: NNP, 3 outdoor slip: NNP, 1
Birks (2003) (82)	Hip protector (Safehip®)	• Aged 70+ • Had one previous hip fracture	• Intervention group given 3 pairs of hip protectors and general advice on fracture reduction (N=139) vs. controls who received advice (N=140)	Median follow-up 14 months	Number of second hip fractures, number falls, fear of falling, compliance	▪ Hip protector vs. control: OR, 3.5 (0.68–17.97) ▪ No difference in number of falls or fear of falling ▪ Low compliance (34%)

*RR refers to relative risk; NNP, number needed to prevent; OR, odds ratio

Multifactorial Interventions: Summary of Evidence*

Study	Population	Intervention	Follow-Up, Number Contacts During Follow-Up	Outcomes Measured	Results
Gillespie: Cochrane Review (2003) (44)	• Elderly • RCTs • Community-dwelling	o Assessment plus multifactorial intervention – all elderly (n=4) o Assessment plus multifactorial intervention – high-risk populations/previous fallers (n=5)	Varied	Number fallers, number injurious falls, number fractures	All Elderly ▪ Fallers: RR, 0.73 (0.63–0.85) Injurious Fall: RR, 0.68 (0.51–0.93) High-risk Population ▪ Fallers: RR, 0.86 (0.76–0.98) Injurious Fall: RR, 0.93 (0.61–1.44)
Clemson (2004) (178)	• Aged 70+ • Fall in previous year or concern about falling	• Intervention (N=157) vs. control (N=153) Intervention: "Stepping On" • Small group learning environment • OT and content experts introduced areas of balance and strength exercises, coping with visual loss, regular visual screening, medication management, environmental and behavioral home safety, community safety.	• Seven 2-hour group sessions • One home visit by OT • 1 booster session 3 months after session 7 (1.5 h) • 14-month follow-up	Falls, falls efficacy scale (fear of falling), worry scale	• Significant reduction in all falls: RR, 0.69 (0.50–0.96) • Subgroup analyses showed effect in men (RR, 0.32, 95% CI, 0.17–0.59), persons aged ≥75 (RR, 0.62, 95% CI, 0.43–0.89), and persons with history of falls (RR, 0.66, 95% CI, 0.46–0.95)
Davison (2005) (179)	• Aged 65+ • Recruited at ED for fall or fall-related injury • Had 1 additional fall in preceding year	• Intervention (N=159) vs. control (N=154) • Hospital based medical assessment, home-based PT and OT assessment (medication, vision) • Assessment of carotid sinus hypersensitivity and vasovagal hypersensitivity • Gait and balance, assistive devices, environmental hazard assessment	• 1 year	Number of falls, number who fell, injury rates, hospital admission, mortality, fear of falling	• Falls: RR, 0.64, 95% CI, 0.46–0.90 • Fallers: RR, 0.95, 95% CI, 0.81–1.12 • Fracture: RR, 0.53, 95% CI, 0.20–1.39 • No difference in number of ED visits, hospital admissions due to fall, or mortality • Duration of hospital admission significantly less for intervention group: mean difference, 3.6 (0.1–7.6)

Huang (2005) (180)	• Aged 65+ • Hospitalized for hip fracture • Discharged to community	• Intervention (N=63) vs. control (N=59) • Intervention provided by master's-prepared gerontological nurse • First visit within 48 hours of admission • One home visit 3–7 days after discharge • Available by phone 7 days/week • Telephone contact 1/week • Brochures with information regarding medication and environment, nurse care and education, proper use of assistive devices, management of needed resources (including home care and assessment for rehabilitation facility)	• Hospital admission to 3 months after discharge	Length of initial hospital stay, rate of readmission to hospital, rate of repeat falls, rate of survival, QoL	• Hospitalized LOS (initial): significantly shorter (*P* = .002) • Time to next readmission shorter in intervention group (*P* = .02) • Survival time longer in intervention group (*P* = .04) • No difference in the number repeat falls • Mean QoL score significantly higher in intervention group (*P* < .05)
Lord (2005) (83)	• Aged 75+ • Stratified analysis by risk	• Extensive intervention (N=210) and minimal intervention (N=206) vs. control (N=204) Extensive Intervention Group (EIG): • Assessment, followed by counseling session where recommendations explained • Group exercises and individualized exercises, vision, peripheral sensation counseling Minimal intervention Group (MIG): • Provided with instruction sheets for home exercises, brief training sessions to teach exercises, list of group exercise programs near house, written advice on vision and precautions for loss of peripheral sensation Control group (CG): • No intervention	• 12 months	Falls, injurious falls	• No significant difference between EIG and CG and between MIG and CG EIG vs. CG • Fallers: RR, 1.03 (0.83–1.27) • Injuries: RR, 1.19 (0.92–1.54) MIG vs. CG • Fallers: RR, 1.08 (0.88–1.34) • Injuries: RR, 1.11 (0.85–1.46)
Mahoney (2007) (181)	• Aged 65+ • 2 falls in previous year, or 1 fall in previous 2 years with injury, or 1 fall in previous 2 years with gait or balance problems	• Intervention (N=174) vs. control (N=175) Controls: • home safety recommendations and advice to see doctor regarding falls Intervention • 2 home visits plus 11 monthly telephone calls • Link participants to existing medical care and service networks: e.g., home care, ophthalmology, podiatry • Could have included assessment of: medications, vision, balance and gait, cognition, mood, functional status, home hazard evaluation • Interventions include acquisition of assistive devices, exercise and medication review	• 1 year: 2 home visits followed by 11 monthly telephone calls	Accidental fall rate (denominator excluded any days in hospital or LTC home), all-cause hospitalization, LTC home admission, days in LTC home	• No significant difference in any outcomes for overall group: Falls: RR, 0.81 (0.57–1.17), *P* = .27 Hosp: RR, 1.05, *P* = .82) LTC: RR, 0.72 (0.38–1.35) Subgroup analyses • ≥2 falls in year prior: LTC admission rate: RR, 0.44 (0.21–0.91), *P* = .03 • 1 fall in year prior with gait or balance issues: hospitalization rate: RR, 4.02; *P* = .04 • 1 fall in year prior with injury: hospitalization rate: RR, 1.52; *P* = 0.30

Rubenstein (2007) (182)	• Aged 65+ • Veterans	• Intervention (N=380) vs. control (N=412) Phone assessment resulting in • Referral to geriatric assessment clinic (included physical exam, mental health, social and environmental status, and urinary incontinence evaluation and falls/gait impairment evaluation if necessary) • Home-based primary care program for homebound individuals • Primary care provider and other services • Individuals were followed up with after 1 month, and again every 3 months for next 3 years.	• 3 years • Phone contact every 3 months • Initial assessment requiring initial phone interview and sometimes geriatric assessment	Falls, UI, mental health, hospital and nursing home admission	• No significant differences in any target conditions between intervention and control groups at 1, 2, or 3 years follow-up • Hospital utilization didn't differ significantly between groups at 3 years' follow-up.
Tinetti (1994) (183)	• Aged 70+	• Targeted intervention based on measured risk factors (N=153) vs. control (N=148) • Interventions available include: behavioural recommendations for postural hypotension, medication review and withdrawal, environmental modifications, gait training, assistive devices, and exercise	• 1 year • Monthly contact for 6 months	Falls, serious injuries	• Adjusted incidence rate-ratio for falling: 0.69 (0.52–0.90)
Whitehead (2003) (93)	• Aged 65+ • Lived in community or low-care residential care (e.g., hostel) • Fall-related ED visit	• Intervention (N=70) vs. control (N=70) Intervention: • Fall risk profile determined from questionnaire • Potential interventions included medication review and withdrawal, environmental modifications, exercise, osteoporosis assessment	• 6 months • Monthly contact	Falls, uptake of interventions	• No significant reduction in fall incidence: OR, 1.7 (0.7–4.4) • 86% of intervention group had taken up a preventive strategy during follow-up compared with 48% of the control group
Sjosten (2007) (184) *In progress*	• Aged 65+ (stratified 65–74, 75+) • Fallen at least once in past year	• Intensive preventive programme (N=293) vs. counseling group (N=298) • Tailored intervention according to risk factors, functional abilities and health status	12 months	Fall incidence, injurious falls	• In progress
Elley (2007) (99) *In progress*	• Aged 75+ • Fallen in past year	• Intervention (≥155) vs. Control (≥157) Control Group: • Printed information on falls prevention and 2 social visits Intervention Group • Medical and home hazards assessment and referral • Otago exercise program for 1 year • 5 home visits	12 months	Fall incidence, self-efficacy (fear of falling) level of physical activity, ADLs	• In progress

Hendriks (2005) (185) *In progress*	• Aged 65+ • Visited hospital for fall	• Intervention (N=166) vs. control (N=167) • Examination by geriatrician, geriatric nurse and rehabilitation physician: comprehensive general examination, vision, mobility, balance, medication review • OT assesses home environment and recommends adaptations, assistive devices, home care and behavioural change	Maximum intervention of 3.5 months 1 year follow-up	Falls, recurrent falls (2 or more), injurious falls, QoL	• In progress (contacted and article has been submitted for publication)
Peeters (2007) (96) *In progress*	• Aged 65+ • Recently experienced a fall	• Intervention (N=100) vs. control (N=100) • Multifactorial risk assessment: general medical and drug history, fall and mobility history, physical examination, postural hypotension, visual impairment, parkinsonism, osteoporosis, gait disorders, psychotropic and cardiac drug use, environmental hazards • Treatment can consist of withdrawal of psychotropic drugs, balance and strength exercises (PT), home hazard reduction (OT), referral to ophthalmologist or cardiologist	12 months 2 home visits, with measurements taken at 3, 6, 9, and 12 months	Number of falls, time to first fall, QoL, ADLs	• In progress (follow-up completed in July 2008)

* ADLs refers to activities of daily living; CG, control group; CI, confidence interval; ED, emergency department; EIG, extensive intervention group; LTC, long-term care; LOS, length of stay; MIG, minimal intervention group; OR, odds ratio; OT, occupational therapist; PT, physical therapist; QoL, quality of life; RCT, randomized controlled trial; RR, relative risk; UI, urinary incontinence.

Appendix 4: Forest Plots

Figure 1: Evidence Surrounding the Risk of Falls After an Exercise Program

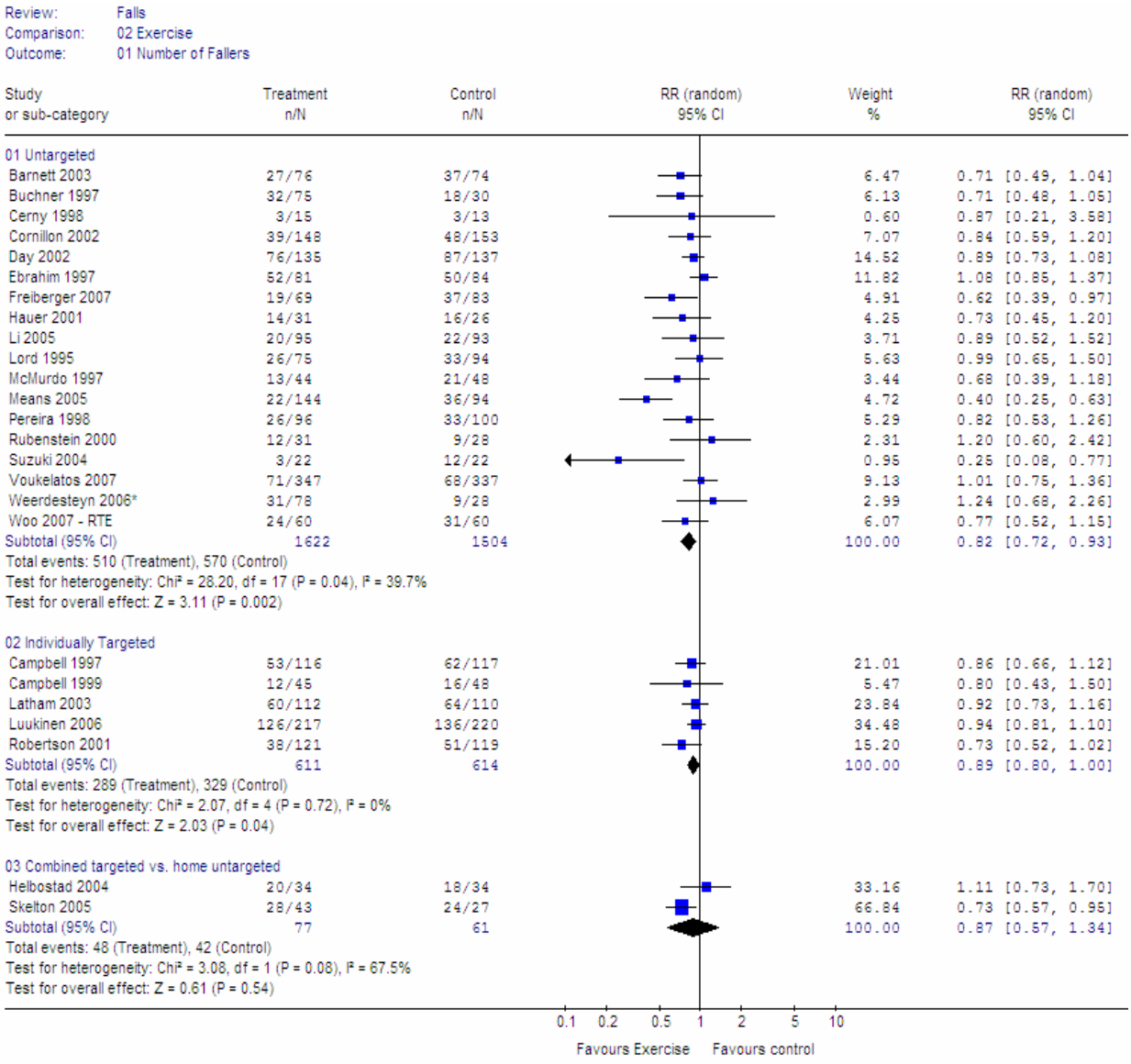


Figure 2: Evidence Surrounding the Risk of Falls After an Exercise Program: High-Risk Population

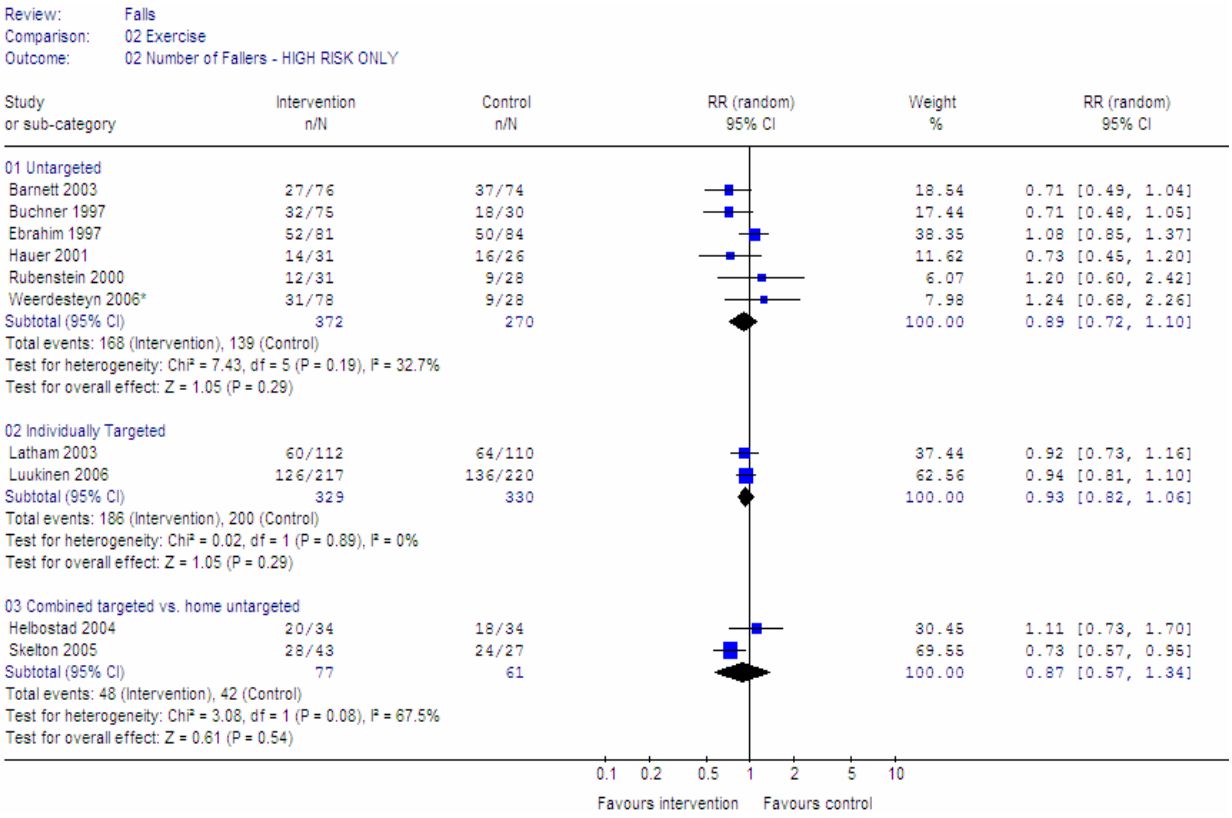


Figure 3: Evidence Surrounding the Risk of Falls After an Exercise Program: General Population

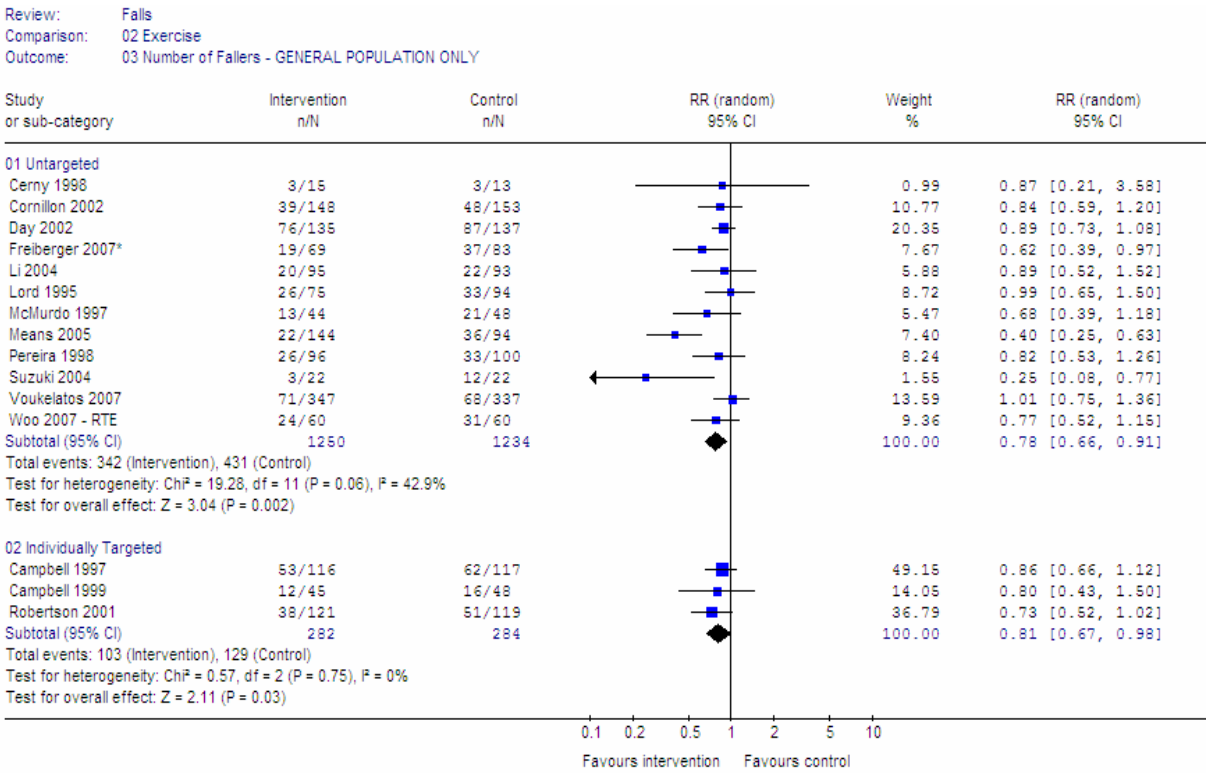


Figure 4: Evidence Surrounding the Risk of Fall-Related Injuries After an Exercise Program: General Population

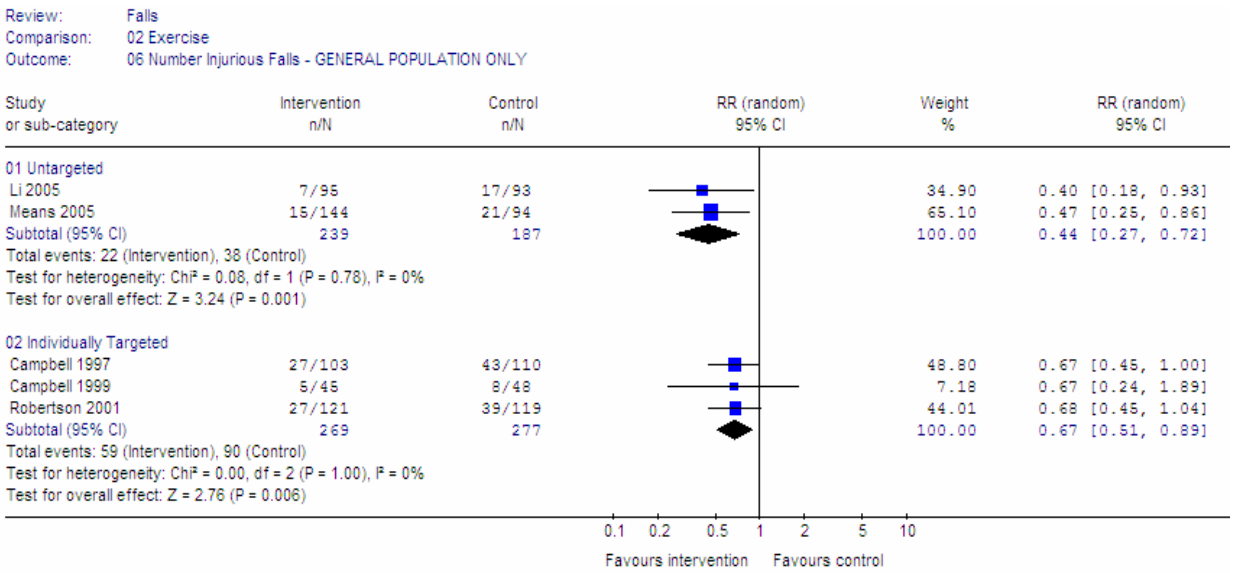


Figure 5: Evidence Surrounding the Risk of Falls After an Exercise Program: Short Intervention (<6 months)

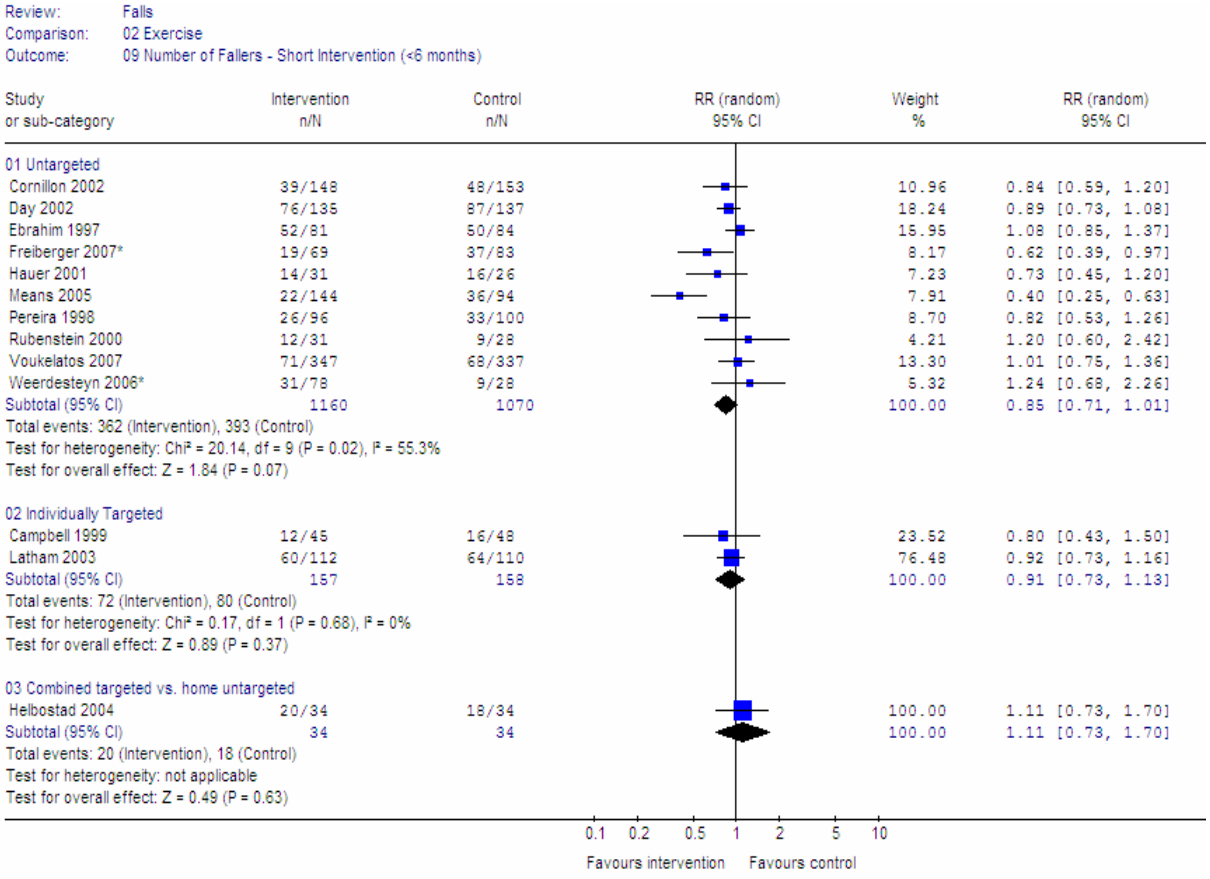


Figure 6: Evidence Surrounding the Risk of Falls After an Exercise Program: Long Intervention (≥6 months)

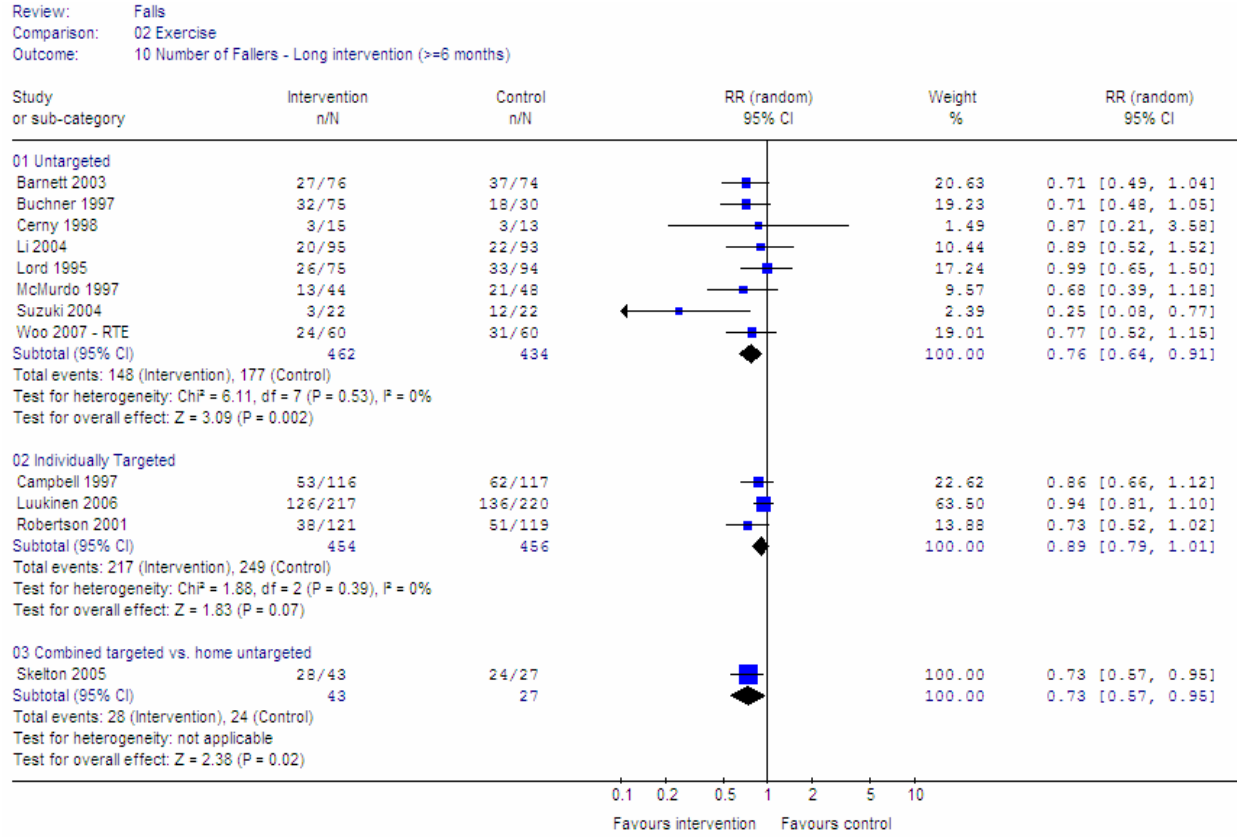


Figure 7: Evidence Surrounding the Risk of Fall-Related Injuries After an Exercise Program: Long Intervention (≥6 months)

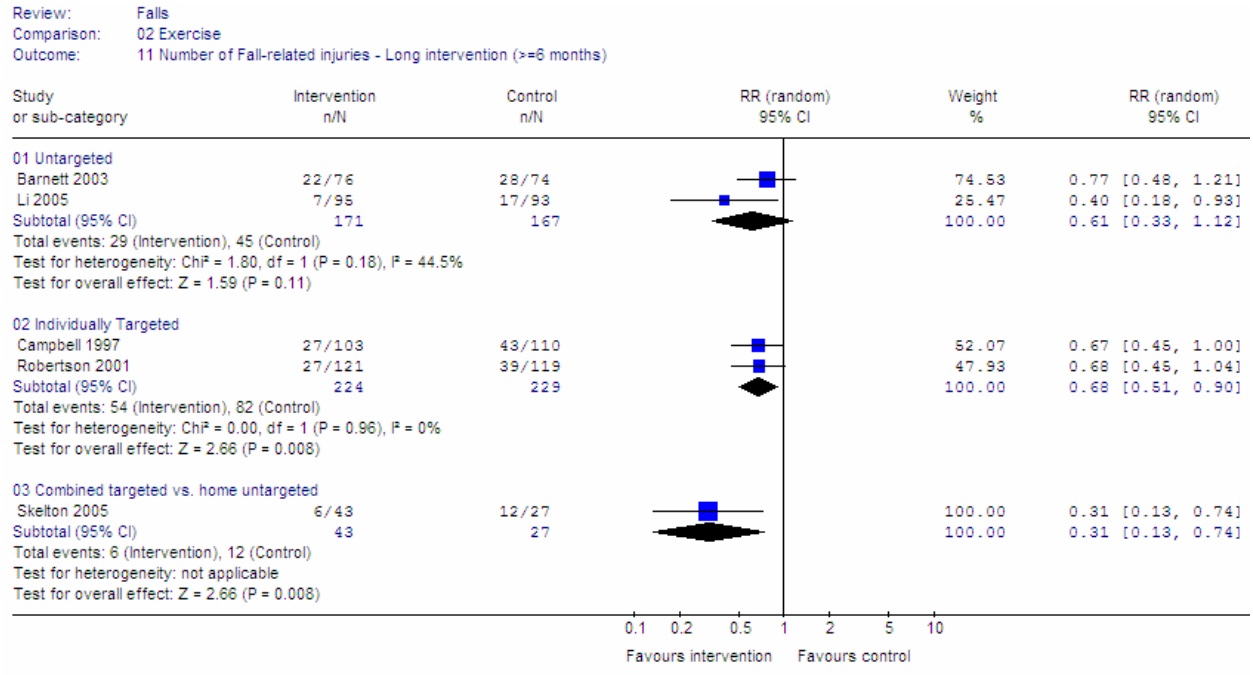


Figure 8: Evidence Surrounding the Risk of Falls After Vision Interventions

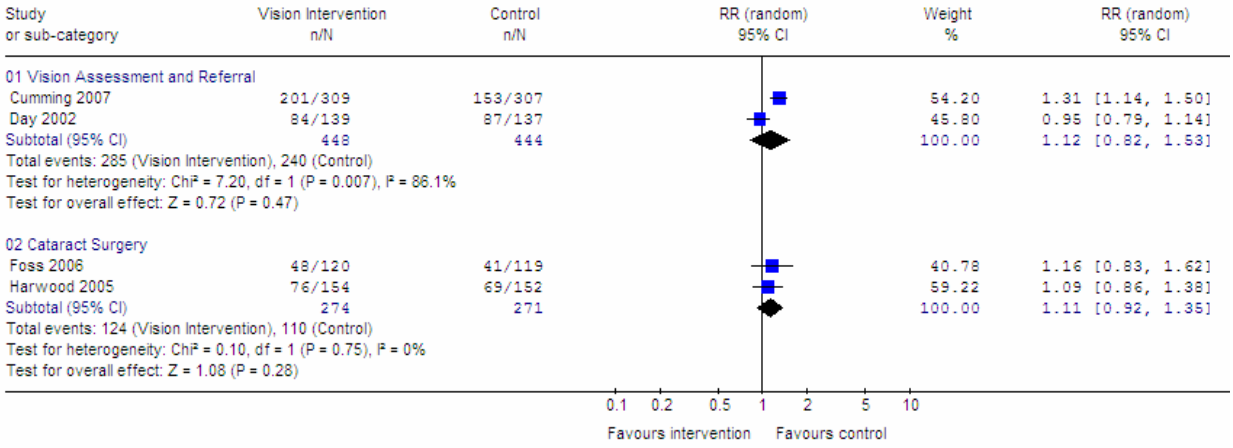


Figure 9: Evidence Surrounding the Risk of Falls After Environmental Modifications

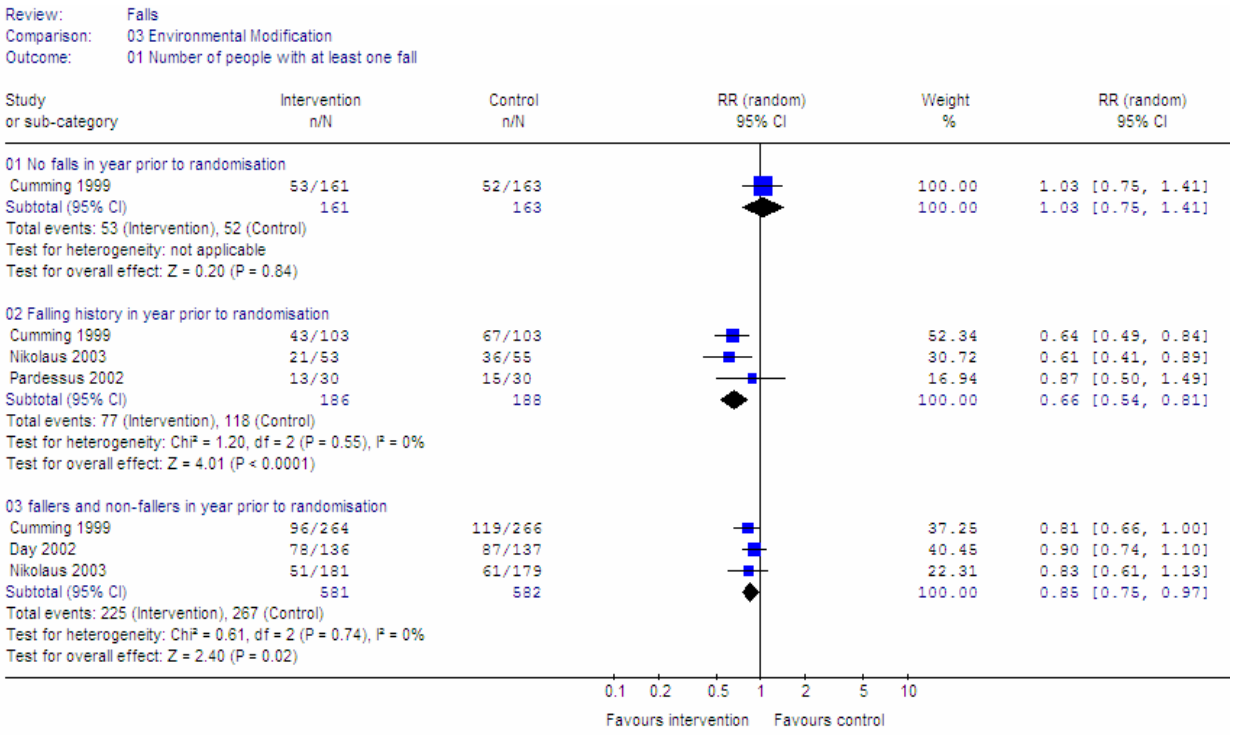


Figure 10: Evidence Surrounding the Risk of Falls After Vitamin D Supplementation

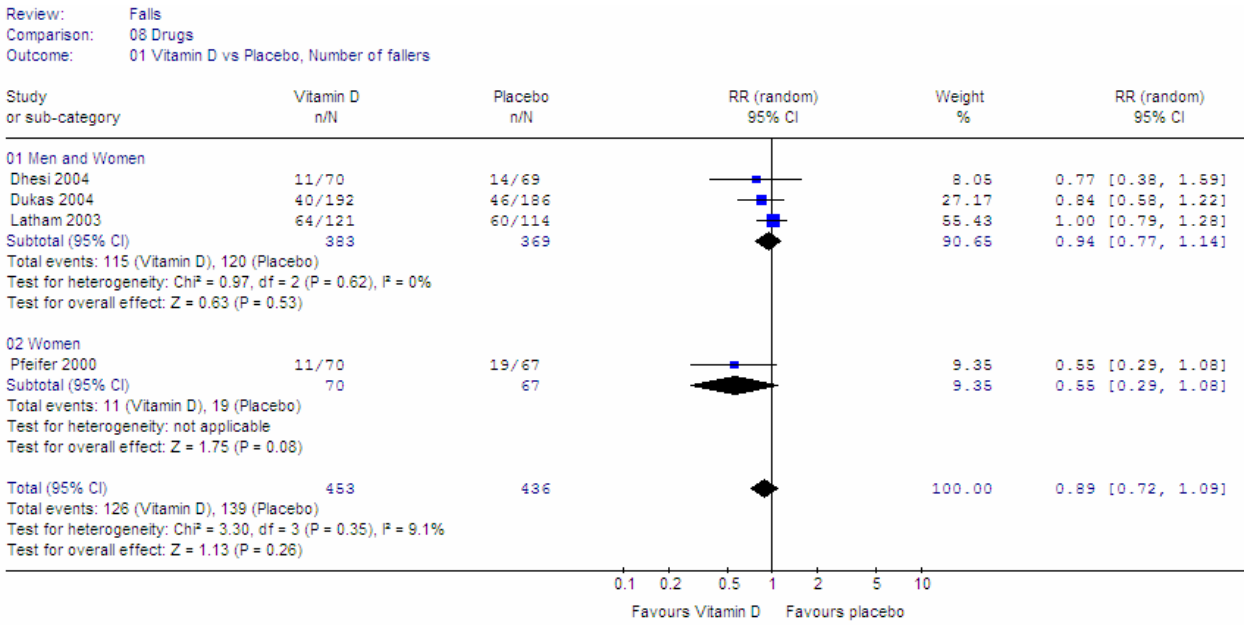


Figure 11: Evidence Surrounding the Risk of Falls After Vitamin D and Calcium Supplementation

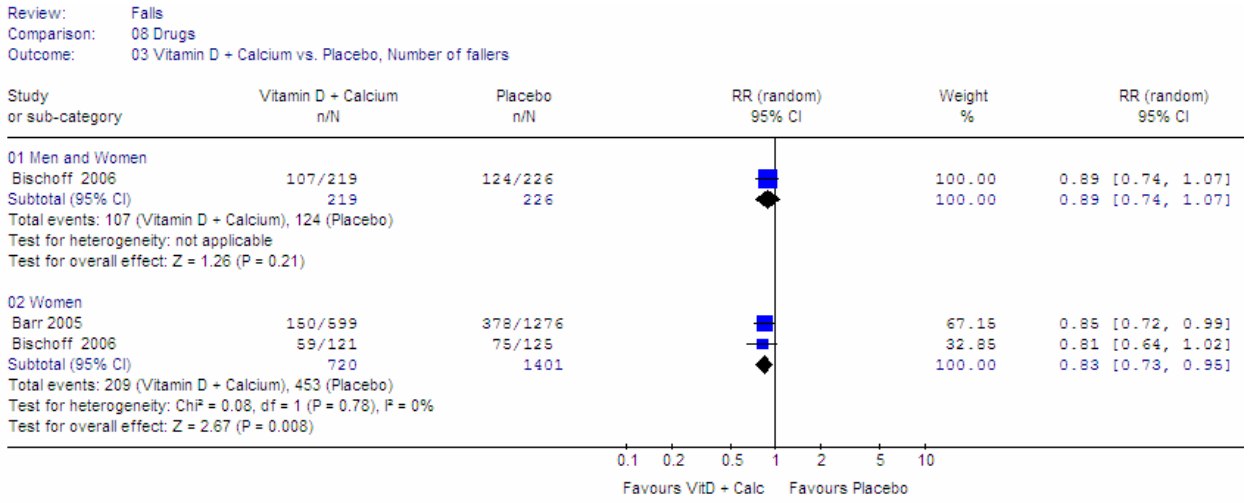


Figure 12: Evidence Surrounding the Risk of Fall-Related Fractures After Vitamin D and Calcium Supplementation

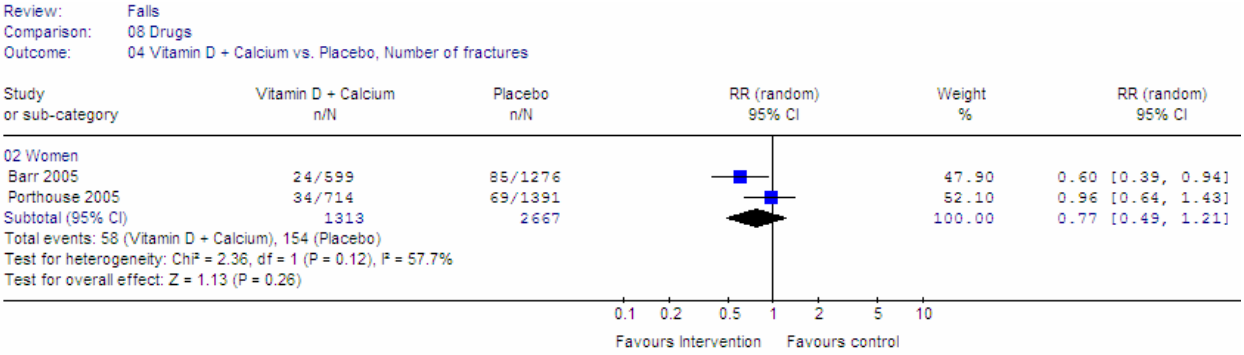


Figure 13: Evidence Surrounding the Risk of Falls After Hormone Replacement Therapy

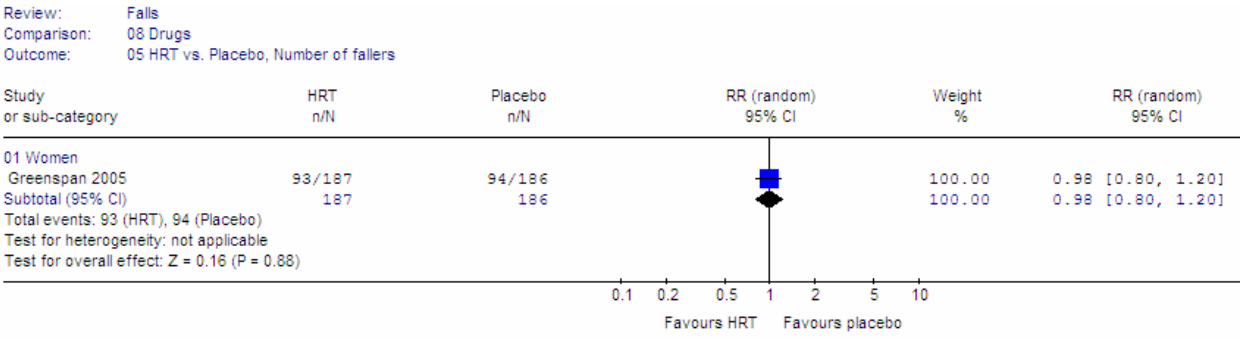


Figure 14: Evidence Surrounding the Risk of Falls After Multifactorial Interventions (Excluding Study by Whitehead et al. (93))

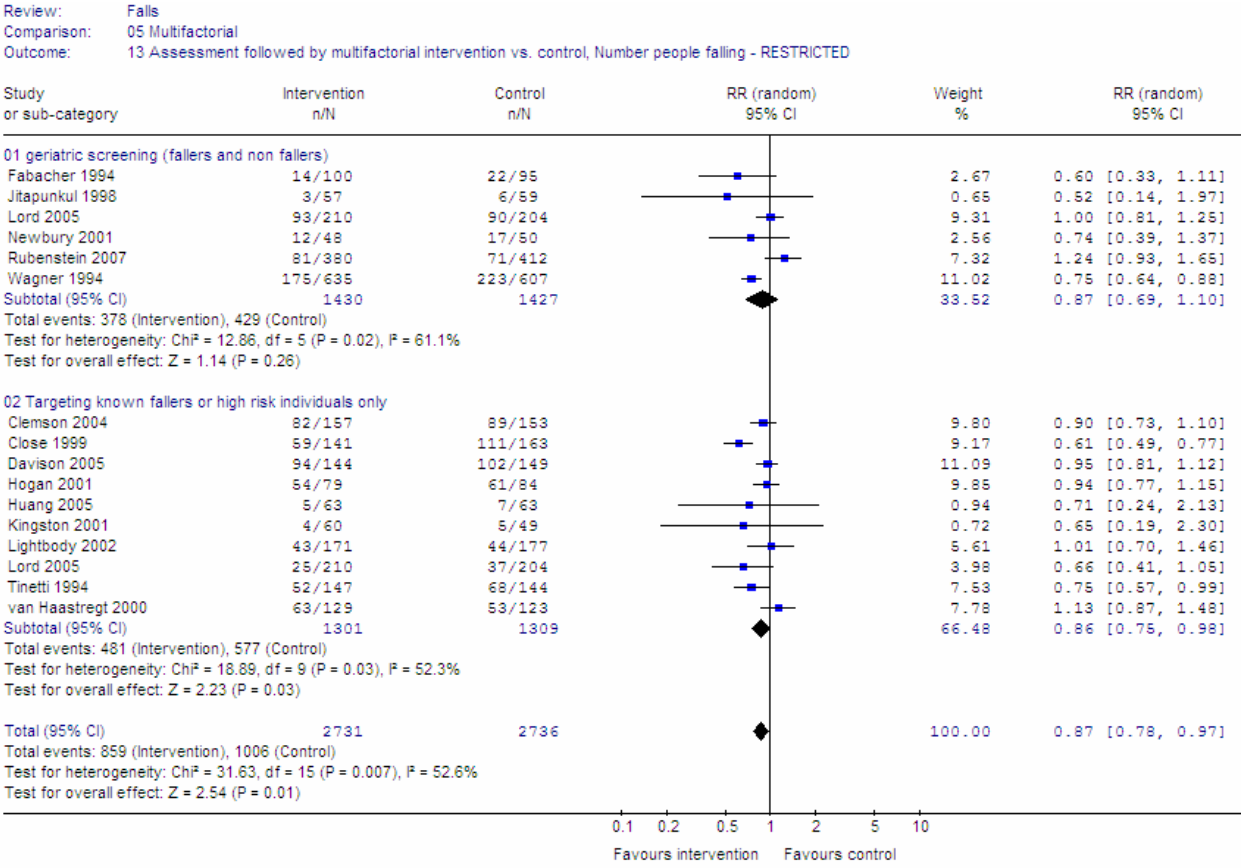
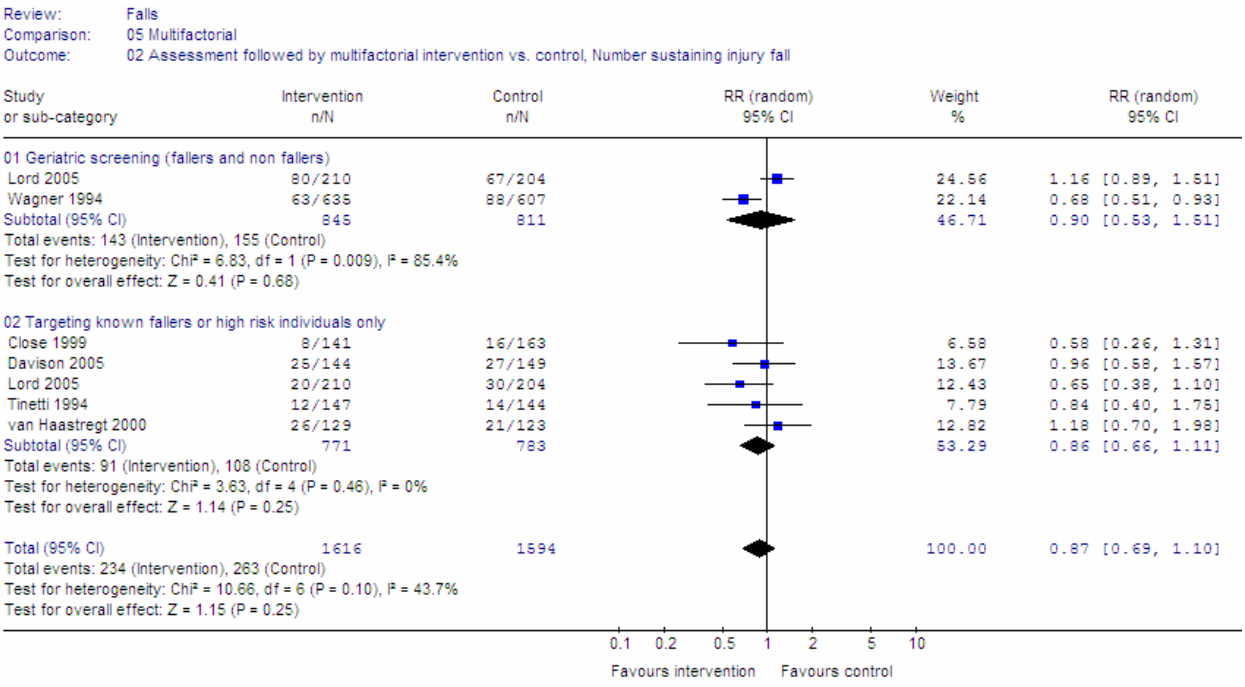


Figure 15: Evidence Surrounding the Risk of Fall-Related Injuries After Multifactorial Interventions



References

(1) Lamb SE, Jorstad-Stein EC, Hauer K, Becker C. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. J Am Geriatr Soc 2005; 53(9):1618-22.

(2) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(3) Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988; 319(26):1701-7.

(4) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(5) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(6) Stalenhoef PA, Crebolder H, Knottnerus JA, van der Horst F. Incidence, risk factors and consequences of falls among elderly subjects living in the community. Eur J Public Health 1997; 7(3):328-34.

(7) Yasumura S, Haga H, Niino N. Circumstances of injurious falls leading to medical care among elderly people living in a rural community. Arch Gerontol Geriatr 1996; 23(2):95-109.

(8) Campbell AJ, Spears GF, Borrie MJ. Examination by logistic regression modelling of the variables which increase the relative risk of elderly women falling compared to elderly men. J Clin Epidemiol 1990; 43(12):1415-20.

(9) Bélanger A, Martel L, Malenfant C. Population projections for Canada, provinces, and territories [Internet]. Ottawa: Statistics Canada; [updated 2005; cited 2008 Aug 1]. Available from: http://www.statcan.ca/english/freepub/91-520-XIE/0010591-520-XIE.pdf

(10) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(11) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(12) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(13) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(14) Macpherson AK, Schull M, Cernat G, Redelmeier DA, Laupacis A. Injuries in Ontario. ICES atlas [Internet]. Toronto: Institute for Clinical Evaluative Sciences; [updated 2005; cited Available from:

http://www.ices.on.ca/webpage.cfm?site_id=1&org_id=31&morg_id=0&gsec_id=0&item_id=3053

(15) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(16) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(17) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(18) Gaugler JE, Duval S, Anderson KA, Kane RL. Predicting nursing home admission in the U.S: a meta-analysis. BMC Geriatr 2007; 7:13.

(19) Hauer K, Lamb SE, Jorstad EC, Todd C, Becker C. Systematic review of definitions and methods of measuring falls in randomised controlled fall prevention trials. Age Ageing 2006; 35(1):5-10.

(20) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(21) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(22) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(23) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(24) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(25) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(26) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(27) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(28) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(29) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention.

Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(30) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(31) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(32) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(33) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(34) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(35) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(36) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(37) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(38) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(39) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(40) Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis: II. Cardiac and analgesic drugs. J Am Geriatr Soc 1999; 47(1):40-50.

(41) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(42) Tinetti ME, Speechley M. Prevention of falls among the elderly. N Engl J Med 1989; 320(16):1055-9.

(43) Report on seniors' falls in Canada. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(44) Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions

for preventing falls in elderly people. Cochrane Database of Systematic Reviews 2003; Issue 4. Art. No.: CD000340. DOI: 10.1002/14651858.CD000340.

(45) Goodman C. Literature searching and evidence interpretation for assessing health care practices. Stockholm, Sweden: The Swedish Council on Technology Assessment in Health Care; 1993

(46) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490.

(47) Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons: effects of a rehabilitation exercise program. Am J Phys Med Rehabil 2005; 84(4):238-50.

(48) Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000; 55(6):M317-M321.

(49) Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons: effects of a rehabilitation exercise program. Am J Phys Med Rehabil 2005; 84(4):238-50.

(50) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(51) Cumming RG, Ivers R, Clemson L, Cullen J, Hayes MF, Tanzer M et al. Improving vision to prevent falls in frail older people: a randomized trial. J Am Geriatr Soc 2007; 55(2):175-81.

(52) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(53) Cumming RG, Ivers R, Clemson L, Cullen J, Hayes MF, Tanzer M et al. Improving vision to prevent falls in frail older people: a randomized trial. J Am Geriatr Soc 2007; 55(2):175-81.

(54) Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomised controlled trial. Age Ageing 2006; 35(1):66-71.

(55) Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. Br J Opthalmol 2005; 89(1):53-9.

(56) Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. Br J Opthalmol 2005; 89(1):53-9.

(57) Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomised controlled trial. Age Ageing 2006; 35(1):66-71.

(58) Nikolaus T, Bach M. Preventing falls in community-dwelling frail older people using a home

intervention team (HIT): results from the randomized Falls-HIT trial. J Am Geriatr Soc 2003; 51(3):300-5.

(59) Pardessus V, Puisieux F, Di Pompeo C, Gaudefroy C, Thevenon A, Dewailly P. Benefits of home visits for falls and autonomy in the elderly: a randomized trial study. Am J Phys Med Rehabil 2002; 81(4):247-52.

(60) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(61) Cumming RG, Thomas M, Szonyi G, Salkeld G, O'Neill E, Westbury C et al. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. J Am Geriatr Soc 1999; 47(12):1397-402.

(62) Cumming RG, Thomas M, Szonyi G, Salkeld G, O'Neill E, Westbury C et al. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. J Am Geriatr Soc 1999; 47(12):1397-402.

(63) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(64) Pardessus V, Puisieux F, Di Pompeo C, Gaudefroy C, Thevenon A, Dewailly P. Benefits of home visits for falls and autonomy in the elderly: a randomized trial study. Am J Phys Med Rehabil 2002; 81(4):247-52.

(65) Cumming RG, Thomas M, Szonyi G, Salkeld G, O'Neill E, Westbury C et al. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. J Am Geriatr Soc 1999; 47(12):1397-402.

(66) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(67) Trivedi DP, Doll R, Khaw KT. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. BMJ 2003; 326(7387):469.

(68) Reid IR. Therapy of osteoporosis: calcium, vitamin D, and exercise. Am J Med Sci 1996; 312(6):278-86.

(69) Mowe M, Haug E, Bohmer T. Low serum calcidiol concentration in older adults with reduced muscular function. J Am Geriatr Soc 1999; 47(2):220-6.

(70) Bischoff HA, Stahelin HB, Urscheler N, Ehrsam R, Vonthein R, Perrig-Chiello P et al. Muscle strength in the elderly: its relation to vitamin D metabolites. Arch Phys Med Rehabil 1999; 80(1):54-8.

(71) Dhesi JK, Jackson SH, Bearne LM, Moniz C, Hurley MV, Swift CG et al. Vitamin D supplementation improves neuromuscular function in older people who fall. Age Ageing 2004; 33(6):589-95.

(72) Latham NK, Anderson CS, Lee A, Bennett DA, Moseley A, Cameron ID et al. A randomized,

controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Interventions Trial in Elderly Subjects (FITNESS). J Am Geriatr Soc 2003; 51(3):291-9.

(73) Dukas L, Bischoff HA, Lindpaintner LS, Schacht E, Birkner-Binder D, Damm TN et al. Alfacalcidol reduces the number of fallers in a community-dwelling elderly population with a minimum calcium intake of more than 500 mg daily. J Am Geriatr Soc 2004; 52(2):230-6.

(74) Pfeifer M, Begerow B, Minne HW, Abrams C, Nachtigall D, Hansen C. Effects of a short-term vitamin D and calcium supplementation on body sway and secondary hyperparathyroidism in elderly women. J Bone Miner Res 2000; 15(6):1113-8.

(75) Lanham-New SA. Importance of calcium, vitamin D and vitamin K for osteoporosis prevention and treatment. Proc Nutr Soc 2008; 67(2):163-76.

(76) Bischoff-Ferrari HA, Orav EJ, Dawson-Hughes B. Effect of cholecalciferol plus calcium on falling in ambulatory older men and women: a 3-year randomized controlled trial. Arch Intern Med 2006; 166(4):424-30.

(77) Barr RJ, Stewart A, Torgerson DJ, Seymour DG, Reid DM. Screening elderly women for risk of future fractures--participation rates and impact on incidence of falls and fractures. Calcif Tissue Int 2005; 76(4):243-8.

(78) Greenspan SL, Resnick NM, Parker RA. The effect of hormone replacement on physical performance in community-dwelling elderly women. Am J Med 2005; 118(11):1232-9.

(79) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(80) McKiernan FE. A simple gait-stabilizing device reduces outdoor falls and nonserious injurious falls in fall-prone older people during the winter. J Am Geriatr Soc 2005; 53(6):943-7.

(81) Yaktrax [Internet]. 2006 [cited 2008 May 12]. Available from: www.yaktrax.com

(82) Birks YF, Hildreth R, Campbell P, Sharpe C, Torgerson DJ, Watt I. Randomised controlled trial of hip protectors for the prevention of second hip fractures. Age Ageing 2003; 32(4):442-4.

(83) Lord SR, Tiedemann A, Chapman K, Munro B, Murray SM, Gerontology M et al. The effect of an individualized fall prevention program on fall risk and falls in older people: a randomized, controlled trial. J Am Geriatr Soc 2005; 53(8):1296-304.

(84) Davison J, Bond J, Dawson P, Steen IN, Kenny RA. Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention--a randomised controlled trial. Age Ageing 2005; 34(2):162-8.

(85) Fabacher D, Josephson K, Pietruszka F, Linderborn K, Morley JE, Rubenstein LZ. An in-home preventive assessment program for independent older adults: a randomized controlled trial. J Am Geriatr Soc 1994; 42(6):630-8.

(86) Newbury J, Marley J. Preventive home visits to elderly people in the community. Visits are most useful for people aged >/= 75. BMJ 2000; 321(7259):512.

(87) Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999; 353(9147):93-7.

(88) Hogan DB, MacDonald FA, Betts J, Bricker S, Ebly EM, Delarue B et al. A randomized controlled trial of a community-based consultation service to prevent falls. CMAJ 2001; 165(5):537-43.

(89) Huang T, Liang S. A randomized clinical trial of the effectiveness of a discharge planning intervention in hospitalized elders with hip fracture due to falling. J Clin Nurs 2005; 14(10):1193-201.

(90) Kingston P, Jones M, Lally F, Crome P. Older people and falls: a randomized controlled trial of a health visitor (HV) intervention. Rev Clin Gerontol 2001; 11(3):209-14.

(91) Jitapunkul S. A randomised controlled trial of regular surveillance in Thai elderly using a simple questionnaire administered by non-professional personnel. J Med Assoc Thai 1998; 81(5):352-6.

(92) Rubenstein LZ, Alessi CA, Josephson KR, Trinidad HM, Harker JO, Pietruszka FM. A randomized trial of a screening, case finding, and referral system for older veterans in primary care. J Am Geriatr Soc 2007; 55(2):166-74.

(93) Whitehead C, Wundke R, Crotty M, Finucane P. Evidence-based clinical practice in falls prevention: a randomised controlled trial of a falls prevention service. Aust Health Rev 2003; 26(3):88-97.

(94) Mahoney JE, Shea TA, Przybelski R, Jaros L, Gangnon R, Cech S et al. Kenosha County falls prevention study: a randomized, controlled trial of an intermediate-intensity, community-based multifactorial falls intervention. J Am Geriatr Soc 2007; 55(4):489-98.

(95) Mahoney JE, Shea TA, Przybelski R, Jaros L, Gangnon R, Cech S et al. Kenosha County falls prevention study: a randomized, controlled trial of an intermediate-intensity, community-based multifactorial falls intervention. J Am Geriatr Soc 2007; 55(4):489-98.

(96) Peeters GM, de Vries OJ, Elders PJ, Pluijm SM, Bouter LM, Lips P. Prevention of fall incidents in patients with a high risk of falling: design of a randomised controlled trial with an economic evaluation of the effect of multidisciplinary transmural care. BMC Geriatr 2007; 7:15.

(97) Sjosten NM, Salonoja M, Piirtola M, Vahlberg T, Isoaho R, Hyttinen H et al. A multifactorial fall prevention programme in home-dwelling elderly people: a randomized-controlled trial. Public Health 2007; 121(4):308-18.

(98) Hendriks MR, van Haastregt JC, Diederiks JP, Evers SM, Crebolder HF, van Eijk JT. Effectiveness and cost-effectiveness of a multidisciplinary intervention programme to prevent new falls and functional decline among elderly persons at risk: design of a replicated randomised controlled trial [ISRCTN64716113]. BMC Public Health 2005; 5:6.

(99) Elley CR, Robertson MC, Kerse NM, Garrett S, McKinlay E, Lawton B et al. Falls Assessment Clinical Trial (FACT): design, interventions, recruitment strategies and participant characteristics. BMC Public Health 2007; 7(147):185.

(100) Suzuki T, Kim H, Yoshida H, Ishizaki T. Randomized controlled trial of exercise intervention for the prevention of falls in community-dwelling elderly Japanese women. J Bone Miner Metab 2004; 22(6):602-11.

(101) Buchner DM, Cress ME, de Lateur BJ, Esselman PC, Margherita AJ, Price R et al. The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. J Gerontol A Biol Sci Med Sci 1997; 52(4):M218-M224.

(102) Cerny K, Blanks R, Mohamed O, Schwab D, Robinson B, Russo A et al. The effect of a multidimensional exercise program on strength, range of motion, balance and gait in the well elderly. Gait Posture 1998; 7(2):185-6.

(103) McMurdo ME, Mole PA, Paterson CR. Controlled trial of weight bearing exercise in older women in relation to bone density and falls. BMJ 1997; 314(7080):569.

(104) Luukinen H, Lehtola S, Jokelainen J, Vaananen-Sainio R, Lotvonen S, Koistinen P. Pragmatic exercise-oriented prevention of falls among the elderly: a population-based, randomized, controlled trial. Prev Med 2007; 44(3):265-71.

(105) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997; 315(7115):1065-9.

(106) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997; 315(7115):1065-9.

(107) Cornillon E, Blanchon MA, Ramboatsisetraina P, Braize C, Beauchet O, Dubost V et al. [Effectiveness of falls prevention strategies for elderly subjects who live in the community with performance assessment of physical activities (before-after)]. Ann Readapt Med Phys 2002; 45(9):493-504.

(108) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(109) Ebrahim S, Thompson PW, Baskaran V, Evans K. Randomized placebo-controlled trial of brisk walking in the prevention of postmenopausal osteoporosis. Age Ageing 1997; 26(4):253-60.

(110) Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000; 55(6):M317-M321.

(111) Weerdesteyn V, Rijken H, Geurts AC, Smits-Engelsman BC, Mulder T, Duysens J. A five-week exercise program can reduce falls and improve obstacle avoidance in the elderly. Gerontology 2006; 52(3):131-41.

(112) Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons: effects of a rehabilitation exercise program. Am J Phys Med Rehabil 2005; 84(4):238-50.

(113) Cornillon E, Blanchon MA, Ramboatsisetraina P, Braize C, Beauchet O, Dubost V et al.

[Effectiveness of falls prevention strategies for elderly subjects who live in the community with performance assessment of physical activities (before-after)]. Ann Readapt Med Phys 2002; 45(9):493-504.

(114) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(115) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997; 315(7115):1065-9.

(116) Buchner DM, Cress ME, de Lateur BJ, Esselman PC, Margherita AJ, Price R et al. The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. J Gerontol A Biol Sci Med Sci 1997; 52(4):M218-M224.

(117) Ebrahim S, Thompson PW, Baskaran V, Evans K. Randomized placebo-controlled trial of brisk walking in the prevention of postmenopausal osteoporosis. Age Ageing 1997; 26(4):253-60.

(118) Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000; 55(6):M317-M321.

(119) Hauer K, Rost B, Rutschle K, Opitz H, Specht N, Bartsch P et al. Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls. J Am Geriatr Soc 2001; 49(1):10-20.

(120) Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000; 55(6):M317-M321.

(121) Barr RJ, Stewart A, Torgerson DJ, Seymour DG, Reid DM. Screening elderly women for risk of future fractures--participation rates and impact on incidence of falls and fractures. Calcif Tissue Int 2005; 76(4):243-8.

(122) Greenspan SL, Resnick NM, Parker RA. The effect of hormone replacement on physical performance in community-dwelling elderly women. Am J Med 2005; 118(11):1232-9.

(123) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(124) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(125) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(126) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls

prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(127) Cumming RG, Ivers R, Clemson L, Cullen J, Hayes MF, Tanzer M et al. Improving vision to prevent falls in frail older people: a randomized trial. J Am Geriatr Soc 2007; 55(2):175-81.

(128) Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. Br J Opthalmol 2005; 89(1):53-9.

(129) Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomised controlled trial. Age Ageing 2006; 35(1):66-71.

(130) Fabacher D, Josephson K, Pietruszka F, Linderborn K, Morley JE, Rubenstein LZ. An in-home preventive assessment program for independent older adults: a randomized controlled trial. J Am Geriatr Soc 1994; 42(6):630-8.

(131) Newbury J, Marley J. Preventive home visits to elderly people in the community. Visits are most useful for people aged >/= 75. BMJ 2000; 321(7259):512.

(132) Rubenstein LZ, Alessi CA, Josephson KR, Trinidad HM, Harker JO, Pietruszka FM. A randomized trial of a screening, case finding, and referral system for older veterans in primary care. J Am Geriatr Soc 2007; 55(2):166-74.

(133) Wagner EH, LaCroix AZ, Grothaus L, Leveille SG, Hecht JA, Artz K et al. Preventing disability and falls in older adults: a population-based randomized trial. Am J Public Health 1994; 84(11):1800-6.

(134) Fabacher D, Josephson K, Pietruszka F, Linderborn K, Morley JE, Rubenstein LZ. An in-home preventive assessment program for independent older adults: a randomized controlled trial. J Am Geriatr Soc 1994; 42(6):630-8.

(135) Jitapunkul S. A randomised controlled trial of regular surveillance in Thai elderly using a simple questionnaire administered by non-professional personnel. J Med Assoc Thai 1998; 81(5):352-6.

(136) Fabacher D, Josephson K, Pietruszka F, Linderborn K, Morley JE, Rubenstein LZ. An in-home preventive assessment program for independent older adults: a randomized controlled trial. J Am Geriatr Soc 1994; 42(6):630-8.

(137) Newbury J, Marley J. Preventive home visits to elderly people in the community. Visits are most useful for people aged >/= 75. BMJ 2000; 321(7259):512.

(138) Rubenstein LZ, Alessi CA, Josephson KR, Trinidad HM, Harker JO, Pietruszka FM. A randomized trial of a screening, case finding, and referral system for older veterans in primary care. J Am Geriatr Soc 2007; 55(2):166-74.

(139) Jitapunkul S. A randomised controlled trial of regular surveillance in Thai elderly using a simple questionnaire administered by non-professional personnel. J Med Assoc Thai 1998; 81(5):352-6.

(140) Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999; 353(9147):93-7.

(141) Huang T, Liang S. A randomized clinical trial of the effectiveness of a discharge planning intervention in hospitalized elders with hip fracture due to falling. J Clin Nurs 2005; 14(10):1193-201.

(142) Kingston P, Jones M, Lally F, Crome P. Older people and falls: a randomized controlled trial of a health visitor (HV) intervention. Rev Clin Gerontol 2001; 11(3):209-14.

(143) Lightbody E, Watkins C, Leathley M, Sharma A, Lye M. Evaluation of a nurse-led falls prevention programme versus usual care: a randomized controlled trial. Age Ageing 2002; 31(3):203-10.

(144) van Haastregt JC, Diederiks JP, van RE, de Witte LP, Voorhoeve PM, Crebolder HF. Effects of a programme of multifactorial home visits on falls and mobility impairments in elderly people at risk: randomised controlled trial. BMJ 2000; 321(7267):994-8.

(145) Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999; 353(9147):93-7.

(146) van Haastregt JC, Diederiks JP, van RE, de Witte LP, Voorhoeve PM, Crebolder HF. Effects of a programme of multifactorial home visits on falls and mobility impairments in elderly people at risk: randomised controlled trial. BMJ 2000; 321(7267):994-8.

(147) Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999; 353(9147):93-7.

(148) van Haastregt JC, Diederiks JP, van RE, de Witte LP, Voorhoeve PM, Crebolder HF. Effects of a programme of multifactorial home visits on falls and mobility impairments in elderly people at risk: randomised controlled trial. BMJ 2000; 321(7267):994-8.

(149) Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999; 353(9147):93-7.

(150) van Haastregt JC, Diederiks JP, van RE, de Witte LP, Voorhoeve PM, Crebolder HF. Effects of a programme of multifactorial home visits on falls and mobility impairments in elderly people at risk: randomised controlled trial. BMJ 2000; 321(7267):994-8.

(151) Maki BE, Cheng KC, Mansfield A, Scovil CY, Perry SD, Peters AL et al. Preventing falls in older adults: new interventions to promote more effective change-in-support balance reactions. J Electromyogr Kinesiol 2008; 18(2):243-54.

(152) Barnett A, Smith B, Lord SR, Williams M, Baumand A. Community-based group exercise improves balance and reduces falls in at-risk older people: a randomised controlled trial. Age Ageing 2003; 32(4):407-14.

(153) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(154) Freiberger E, Menz HB, Abu-Omar K, Rutten A. Preventing falls in physically active

community-dwelling older people: A comparison of two intervention techniques. Gerontology 2007; 53(5):298-305.

(155) Hauer K, Rost B, Rutschle K, Opitz H, Specht N, Bartsch P et al. Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls. J Am Geriatr Soc 2001; 49(1):10-20.

(156) Helbostad JL, Sletvold O, Moe-Nilssen R. Effects of home exercises and group training on functional abilities in home-dwelling older persons with mobility and balance problems. A randomized study. Aging Clin Exp Res 2004; 16(2):113-21.

(157) Latham NK, Anderson CS, Lee A, Bennett DA, Moseley A, Cameron ID et al. A randomized, controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Interventions Trial in Elderly Subjects (FITNESS). J Am Geriatr Soc 2003; 51(3):291-9.

(158) Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60(2):187-94.

(159) Luukinen H, Lehtola S, Jokelainen J, Vaananen-Sainio R, Lotvonen S, Koistinen P. Prevention of disability by exercise among the elderly: A population-based, randomized, controlled trial. Scand J Prim Health Care 2006; 24(4):199-205.

(160) Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons: effects of a rehabilitation exercise program. Am J Phys Med Rehabil 2005; 84(4):238-50.

(161) Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. BMJ 2001; 322(7288):697-701.

(162) Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000; 55(6):M317-M321.

(163) Skelton D, Dinan S, Campbell M, Rutherford O. Tailored group exercise (Falls Management Exercise--FaME) reduces falls in community-dwelling older frequent fallers (an RCT). Age Ageing 2005; 34(6):636-9.

(164) Voukelatos A, Cumming RG, Lord SR, Rissel C. A randomized, controlled trial of tai chi for the prevention of falls: the Central Sydney tai chi trial. J Am Geriatr Soc 2007; 55(8):1185-91.

(165) Woo J, Hong A, Lau E, Lynn H. A randomised controlled trial of Tai Chi and resistance exercise on bone health, muscle strength and balance in community-living elderly people. Age Ageing 2007; 36(3):262-8.

(166) Cumming RG, Ivers R, Clemson L, Cullen J, Hayes MF, Tanzer M et al. Improving vision to prevent falls in frail older people: a randomized trial. J Am Geriatr Soc 2007; 55(2):175-81.

(167) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(168) Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomised controlled trial. Age Ageing 2006; 35(1):66-71.

(169) Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. Br J Opthalmol 2005; 89(1):53-9.

(170) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325(7356):128-31.

(171) Pardessus V, Puisieux F, Di Pompeo C, Gaudefroy C, Thevenon A, Dewailly P. Benefits of home visits for falls and autonomy in the elderly: a randomized trial study. Am J Phys Med Rehabil 2002; 81(4):247-52.

(172) Barr RJ, Stewart A, Torgerson DJ, Seymour DG, Reid DM. Screening elderly women for risk of future fractures--participation rates and impact on incidence of falls and fractures. Calcif Tissue Int 2005; 76(4):243-8.

(173) Dhesi JK, Jackson SH, Bearne LM, Moniz C, Hurley MV, Swift CG et al. Vitamin D supplementation improves neuromuscular function in older people who fall. Age Ageing 2004; 33(6):589-95.

(174) Dukas L, Bischoff HA, Lindpaintner LS, Schacht E, Birkner-Binder D, Damm TN et al. Alfacalcidol reduces the number of fallers in a community-dwelling elderly population with a minimum calcium intake of more than 500 mg daily. J Am Geriatr Soc 2004; 52(2):230-6.

(175) Greenspan SL, Resnick NM, Parker RA. The effect of hormone replacement on physical performance in community-dwelling elderly women. Am J Med 2005; 118(11):1232-9.

(176) Latham NK, Anderson CS, Lee A, Bennett DA, Moseley A, Cameron ID et al. A randomized, controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Interventions Trial in Elderly Subjects (FITNESS). J Am Geriatr Soc 2003; 51(3):291-9.

(177) Porthouse J, Cockayne S, King C, Saxon L, Steele E, Aspray T et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. BMJ 2005; 330(7498):1003-6.

(178) Clemson L, Cumming RG, Kendig H, Swann M, Heard R, Taylor K. The effectiveness of a community-based program for reducing the incidence of falls in the elderly: a randomized trial. J Am Geriatr Soc 2004; 52(9):1487-94.

(179) Davison J, Bond J, Dawson P, Steen IN, Kenny RA. Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention--a randomised controlled trial. Age Ageing 2005; 34(2):162-8.

(180) Huang T, Liang S. A randomized clinical trial of the effectiveness of a discharge planning intervention in hospitalized elders with hip fracture due to falling. J Clin Nurs 2005; 14(10):1193-201.

(181) Mahoney JE, Shea TA, Przybelski R, Jaros L, Gangnon R, Cech S et al. Kenosha County falls

prevention study: a randomized, controlled trial of an intermediate-intensity, community-based multifactorial falls intervention. J Am Geriatr Soc 2007; 55(4):489-98.

(182) Rubenstein LZ, Alessi CA, Josephson KR, Trinidad HM, Harker JO, Pietruszka FM. A randomized trial of a screening, case finding, and referral system for older veterans in primary care. J Am Geriatr Soc 2007; 55(2):166-74.

(183) Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett P, Gottschalk M et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N Engl J Med 1994; 331(13):821-7.

(184) Sjosten NM, Salonoja M, Piirtola M, Vahlberg T, Isoaho R, Hyttinen H et al. A multifactorial fall prevention programme in home-dwelling elderly people: a randomized-controlled trial. Public Health 2007; 121(4):308-18.

(185) Hendriks MR, van Haastregt JC, Diederiks JP, Evers SM, Crebolder HF, van Eijk JT. Effectiveness and cost-effectiveness of a multidisciplinary intervention programme to prevent new falls and functional decline among elderly persons at risk: design of a replicated randomised controlled trial [ISRCTN64716113]. BMC Public Health 2005; 5:6.

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 3

Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors

An Evidence-Based Analysis

October 2008

Ontario

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. Behavioural interventions for urinary incontinence in community-dwelling seniors: an evidence-based analysis. *Ontario Health Technology Assessment Series* 2008;8(3).

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to MASinfo.moh@ontario.ca.

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-7286-9 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee (OHTAC).

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

List of Figures

Abbreviations

CCAC	Community Care Access Centre
CI	Confidence interval
CNS	Clinical nurse specialist
HTA	Health technology assessment
HR	Hazard ratio
ICS	International Continence Society
IIQ	Incontinence impact questionnaire
I-QOL	Incontinence Quality of Life (questionnaire)
LTC	Long-term care
MWES	Mean weighted effect size
NCA	Nurse continence advisor
NS	Not statistically significant
OR	Odds ratio
PFMT	Pelvic floor muscle training
PVR	Postvoid residual
RCT	Randomized controlled trial
RR	Relative risk
SD	Standard deviation
SE	Standard error
TVT	Tension-free vaginal tape
UI	Urinary incontinence
WMD	Weighted mean difference

Executive Summary

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective

To assess the effectiveness of behavioural interventions for the treatment and management of urinary incontinence (UI) in community-dwelling seniors.

Clinical Need: Target Population and Condition

Urinary incontinence defined as "the complaint of any involuntary leakage of urine" was identified as 1 of the key predictors in a senior's transition from independent community living to admission to a long-term care (LTC) home. Urinary incontinence is a health problem that affects a substantial proportion of Ontario's community-dwelling seniors (and indirectly affects caregivers), impacting their health, functioning, well-being and quality of life. Based on Canadian studies, prevalence estimates range from 9% to 30% for senior men and nearly double from 19% to 55% for senior women. The direct and indirect costs associated with UI are substantial. It is estimated that the total annual costs in Canada are

$1.5 billion (Cdn), and that each year a senior living at home will spend $1,000 to $1,500 on incontinence supplies.

Interventions to treat and manage UI can be classified into broad categories which include lifestyle modification, behavioural techniques, medications, devices (e.g., continence pessaries), surgical interventions and adjunctive measures (e.g., absorbent products).

The focus of this review is behavioural interventions, since they are commonly the first line of treatment considered in seniors given that they are the least invasive options with no reported side effects, do not limit future treatment options, and can be applied in combination with other therapies. In addition, many seniors would not be ideal candidates for other types of interventions involving more risk, such as surgical measures.

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Description of Technology/Therapy

Behavioural interventions can be divided into 2 categories according to the target population: caregiver-dependent techniques and patient-directed techniques. Caregiver-dependent techniques (also known as toileting assistance) are targeted at medically complex, frail individuals living at home with the assistance of a caregiver, who tends to be a family member. These seniors may also have cognitive deficits and/or motor deficits. A health care professional trains the senior's caregiver to deliver an intervention such as prompted voiding, habit retraining, or timed voiding. The health care professional who trains the caregiver is commonly a nurse or a nurse with advanced training in the management of UI, such as a nurse continence advisor (NCA) or a clinical nurse specialist (CNS).

The second category of behavioural interventions consists of patient-directed techniques targeted towards mobile, motivated seniors. Seniors in this population are cognitively able, free from any major physical deficits, and motivated to regain and/or improve their continence. A nurse or a nurse with advanced training in UI management, such as an NCA or CNS, delivers the patient-directed techniques. These are often provided as multicomponent interventions including a combination of bladder training techniques, pelvic floor muscle training (PFMT), education on bladder control strategies, and self-monitoring. Pelvic floor muscle training, defined as a program of repeated pelvic floor muscle contractions taught and supervised by a health care professional, may be employed as part of a multicomponent intervention or in isolation.

Education is a large component of both caregiver-dependent and patient-directed behavioural interventions, and patient and/or caregiver involvement as well as continued practice strongly affect the success of treatment. Incontinence products, which include a large variety of pads and devices for effective containment of urine, may be used in conjunction with behavioural techniques at any point in the patient's management.

Evidence-Based Analysis Methods

A comprehensive search strategy was used to identify systematic reviews and randomized controlled trials that examined the effectiveness, safety, and cost-effectiveness of caregiver-dependent and patient-directed behavioural interventions for the treatment of UI in community-dwelling seniors (see Appendix 1).

Research Questions

1. Are caregiver-dependent behavioural interventions effective in improving UI in medically complex, frail community-dwelling seniors with/without cognitive deficits and/or motor deficits?
2. Are patient-directed behavioural interventions effective in improving UI in mobile, motivated community-dwelling seniors?
3. Are behavioural interventions delivered by NCAs or CNSs in a clinic setting effective in improving incontinence outcomes in community-dwelling seniors?

Assessment of Quality of Evidence

The quality of the evidence was assessed as high, moderate, low, or very low according to the GRADE methodology and GRADE Working Group. As per GRADE the following definitions apply:

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Summary of Findings

Executive Summary Table 1 summarizes the results of the analysis.

The available evidence was limited by considerable variation in study populations and in the type and severity of UI for studies examining both caregiver-directed and patient-directed interventions. The UI literature frequently is limited to reporting subjective outcome measures such as patient observations and symptoms. The primary outcome of interest, admission to a LTC home, was not reported in the UI literature. The number of eligible studies was low, and there were limited data on long-term follow-up.

Executive Summary Table 1: Summary of Evidence on Behavioural Interventions for the Treatment of Urinary Incontinence in Community-Dwelling Seniors

Intervention	Target Population	Interventions	Conclusions	GRADE quality of the evidence
1. Caregiver-dependent techniques (toileting assistance)	Medically complex, frail individuals at home with/without cognitive deficits and/or motor deficits Delivered by informal caregivers who are trained by a nurse or a nurse with specialized UI training (NCA/CNS)	• Prompted voiding • Habit retraining • Timed voiding	There is no evidence of effectiveness for habit retraining (n=1 study) and timed voiding (n=1 study). Prompted voiding may be effective, but effectiveness is difficult to substantiate because of an inadequately powered study (n=1 study). Resource implications and caregiver burden (usually on an informal caregiver) should be considered.	Low
2. Patient-directed techniques	Mobile, motivated seniors Delivered by a nurse or a nurse with specialized UI training (NCA/CNS)	Multicomponent behavioural interventions Include a combination of • Bladder training • PFMT (with or without biofeedback) • Bladder control strategies • Education • Self-monitoring	Significant reduction in the mean number of incontinent episodes per week (n=5 studies, WMD 3.63, 95% CI, 2.07–5.19) Significant improvement in patient's perception of UI (n=3 studies, OR 4.15, 95% CI, 2.70–6.37) Suggestive beneficial impact on patient's health-related quality of life	Moderate
		PFMT alone	Significant reduction in the mean number of incontinent episodes per week (n=1 study, WMD 10.50, 95% CI, 4.30–16.70)	Moderate
3. Behavioural interventions led by an NCA/CNS in a clinic setting	Community-dwelling seniors	Behavioural interventions led by NCA/CNS	Overall, effective in improving incontinence outcomes (n=3 RCTs + 1 Ontario-based before/after study)	Moderate

*CI refers to confidence interval; CNS, clinical nurse specialist; NCA, nurse continence advisor; PFMT, pelvic floor muscle training; RCT, randomized controlled trial; WMD, weighted mean difference; UI, urinary incontinence.

Economic Analysis

A budget impact analysis was conducted to forecast costs for caregiver-dependent and patient-directed multicomponent behavioural techniques delivered by NCAs, and PFMT alone delivered by physiotherapists. All costs are reported in 2008 Canadian dollars. Based on epidemiological data, published medical literature and clinical expert opinion, the annual cost of caregiver-dependent behavioural techniques was estimated to be $9.2 M, while the annual costs of patient-directed behavioural techniques delivered by either an NCA or physiotherapist were estimated to be $25.5 M and $36.1 M, respectively. Estimates will vary if the underlying assumptions are changed.

Currently, the province of Ontario absorbs the cost of NCAs (available through the 42 Community Care Access Centres across the province) in the home setting. The 2007 *Incontinence Care in the Community Report* estimated that the total cost being absorbed by the public system of providing continence care in the home is $19.5 M in Ontario. This cost estimate included resources such as personnel, communication with physicians, record keeping and product costs. Clinic costs were not included in this estimation because currently these come out of the global budget of the respective hospital and very few continence clinics actually exist in the province. The budget impact analysis factored in a cost for the clinic setting, assuming that the public system would absorb the cost with this new model of community care.

Considerations for Ontario Health System

An expert panel on aging in the community met on 3 occasions from January to May 2008, and in part, discussed treatment of UI in seniors in Ontario with a focus on caregiver-dependent and patient-directed behavioural interventions. In particular, the panel discussed how treatment for UI is made available to seniors in Ontario and who provides the service. Some of the major themes arising from the discussions included:

- Services/interventions that currently exist in Ontario offering behavioural interventions to treat UI are not consistent. There is a lack of consistency in how seniors access services for treatment of UI, who manages patients and what treatment patients receive.
- Help-seeking behaviours are important to consider when designing optimal service delivery methods.
- There is considerable social stigma associated with UI and therefore there is a need for public education and an awareness campaign.
- The cost of incontinent supplies and the availability of NCAs were highlighted.

Conclusions

There is moderate-quality evidence that the following interventions are effective in improving UI in mobile motivated seniors:

- Multicomponent behavioural interventions including a combination of bladder training techniques, PFMT (with or without biofeedback), education on bladder control strategies and self-monitoring techniques.
- Pelvic floor muscle training alone.

There is moderate quality evidence that when behavioural interventions are led by NCAs or CNSs in a clinic setting, they are effective in improving UI in seniors.

There is limited low-quality evidence that prompted voiding may be effective in medically complex, frail seniors with motivated caregivers.

There is insufficient evidence for the following interventions in medically complex, frail seniors with motivated caregivers:

- habit retraining, and
- timed voiding.

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective

To assess the effectiveness of behavioural interventions for the treatment and management of urinary incontinence (UI) in community-dwelling seniors.

Clinical Need: Target Population and Condition

Urinary Incontinence Identified as a Predictor of Long-Term Care Home Admission

Urinary incontinence, defined as "the complaint of any involuntary leakage of urine," (1) was identified as 1 of the key predictors in a senior's transition from independent community living to admission to a

long-term care (LTC) home. For caregivers, UI is often a major driver in the decision to institutionalize elderly family members and is often cited as the "tipping point."

Several large recent cohort studies have examined UI as a possible predictor of LTC home admission. Studies followed cohorts of community-dwelling seniors and determined the number of seniors with UI who were admitted to LTC homes by the end of follow-up. Study characteristics are presented in Table 1. Figure 1 pools the results from 4 of the studies that investigated UI as a predictor of LTC home admission. Based on the pooled results, it appears that UI is a predictor of LTC home admission. However, it is important to note that the estimates presented in Figure 1 are not adjusted for age, sex, or other chronic conditions that may also be important factors in influencing LTC home admission. As noted in Table 1, when Banaszak-Holl et al. (2) adjusted the hazard ratio for disability, which was defined as requiring assistance with activities of daily living,[1] they found that UI was not a predictor of LTC home admission. Lachs et al. (3) and Andel et al. (4) did not report adjusted results. Thom et al. (5) reported adjusted results stratified by sex, and found that UI was a predictor of LTC home admission even when the results were adjusted for age, dementia, cardiovascular disease, and renal disease.

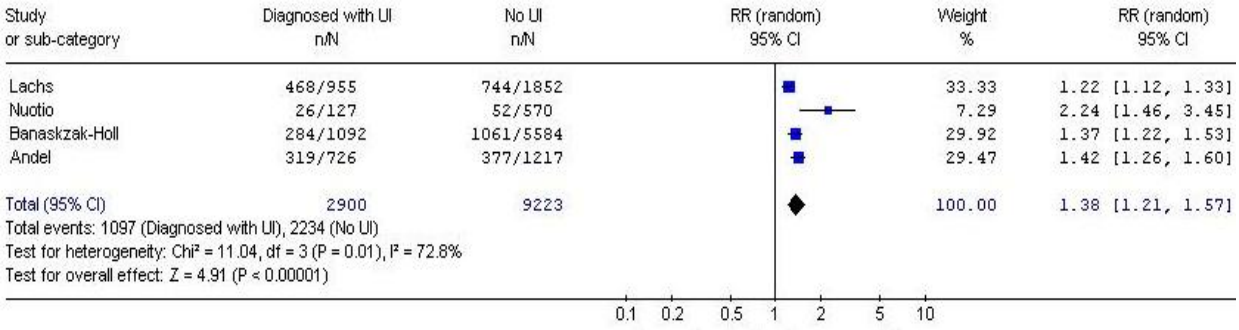
[1] Activities of Daily Living (ADL) are basic but important general tasks required for day-to-day living such as bathing, dressing, grooming, eating, and toileting.

Table 1: Studies Reporting Urinary Incontinence as a Possible Predictor of Long-Term Care Home Admission*

Study, Year	Location	Sample	Cohort Follow-Up (years)	Number Placed in LTC Home With UI by the End of Follow-Up (%)	Number Not Placed in LTC Home With UI by the End of Follow-Up (%)	Statistical Results
Andel et al., 2007 (4)	United States (Florida)	1,943 community-dwelling older adults (≥ 65 y)	4	319/726 (44)	377/1217 (31)	Overall $P < .001$ Without dementia $P < .001$ With dementia $P > .05$
Banaszak-Holl et al., 2004 (AHEAD study) (2)	United States (national sample)	6,676 community-dwelling older adults (≥ 70 y)	6.6	284/1,092 (26)	1,061/5,584 (19)	Univariate HR 1.7 (95% CI, 1.5–1.9; $P < .001$) Adjusted HR without disability 1.2 (95% CI, 1.1–1.4; $P < .001$) Adjusted HR with disability 1.0 (95% CI, 0.9–1.2; $P < .001$)
Nuotio et al., 2003 (6)	Finland	775 community-dwelling older adults (≥ 60 y)	13	26/127 (20.5)	52/570 (9.1)	For men, unadjusted $P = .006$, age-adjusted RR 2.96 (95% CI, 1.33–6.61, $P = .008$) For women, unadjusted $P = .125$, age-adjusted RR 1.37 (95% CI, 0.84–2.22, $P = .206$)
Lachs et al., 2002 (3)	United States (Connecticut)	2,812 community-dwelling older adults (≥ 65 y)	9	468/955 (49.4)	744/1852 (40.5)	$P < .001$
Thom et al., 1997 (5)	United States (Northern California)	5,986 HMO members (≥65 y)	9	Not reported	Not reported	Adjusted RR for women 2.0 (95% CI, 1.7–2.4) Adjusted RR for men 3.2 (95% CI, 2.7–3.8) (adjusted for age, cardiovascular disease, dementia, heart disease, renal disease)

*AHEAD refers to Asset and Health Dynamics Among the Oldest Old Study; CI, confidence interval; HMO, Health Maintenance Organization; LTC, long-term care; HR, hazard ratio; RR, relative risk; UI, urinary incontinence.

Figure 1: Pooled Unadjusted Results From Studies Examining Urinary Incontinence as a Predictor of Long-term Care Home Admission*



*CI refers to confidence interval; RR, relative risk; UI, urinary incontinence.
†Results become more complex when adjusted for activities of daily living (ADLs), sex, age, chronic disease.

Reasons for admission to LTC are complex, as is evidenced by the studies investigating UI as a predictor of LTC home admission. According to unadjusted univariate analysis, UI is a significant predictor of LTC home admission (Figure 1). However, when UI data are adjusted for activities of daily living, chronic conditions (such as dementia and cardiovascular disease), age, and sex, the strength of UI as a predictor of LTC home admission is less clear.

Morrison et al. (7) used data from the Thom et al. (5) study to calculate the fraction of LTC home admissions attributable to UI. The authors determined that 10% of all admissions for men and 6% of all admissions for women were attributable solely to UI. By extrapolating data to the population of the United States in 2000, the annualized cost of LTC home admissions due to UI was estimated at $6 billion. (7)

Urinary Incontinence in Seniors

There is a large amount of literature on the prevalence, diagnosis, treatment, and management of incontinence. Incontinence can span a person's lifetime, and it has many causes and various classifications.

Urinary incontinence affects a substantial proportion of Ontario's community-dwelling seniors, impacting their health, functioning, and well-being. It can also have potentially devastating effects on quality of life, which encompasses physical, psychological, sexual, and social domains. It impacts upon caregivers, and as mentioned, it is often a major driver in the decision to institutionalize elderly people. The situation has the potential to be psychologically difficult for all parties involved because of feelings of humiliation and guilt. (8;9)

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Causes of Urinary Incontinence

Urinary incontinence may occur as a result of different functional abnormalities of the lower urinary tract or as a result of other illnesses. Normal continence is maintained through the neurologically mediated coordination between bladder, urethra, urethral sphincter, and pelvic floor. Incontinence occurs when

there is a breakdown in the relationship between the above components, either due to physical damage or nerve dysfunction. Additional causes of UI include but are not limited to adverse drug effects, cognitive impairment, and physical/mobility impairment. (9)

Seniors are especially predisposed to developing UI because of changes in bladder physiology that occur as a part of the aging process. (9) This predisposition, coupled with pathologic, physiologic, or pharmacologic factors, explains why the elderly are so likely to become incontinent. Urinary incontinence should not, however, be considered a normal part of the aging process. (10) A key distinction in etiology of UI between younger and older individuals is the frequent role of conditions outside the lower urinary tract in precipitating or aggravating symptoms. Some of these multifactorial influences may include mobility limitations, chronic illnesses, medications, and cognitive impairment. (10;11)

Complications associated with UI include skin breakdown, pressure ulcers, urinary tract infections, and psychosocial consequences such as shame, isolation, and depression. (10)

Types of Urinary Incontinence

As mentioned, several physiological mechanisms and changes can result in different types of UI. Urinary incontinence may also be transient in nature. The transient causes of UI can be described by the mnemonic DIAPERS: delirium, infection, atrophic urethritis/vaginitis, pharmaceuticals, excess urine output, restricted mobility, stool impaction. (9) Once transient causes of UI have been addressed, the established causes of UI can then be targeted.

Dysfunction of the bladder wall muscle (detrusor overactivity) may result in urge UI, and poor functioning of the bladder outlet (urethra, sphincters, pelvic floor muscles) may result in stress UI. Detrusor underactivity may result in overflow UI. (9;10) The major types of UI and their characteristics are listed below.

- Stress UI is involuntary urine leakage on effort or exertion, or on sneezing or coughing.
- Urge UI is involuntary urine leakage accompanied by or immediately preceded by a sudden compelling desire to pass urine, a desire that is difficult to defer.
- Mixed UI is a combination of stress and urge incontinence. It is involuntary urine leakage associated with urgency and also with exertion, effort, sneezing, or coughing.

Other types of incontinence include

- Overflow UI is the constant leaking or dribbling from a full bladder.
- Functional UI denotes incontinence related to causes outside of the urinary system. For example, UI may be exacerbated by functional factors such as physical barriers to the toilet, a lack of mobility, a degree of unwillingness to comply, and medication. This type of UI may be managed by addressing these functional factors.

Prevalence of Urinary Incontinence

Estimates for the prevalence of UI are inconsistent because of issues with underreporting, social stigma, and variation in definitions and measurement tools. Many patients are also never screened for UI and are too embarrassed to tell their physicians about this problem. Prevalence of UI increases with age, institutionalization, failing mental powers, and loss of mobility. (8;12)

For people aged 65 years and older, prevalence estimates derived from Canadian studies range from 9% to 30% for men and from 19% to 55% for women (Table 2). Thus, the prevalence of UI in senior women is nearly double that of senior men. The survey by Herschorn et al. (13) also collected information on severity. Only about 25% of respondents indicated that their incontinence resulted in “moderate to severe

interference with everyday life," and approximately one-quarter of the people who reported having any bladder problem indicated that they had consulted a health care provider regarding their condition.

Table 2: Recent Canadian Surveys on Prevalence of Urinary Incontinence

Study, Year	Prevalence
Irwin et al., 2006 (14) EPIC Study	men 10.4%, women 19.3% (≥ 60 years)
Canadian Community Health Survey, 2003 (CCHS) (15)	10.7% (≥ 65 years)
Ostbye et al., 2004 (16) The Canadian Study of Health and Aging (CSHA)	men 9%, women 19% (≥ 65 years)
Herschorn et al., 2008 (13) The Canadian Urinary Bladder Survey (CUBS)	men 30%, women 55%, combined 21.8% (≥ 65 years)

Swanson et al. (17) published results of an Ontario survey of 606 community-dwelling women aged 45 years and older in 2 family practice clinics in Hamilton. The survey was not limited to seniors but provided useful information on prevalence in Ontario and on help-seeking behaviour. They found that UI was reported by 51.3% of women, of whom 35.7% perceived it as a problem. Roughly one-third of incontinent women had discussed urine loss with their physician, and among these, 70% felt satisfied with their physician's responses.

In their 2007 report on UI, the Agency for Healthcare Research and Quality (18) in the United States presented pooled UI prevalence estimates in seniors 65 years and older. Using a broad definition of UI that included various frequencies (monthly, weekly, daily) and levels of severity, the prevalence of UI was estimated to be 45.1% for women and 20.5% for men. The prevalence of daily UI in women was 17% and in men was 9%. The prevalence of severe UI, defined as UI resulting in wet clothes or severe enough for the person to seek treatment, was 9% in women and 4% in men.

Given the high prevalence of UI among community-dwelling seniors, the direct and indirect costs associated with UI are substantial. Herschorn et al. (13) reported that the total annual costs of UI in Canada were estimated at $1.5 billion. The Canadian Continence Foundation (8) estimates that each year a senior living at home will spend $1,000 to $1,500 on incontinence supplies.

Treatment and Management of Urinary Incontinence

Early and effective treatment of UI is reported to be important for restoring both physical function and emotional well-being. (10) In most seniors, the type of UI can be diagnosed by history, physical examination, and postvoid residual (PVR) urine volume measurement. (10) This initial assessment is an essential part of managing UI, since it allows health care professionals and patients to discuss patient expectations, determine treatment preferences, and identify realistic outcomes that would reflect a meaningful improvement in the patient's quality of life. (8) An individual's progress and expectations can then be continually reviewed throughout the treatment process.

Patients with UI are treated and managed by a variety of health care professionals including family

physicians, nurses, nurses with specialized training in UI such as a nurse continence advisor[2] (NCA) or clinical nurse specialist[3] (CNS), physiotherapists, urologists, or gynecologists. There may also be an opportunity to improve health care professionals' awareness and knowledge on UI. A recent survey of Canadian family physicians reported that only 46% of physicians clearly understood incontinence, and just 38% had an organized plan for incontinence problems. (19) Almost half reported that they usually referred patients with incontinence. (19)

Interventions to treat and manage UI can be classified into broad categories including lifestyle modification, behavioural techniques, medications, devices (e.g., continence pessaries), surgical interventions, and adjunctive measures (e.g., absorbent products). The Medical Advisory Secretariat previously conducted 2 reviews on surgical interventions to treat UI: *Sacral Nerve Stimulation for the Management of Urge Incontinence, Urgency-Frequency, Urinary Retention and Fecal Incontinence* and *Midurethral Slings for Women with Stress Urinary Incontinence*. (20;21) Although the reviews were not conducted for an exclusively senior population, the evidence indicated that both of the surgical interventions were effective at treating and managing UI in select patient populations.

The focus of the current review was on behavioural interventions since they are commonly the first line of treatment for UI in seniors. (22-24) Behavioural interventions are the least invasive options, have no reported side effects, do not limit future treatment options, and can be applied in combination with other therapies. (23;24) Further, many seniors would not be ideal candidates for other types of interventions involving more risk, such as surgical treatment.

Behavioural Interventions for the Treatment of Urinary Incontinence

Behavioural interventions can be divided into 2 categories according to the target population: caregiver-dependent techniques and patient-directed techniques (Table 3).

Caregiver-dependent techniques (also known as toileting assistance) are targeted at medically complex, frail individuals living at home with the assistance of a caregiver, who tends to be a family member. The elderly person may also have cognitive deficits and/or motor deficits. The Canadian Continence Foundation (8) defines frail elderly persons as "those who depend on others for the activities of daily living or who are at high risk of becoming dependent." Caregiver-dependent techniques are delivered by the senior's caregiver, who is trained by a health care professional to deliver a prompted voiding, habit retraining or timed voiding intervention. The health care professional who trains the caregiver is commonly a nurse or a nurse with advanced training in the management of UI, such as an NCA or CNS.

Prompted voiding is a caregiver-dependent technique that is "…used to teach people with or without cognitive impairment to initiate their own toileting through requests for help and positive reinforcement from carers when they do this." (25) The Registered Nurses' Association of Ontario (26) published best practice guidelines on prompted voiding in 2005 which were developed through a process of consensus and based on the literature. In North America, prompted voiding is mainly used in institutional settings although it can also be applied to community-dwelling seniors.

---

[2] A nurse continence advisor (NCA) is a nurse certified with specialized training in conservative methods of managing incontinence.

[3] A clinical nurse specialist (CNS) is an advanced practice nurse with graduate preparation (master's or doctorate) and advanced training in continence care.

Habit retraining is another caregiver-dependent technique that involves "the identification of a person's natural voiding pattern and the development of an individualized toileting schedule which pre-empts involuntary bladder emptying." (27) Like prompted voiding, habit retraining is mostly employed in LTC home settings, but it can also be applied to the frail elderly community-dwelling population.

Timed voiding involves voiding on a fixed schedule, typically every 2 to 4 hours. This interval remains fixed for the duration of the intervention. It is also mainly used in institutional settings. (28)

All 3 caregiver-dependent techniques can be labour intensive and require motivation by caregivers to carry out the intervention.

The second category of behavioural interventions is referred to as patient-directed techniques which target mobile and motivated seniors. This population of seniors is cognitively able without any major physical deficits and is motivated to regain and/or improve their continence. A nurse or a nurse with advanced training in UI management, such as an NCA or CNS, delivers the patient-directed techniques which are often provided as multicomponent interventions including a combination of bladder training techniques, pelvic floor muscle training (PFMT), education on bladder control strategies and fluid management, and self-monitoring. The principal aim of bladder training is to increase the interval between voids either though a mandatory or self-adjustable schedule. (29) Pelvic floor muscle training, defined as a program of repeated pelvic floor muscle (PFM) contractions taught and supervised by a health care professional, may be employed as part of a multicomponent intervention or in isolation. When delivered in isolation, PFMT may be delivered by a physiotherapist. A PFMT program may be prescribed to increase strength, endurance, and coordination of muscle activity, or to suppress urge, or a combination of these. Strength training decreases the frequency of UI with time, and skill training immediately reduces the amount of leakage. The training may or may not include biofeedback. (30;31)

Education is a large component of both caregiver-dependent and patient-directed behavioural interventions and patient and/or caregiver involvement as well as continued practice heavily impact treatment success. The use of incontinence products, which includes a large variety of pads and devices for effective containment of urine, may be used in conjunction with behavioural techniques at any point in the patient's management. (10;23)

Table 3: Characteristics of Behavioural Interventions for the Treatment and Management of Urinary Incontinence

Intervention	Target Population	Interventions
1. Caregiver-dependent techniques (toileting assistance)	Medically complex, frail individuals at home with/without cognitive deficits and/or motor deficits	Delivered by family caregivers who are trained by nurse or a nurse specializing in UI (NCA/CNS) Includes • prompted voiding • habit retraining • timed voiding
2. Patient-directed techniques	Mobile, motivated seniors	A) Multicomponent Interventions Delivered by a nurse or a nurse specializing in UI (NCA/CNS) Includes a combination of • bladder training techniques • PFMT (with or without biofeedback) • education on bladder control strategies • self-monitoring B) Pelvic floor muscle training (PFMT) alone Delivered by a nurse, a nurse specializing in UI (NCA/CNS) or a physiotherapist • a program of repeated PFM contraction taught and supervised by a health care professional (with or without biofeedback)

*CNS refers to clinical nurse specialist; NCA, nurse continence advisor; PFMT, pelvic floor muscle training.

Evidence-Based Analysis of Effectiveness

Objective

To assess the effectiveness of behavioural interventions for the treatment and management of UI in community-dwelling seniors.

Research Questions

1. Are caregiver-dependent behavioural interventions effective in improving UI in medically complex, frail community-dwelling seniors with/without cognitive deficits and/or motor deficits?
2. Are patient-directed behavioural interventions effective in improving UI in mobile motivated community-dwelling seniors?
3. Are behavioural interventions delivered by an NCA or CNS in a clinic setting effective in improving incontinence outcomes in community-dwelling seniors?

Methods

Inclusion Criteria

- English language (January 2000–September 2007);
- population of community-dwelling seniors (majority of study participants aged 65 years and older) with any type of UI;
- randomized controlled trial (RCT), quasi-experimental design, or systematic review/meta-analysis; and
- studies comparing behavioural interventions (caregiver-dependent techniques and patient-directed techniques) or PFMT alone or interventions led by an NCA or CNS versus usual care.

Exclusion Criteria

- studies reporting only fecal incontinence or acute incontinence (e.g., temporary incontinence as a result of surgery);
- abstracts, non-peer-reviewed reports, nonsystematic reviews, case reports;
- studies with special populations (e.g., patients undergoing liver transplantation, patients with multiple sclerosis, patients with bladder cancer); or
- studies that lack a control group or studies with a small sample size (N<10).

Outcomes of Interest

- admission to LTC home;
- improvement/cure in incontinence symptoms, and
  - measures of patient observations and symptoms, or
  - change in incontinent episodes measured though bladder diaries; or
- quality of life.

Note: Given the shortage of appropriate evidence in this area, the inclusion/exclusion criteria were less rigorously applied to existing systematic reviews. For example, the results of a systematic review on

prompted voiding were presented although not all studies included in the review were conducted in community-dwelling seniors (some studies were conducted in LTC home residents). Although existing reviews did not always limit themselves to studies that satisfied our criteria, it was deemed important to highlight the results of existing systematic reviews due to the shortage of relevant evidence in this area. The conclusions of this report are, however, based on studies that met all eligibility criteria.

Method of Review

A search of electronic databases (OVID MEDLINE, MEDLINE In-Process & Other Non-Indexed Citations, EMBASE, The Cochrane Library, and the International Agency for Health Technology Assessment/Centre for Reviews and Dissemination [INAHTA/CRD] database) was undertaken to identify evidence published between January 1, 2000, and September 23, 2007. The search strategy is detailed in Appendix 1.

Studies meeting the inclusion criteria were selected from the search results. Data on the study characteristics, patient characteristics, primary and secondary treatment outcomes, and adverse events were extracted. Reference lists of selected articles were also checked for relevant studies.

Assessment of Quality of Evidence

The quality rating assigned to individual studies was determined using the Medical Advisory Secretariat's adaptation of a hierarchy proposed by Goodman. (32)

The overall quality of the evidence was examined according to the GRADE Working Group criteria. (33;34)

Quality refers to criteria such as the adequacy of allocation concealment, blinding, and follow-up.

Consistency refers to the similarity of estimates of effect across studies. If there is important unexplained inconsistency in the results, confidence in the estimate of effect for that outcome decreases. Differences in the direction of effect, the size of the differences in effect, and the significance of the differences guide the decision about whether important inconsistency exists.

Directness refers to the extent to which the interventions and outcome measures are similar to those of interest.

As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence.

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Results of Evidence-Based Analysis

The search identified 722 articles published from January 1, 2000, to September 23, 2007. Of the 722 citations identified, 9 existing reviews and 15 studies met the inclusion criteria. The present review included four existing reviews and 3 RCTs on caregiver-dependent techniques; 4 existing reviews and 8 RCTs on patient-directed techniques; and 1 existing review, 3 RCTs, and 1 Ontario-based quasi-experimental before/after study on the role of the NCA/CNS in delivering behavioural interventions in a clinic setting. Table 4 lists the level of evidence of individual studies and the number of studies identified.

Table 4: Quality of Evidence of Included Studies*

Study Design	Level of Evidence	Number of Eligible Studies
Large RCT,*systematic reviews of RCT	1	4– caregiver-dependent techniques 4 – patient-directed techniques 1 – role of the NCA/CNS
Large RCT unpublished but reported to an international scientific meeting	1(g)	
Small RCT	2	3 – caregiver-dependent techniques 8 – patient-directed techniques 3 – role of the NCA/CNS
Small RCT unpublished but reported to an international scientific meeting	2(g)	0
Non-RCT with contemporaneous controls	3a	0
Non-RCT with historical controls	3b	1 – role of the NCA/CNS
Non-RCT presented at international conference	3(g)	0
Surveillance (database or register)	4a	0
Case series (multisite)	4b	0
Case series (single site)	4c	0
Retrospective review, modeling	4d	0
Case series presented at international conference	4(g)	0

*CNS refers to clinical nurse specialist; NCA, nurse continence advisor; g, grey literature; RCT, randomized controlled trial.
†For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. (32) An additional designation "g" was added for preliminary reports of studies that have been presented at international scientific meetings.

The results will be presented in 3 sections:
1. Caregiver-dependent techniques
2. Patient-directed techniques
3. The role of the NCA/CNS in delivering behavioural interventions in a clinic setting

Summary of Existing Evidence

The Agency for Healthcare Research and Quality (18) in the United States recently published a wide-ranging evidence-based report on UI. The objective of the report was to assess the prevalence of and risk factors for urinary and fecal incontinence in adults in LTC settings and in the community; to assess the effectiveness of diagnostic methods to identify adults at risk and patients with incontinence; and to review the effectiveness of clinical interventions to reduce the risk of incontinence. There were 1,077 articles eligible for the analysis. Given that this report did not focus specifically on community-dwelling seniors, it was not directly included in the Medical Advisory Secretariat analysis; however, relevant information was incorporated when appropriate.

Section 1 – Caregiver-Dependent Behavioural Techniques

Summary of Existing Evidence

Four existing systematic reviews on caregiver-dependent techniques were included in the analysis (Table 5). Three existing Cochrane reviews focused on specific caregiver-dependent techniques, (25;27;28) and a review by Fonda et al. (11) included studies on all caregiver-dependent techniques. Overall, the majority of studies that were included in these existing reviews were conducted in LTC home residents, which limited the generalizability of their findings to the population of interest, community-dwelling seniors. Although the existing reviews did not limit themselves to studies that satisfied the inclusion criteria of community-dwelling seniors (the reviews included some studies conducted in LTC home residents), they provided relevant information regarding caregiver-dependent techniques, and given the scarcity of evidence in this area, they were included in the Medical Advisory Secretariat's review.

Table 5: Existing Systematic Reviews on Caregiver-Dependent Techniques for Urinary Incontinence*

Systematic Review, Year	Intervention	Number of Studies Included in Review	Results and Conclusions	Comments
Eustice et al., 2000 Updated in 2006 Cochrane review (25)	Prompted voiding	9 RCTs or quasi-randomized trials	Clear conclusions on effectiveness are difficult to make based on the limited evidence available; however, there is suggestive evidence of short-term benefit. Prompted voiding is resource-intensive, but size of resource implications is not clear	Majority of study participants were women Majority of studies were conducted in nursing home setting, One study was conducted in homebound seniors with full-time caregiver
Ostaszkiewicz et al., 2004 Cochrane review (27)	Habit retraining	3 RCTs or quasi-randomized trials	Clear conclusions regarding the effectiveness are difficult to make based on the limited evidence available.	Small number of eligible studies Majority of study participants were women One study was conducted in a nursing home setting, Two studies were conducted in a community setting
Ostaszkiewicz et al., 2005 Cochrane review (28)	Timed voiding	2 RCTs	The quality of the studies was "modest" according to the authors, and did not permit them to confidently make conclusions regarding the effectiveness of timed voiding	Small number of eligible studies and old publication dates Both studies included older women predominantly with cognitive and physical impairments Both studies were conducted in nursing home setting

Fonda et al., 2006 Report by the International Continence Society (11)	All caregiver-dependent techniques in frail seniors	Included the above-mentioned systematic reviews and any recent studies	Prompted voiding is effective for the short-term treatment of UI in nursing home residents and home-care clients if caregivers comply with intervention. Unable to determine the treatment effect of habit retraining Unable to determine the treatment effect of timed voiding	Majority of studies were conducted in nursing home setting.

*RCT refers to randomized controlled trial.

Overall, the 3 Cochrane reviews that focused on specific caregiver-dependent techniques found that clear conclusions regarding the effectiveness of prompted voiding, habit retraining, and timed voiding were difficult to make based on the limited evidence available. Eustice et al. (25) also concluded that there was evidence suggestive of short-term benefit of prompted voiding. The review by Fonda et al. (11) concluded that prompted voiding was effective for the short-term treatment of UI in nursing home residents and home-care clients if caregivers were compliant with the intervention. They also stated that it was not possible for them to determine the treatment effect of habit retraining and timed voiding.

Systematic Review by the Medical Advisory Secretariat

Three RCTs examining the effectiveness of caregiver-dependent techniques met the inclusion criteria. (35-37) Details of the studies are outlined in Table 6 below. All 3 studies focused on different caregiver-dependent interventions. Caregivers were typically trained by nurses.

Overall, clear conclusions regarding the effectiveness of caregiver-dependent techniques to treat UI in medically complex, frail community-dwelling seniors are difficult to make, based on the limited evidence available and the heterogeneity between studies. Inadequate evidence indicates that prompted voiding may be effective in improving UI in this population, but its effectiveness is difficult to substantiate due to an inadequately powered study (small sample size, high risk of type II error). To date, the majority of studies on prompted voiding have been conducted in institutional settings and not in community-dwelling seniors. With interventions delivered by caregivers, it is important to consider the associated resource implications and caregiver burden. (25)

Table 6: Studies on Caregiver-dependent Techniques for Urinary Incontinence*

Study, Year	Intervention	Study Design and Methods	Results	Limitations
Jirovec et al., 2001 (35)	Timed voiding	RCT 118 memory-impaired seniors living in the community with UI and having the assistance of a caregiver 6 months duration Outcome: Change in incontinence calculated as the percentage of time the patient was incontinent	Treatment group had significantly reduced incontinence from baseline ($Z = -1.83$, $P < .05$) but no significant difference between groups	No intention-to-treat analysis, allocation concealment unclear, no justification provided for sample size
Engberg et al., 2002 (36)	Prompted voiding	RCT (crossover) 19 cognitively impaired homebound seniors aged 60 years and older with UI and a full-time caregiver 8 weeks duration Outcome: change in incontinence frequency	Treatment group reduced daily incontinent episodes by 47% (SD 39.2) compared with 27% (SD 26.1) in the control group, but this difference was not statistically significant ($P = .19$)	Study not adequately powered to detect a difference (risk of type II error), allocation concealment unclear
Colling et al., 2003 (37)	Habit retraining "Pattern Urge Response Toileting" (PURT)	RCT (delayed control group) 106 community-dwelling, caregiver-dependent non-demented elderly persons ≥55 yrs with urge or mixed UI 6 weeks duration Outcome: change in incontinence frequency	Treatment group had fewer daily incontinent episodes (4.0, SD 2.6) than control group (3.4 SD 2.6), but this difference was not statistically significant ($P = .23$)	Allocation concealment unclear, difficulty in recruiting an appropriate sample, patient/ caregiver study retention problematic

*RCT refers to randomized controlled trial; SD, standard deviation; UI, urinary incontinence.

Section 2 – Patient-Directed Behavioural Techniques

Summary of Existing Evidence

Four existing systematic reviews on patient-directed behavioural techniques for the treatment of UI in community-dwelling seniors were identified (Table 7). One review focused on bladder training, (29) 1 review included all behavioural techniques as well as drug therapy in the elderly, (38) and 2 reviews focused on PFMT alone. (30;31) Although the existing reviews did not limit to studies that satisfied the age inclusion criteria of greater than 65 years (the reviews included some studies conducted in younger populations), they provided relevant information regarding patient-directed techniques, and given the scarcity of evidence in this area, they were included in Medical Advisory Secretariat's review.

Table 7: Existing Systematic Reviews on Patient-Directed Behavioural Techniques for the Treatment of Urinary Incontinence*

Systematic Review, Year	Intervention	Number of Studies Included in Review	Results and Conclusions	Comments
Wallace et al., 2004 Updated in 2006 Cochrane review (29)	Bladder training	12 studies; 8 studies provided usable data	Clear conclusions regarding the effectiveness of bladder training are difficult to make based on the limited evidence available. Compared with no bladder training, point estimates of effect favoured bladder training; however, CI were wide and no statistically significant differences were found.	Not limited to seniors Only 2 of 12 studies where majority of population >65 y
Teunissen et al., 2004 (38)	Behavioural therapy and drug therapy in community-based seniors	4 before-after studies 4 RCTs	Behaviour therapy, including PFMT, is effective in reducing urinary leakage (5 studies). Behaviour therapy appears more effective than drug therapy in seniors (3 studies). There is insufficient high-quality evidence to make conclusions regarding drug therapy in seniors.	Not limited to RCT evidence
Choi et al., 2007 (30)	PFMT versus no treatment	12 studies	Studies heterogeneous in terms of types of incontinence, eligible ages, duration of PFMT. PFMT is effective in reducing • Incontinent episodes (MWES −0.68; 95% CI, −0.91 to −0.46); • Urine leakage amount (MWES −1.48; 95% CI, −2.58 to −0.38); and • Perceived severity (NS) (MWES −1.66; 95% CI, −3.59 to 0.27).	Only 5 of 12 studies where majority of population >65 y Included studies with multicomponent behavioural interventions and not just PFMT alone
Hay-Smith et al., 2006 Cochrane review (31)	PFMT alone versus no treatment	13 studies; 6 studies contributed data to the analysis	Considerable variation among studies in inclusion criteria, interventions and outcome measures • Patient perceived cure more likely after PFMT than control • Fewer incontinent episodes with PFMT than control • May be improved condition-specific quality of life with PFMT compared with control • Treatment adherence likely to impact size and direction of treatment effect, but difficult to measure • No serious adverse effects reported Final conclusion: PFMT is better than no treatment for women with stress, urge, or mixed UI.	Excluded trials where PFMT was combined with another conservative therapy (to be examined in future reviews) Only 3 of 13 studies where majority of population >65 y Did not pool estimates of effect

*CI refers to confidence interval(s); MWES, mean weighted effect size; NS, not significant; PFMT, pelvic floor muscle training; RCT, randomized controlled trial; UI, urinary incontinence.

The review by Wallace et al. (29) on bladder training did not limit itself to studies conducted in the elderly population, and only 2 out of the 12 studies that were included in their review were conducted in community-dwelling seniors, thus limiting the generalizability of the findings. Nonetheless, Wallace et al. reported that although point estimates of effectiveness favoured bladder training when the authors compared seniors in the bladder training group with controls, these differences were not statistically

significant, and therefore clear conclusions regarding the effectiveness of bladder training could not be drawn.

The review by Teunissen et al. (38) included both behavioural therapies and drug therapies for the treatment of UI in community-dwelling seniors. They concluded that behaviour therapy, including PFMT, was effective in improving UI outcomes, and that it appeared to be more effective than drug therapy in seniors.

The systematic reviews by Choi et al. (30) and Hay-Smith et al. (31) examined the effectiveness of PFMT compared with no treatment for the management of UI. In order to be included in the systematic review, studies had to include PFMT by a health care professional on a repeated basis. Only a limited number of studies included in the reviews were conducted in community-dwelling elderly women, thus limiting the generalizability of the findings. The review by Choi et al. (30) included studies with multicomponent behavioural interventions and not just PFMT alone, whereas the Cochrane review (31) excluded studies where PFMT was combined with another conservative therapy. Overall, both systematic reviews concluded that for women with all types of UI, PFMT was more effective in managing and treating UI than no treatment.

Systematic Review by the Medical Advisory Secretariat

Part A – Multicomponent Behavioural Interventions

Six RCTs examining the effectiveness of multicomponent patient-directed behavioural interventions met the inclusion criteria. Details of the studies are outlined in Table 8 below. Studies were classified as multicomponent if the intervention included a combination of bladder training techniques, PFMT (with or without biofeedback), education on bladder control strategies, and self-monitoring techniques.

Table 8: Studies on Multicomponent Patient-Directed Behavioural Techniques for Urinary Incontinence*

Study, Year	Intervention	Study Design	Methods	Outcomes	Limitations
Johnson et al., 2005 (39)	PFMT, bladder control strategies and self-monitoring	Secondary analysis of RCT	131 community-dwelling women aged ≥55 y Urge or urge-predominant incontinence 8 weeks duration, clinic setting	Nocturia outcomes	Randomization and allocation concealment unclear, sample size not justified
Burgio et al., 2002 (40)	PFMT + biofeedback and bladder control strategies	RCT	22 ambulatory, non-demented, community-dwelling women aged ≥55 y Urge or mixed UI (urge predominant pattern) 8 weeks duration, clinic setting	Mean reduction in incontinence Bladder capacity	Allocation concealment unclear
Goode et al., 2002 (41;42)	PFMT + biofeedback and bladder control strategies	RCT	197 ambulatory, non-demented, community-dwelling women aged ≥55 y Urge or mixed UI (urge predominant pattern) 8 weeks duration, clinic setting	Incontinent episodes Voiding frequency Bladder capacity	No intention-to-treat analysis, allocation concealment unclear, sample size not justified

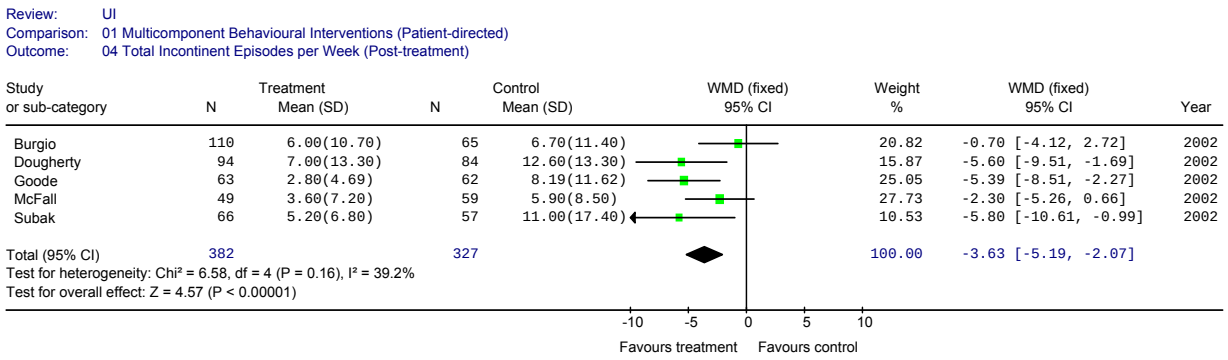
Dougherty et al., 2002 (43)	PFMT + biofeedback, bladder training and self-monitoring	RCT	218 community-dwelling rural women aged ≥55 y with stress, urge or mixed UI 6 months duration, patient's home	Incontinent episodes Severity of urine loss	Allocation concealment unclear, sample size not justified
Subak et al., 2002 (44)	"Low-intensity" program consisting of bladder training and development of individualized voiding schedules and instructions on PFMT	RCT	152 women aged >55 y Urge, stress, or mixed UI 6 weeks duration, clinic setting	Incontinent episodes	No intention-to-treat analysis, allocation concealment unclear
McFall et al., 2000 (45)	Group educational approach consisting of bladder training, managing urge to urinate, PFMT, and group support	RCT (delayed control group)	145 community-dwelling, literate women aged >65 y with self-reported UI and no cognitive, visual, or hearing impairment 12 weeks duration, clinic setting	Incontinent episodes	No intention-to-treat analysis, randomization and allocation concealment not reported, no justification for sample size

*PFMT refers to pelvic floor muscle training; RCT, randomized controlled trial; UI; urinary incontinence.

All study participants were elderly women, the sample size ranged from 131 to 222, interventions were typically delivered by nurses, and the duration of the intervention ranged from 6 weeks to 6 months. Although the inclusion criteria for age in most studies was listed as greater than 55 years of age, the mean age of participants in each study was greater than 65 years and thus satisfied the Medical Advisory Secretariat's criteria.

Five studies used information collected from bladder diaries to report on changes in incontinent episodes following treatment. (40;41;43-45) As shown in Figure 2, multicomponent patient-directed behavioural interventions resulted in significantly fewer incontinent episodes posttreatment compared with controls (n=5 studies; weighted mean difference [WMD] 3.63; 95% CI, 2.07–5.19).

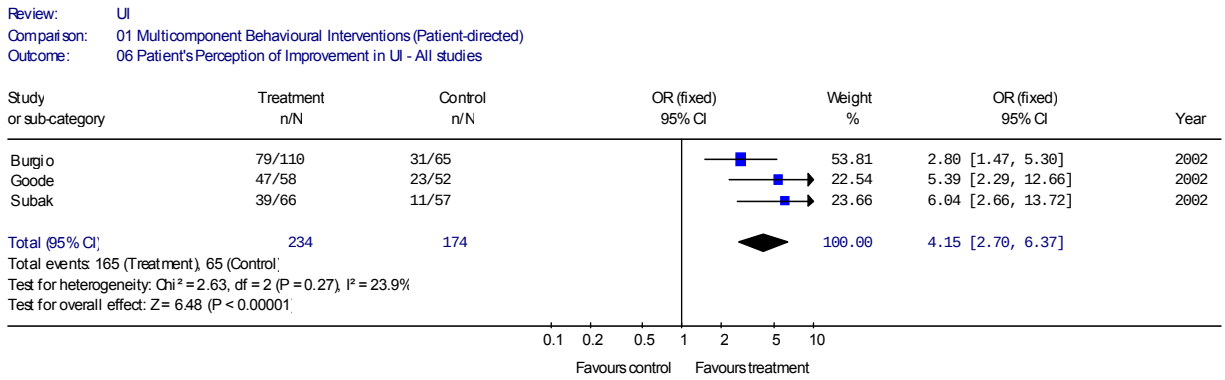
Figure 2: Total Incontinent Episodes per Week (Posttreatment)*



*CI refers to confidence interval; SD, standard deviation; WMD, weighted mean difference.
†Note that studies reporting daily incontinent episodes were converted to weekly estimates.

Three studies reported on the subjective measure of patients' perception of improvement in UI. (40;41;44) As shown in Figure 3, a meta-analysis of multicomponent patient-directed behavioural interventions resulted in a significant improvement in patients' perception of UI when compared with the control group (n=3 studies, odds ratio [OR], 4.15; 95% CI, 2.70–6.37).

Figure 3: Patients' Perception of Improvement in Urinary Incontinence



*CI refers to confidence interval; OR, odds ratio.
†Improvement was defined as self-reported improvement or no restriction in daily activities.

Quality of life was assessed in 3 out of the 6 studies. Dougherty et al. (43) reported that the intervention group reported significantly better quality of life as assessed by the Incontinence Impact Questionnaire than controls ($P = .0025$). Burgio et al. (40) found that the intervention had statistically significant effects on quality of life as measured by the Incontinence Impact Questionnaire (all 4 questionnaire subscales $P < .001$). McFall et al. (45;46) reported that the intervention affected condition-specific quality of life and self-management but did not affect general health-related quality of life as measured with the Medical Outcomes Study Short Form-36. Overall, multicomponent patient-directed behavioural interventions appear to beneficially affect quality of life.

There were several limitations of the studies included in the analysis. Although all study participants were women, there was variation in their method of diagnosis and type of UI. There was also variation in the components of the behavioural interventions so that not all studies incorporated the same mix of elements. The use of different outcome measures also hampered comparisons between studies, and none of the studies addressed compliance, which is likely to be an important factor in behavioural interventions. Lastly, the control group was not always usual care. For example, the control groups in the studies by Burgio et al. (40) and Goode et al. (41) consisted of a self-help pamphlet. This could be considered another approach to behavioural techniques; however, it was regarded as usual care for the purposes of this review.

Part B – Pelvic Floor Muscle Training Alone

The Medical Advisory Secretariat review included two older RCTs that had been included in the previously described systematic reviews by Choi et al. (30) and Hay-Smith et al. (31) and that focused on PFMT alone. Although the inclusion criteria for age in the studies was listed as greater than 55 years or 60 years, the mean age of participants in each study was greater than 65 years and thus satisfied the secretariat's criteria. Details of the 2 RCTs are presented in Table 9.

Table 9: Studies on PFMT Interventions for Urinary Incontinence*

Study, Year	Intervention	Study Design	Methods	Outcome	Results	Limitations
Burns et al., 1993 (47)	PFMT + Biofeedback, PFMT alone	RCT	135 cognitively intact community-dwelling women aged >55 y with predominant stress UI 8 weeks duration	Total incontinent episodes per week	Both the PFMT + biofeedback and the PFMT alone treatment groups had significantly fewer weekly incontinent episodes posttreatment than the control group (WMD 10.50; 95% CI, 4.30–16.70) The 2 treatment groups had similar impacts on mild, moderate, and severe urine-loss groups	No intention-to-treat analysis, randomization and allocation concealment not reported, sample size not justified
Miller et al., 1998 (48)	PFMT – basic and digital palpation to teach PFMT Taught "The Knack" method (intentionally contract the PFM before and during a cough)	RCT	27 community-dwelling women >60 y with self-reported stress UI 1 week duration	Urine leakage on the Paper Towel Test	Urine leakage was similar in both groups without The Knack, but when Group 1 used The Knack, subjects leaked 98.1% less than subjects in Group 2 who had not yet learned The Knack (P = .293).	Intention-to-treat analysis not stated, allocation concealment not reported, baseline data not reported, sample size not justified

*PFM indicates pelvic floor muscles; PFMT, pelvic floor muscle training; RCT, randomized controlled trial, WMD, weighted mean difference; UI, urinary incontinence.

Burns et al. (47) reported that women in the treatment groups receiving either PFMT with biofeedback or PFMT alone had significantly fewer weekly incontinent episodes posttreatment than the control group (WMD for treatment groups combined, 10.50; 95% CI, 4.30–16.70). The 2 treatment groups also had similar impacts on mild, moderate, and severe urine loss groups. Miller et al. (48) reported a different outcome, which was urine leakage on the paper towel test, after participants were taught "The Knack" method (i.e., intentionally contracting the PFM before and during a cough). They found that urine leakage without The Knack was similar in both groups, but that when participants used The Knack, they leaked less than participants who had not yet learned the method; however, this difference was not statistically significant (P = .293).

The major limitation of this section was that few studies examined PFMT alone. Most recent trials examined the effectiveness of PFMT as 1 element of a multicomponent intervention. Studies also varied in outcome measures and according to parameters of PFMT. There were no long-term data on adherence. A study by Bo et al. (49) examined PFMT adherence after 15 years but was not limited to the elderly population. They found that women's adherence to training after 15 years was low and that there was no difference in the continence status of women who had received PFMT versus those who had not.

Overall, PFMT alone resulted in an improvement in incontinence outcomes.

Section 3 – Role of Nurse Continence Advisor or Clinical Nurse Specialist in Delivering Behavioural Interventions in a Clinic Setting

Summary of Existing Evidence

One existing systematic review on the role of the nurse in continence care by Du Moulin et al. (50) was identified (Table 10). The review was limited to RCTs that compared the effectiveness of UI treatment by nurses with usual care or no treatment. In order to be included in the analysis, the intervention had to include a nurse playing an important role in the care for UI patients. Eleven RCTs met eligibility criteria. Studies varied in terms of the setting, age limits, and outcomes. The components of the interventions also varied across studies, but the majority of interventions included a combination of patient-directed behavioural treatment elements such as PFMT, bladder training, and education. Overall, the authors reported that the limited evidence indicated that treatment by nurses resulted in a decrease in incontinence. The major limitation of this review was that no set criteria were defined for the nurse's qualifications or the nurse's degree of specialized training in UI. The review included studies with nurses ranging from those with no specialized training in continence care to NCAs, nurse practitioners who were specially trained in UI management, and nurses instructed in treatment details by a urotherapist nurse. Another limitation was that there was ambiguity in the definition of usual care in the control groups.

Table 10: Existing Systematic Review of the Role of the Nurse in Treating Urinary Incontinence*

Systematic Review, Year	Intervention	Number of Studies Included in Review	Results and Conclusions	Comments
Du Moulin et al., 2005 (50)	An intervention with a nurse playing an important role in patient care versus usual care or no treatment Not limited to seniors	11 RCTs	Variation among studies in age, inclusion criteria, outcomes, setting Variation in intervention components, but majority included a combination of treatment elements, of which most common included PFMT, bladder training, and patient education • All studies reported a significantly greater reduction in incontinence episodes in the intervention group. However, most studies had follow-up periods less than 1 year. • One of the 2 RCTs reporting on costs found a significant reduction in costs relating to treatment, but no formal cost-utility analysis was conducted Overall Conclusion: There is limited evidence that treatment by nurses results in a decrease in incontinence.	Not limited to NCA/CNS (only 8/11 studies had nurses that were skilled or specially trained in managing UI) No pooled estimate of effect Ambiguity in definition of usual care in control groups

*CNS refers to clinical nurse specialist; NCA, nurse continence advisor; RCT, to randomized controlled trial.

Systematic Review by the Medical Advisory Secretariat

Given that no studies were identified that were conducted in an exclusively elderly population where the majority of study participants were older than 65 years, the scope of the review was broadened to include studies where the mean age of participants was greater than 60 years. The review was limited to studies with an NCA or CNS with advanced training in UI management who delivered behavioural techniques in a clinic setting. Three RCTs were identified (see Table 11). (51-53) One before/after study was also included in the analysis because it was conducted in Ontario, even though it did not satisfy RCT criteria. (54) It is further described below.

Table 11: Studies with Interventions for Urinary Incontinence Led by Nurse Continence Advisors *

Study, Year Location	Intervention	Study Design	Methods Population	Outcome	Results	Limitations
Borrie et al., 2002 (51) Ontario, Canada	NCA	RCT	NCA sessions every 4 weeks for 6 months versus usual primary care 421 men and women, 50% of participants > 65 y	Incontinent episodes and pad use	Treatment group reported significantly fewer incontinent episodes (P = .001) and less pad usage (P = .021) than control group	Allocation concealment not adequate, no justification for sample size Potential for selection bias since subjects responded to active advertising
Moore et al., 2003 Australia (52)	NCA	RCT	NCA sessions weekly for 12 weeks versus outpatient urogynecology regimen (tertiary unit) 145 women, mean age 60 y	Incontinent episodes and pad use	No significant differences between groups, but changes from baseline showed highly significant reduction of incontinence (incontinent episodes, pad use) for both treatment regimens (P < .01). Caution – study not designed for an intragroup comparison Caution – comparison group not usual primary care NCA regimen was less expensive than the standard urogynecology regimen (median difference A$87.30)	Allocation concealment not adequate, caution by authors of a high drop-out rate (24%)
Williams et al., 2005 (53) United Kingdom	Specially trained nurses	RCT	Continence service by specially trained nurses for 4 weeks over 8-week treatment period versus standard primary care 3,746 men and women, 53% of participants > 60 y	Urinary symptoms	Treatment group reported significantly less leakage (P = .002) and a greater overall improvement (at least 1 symptom alleviated) than control group (P < .001) Cost-effectiveness analysis indicated that a nurse-led intervention could alleviate symptoms at a cost of £242 per symptom over a 3-month period Unclear if this represents value for money	Note that randomization was carried out by household, at a ratio of 4:1 in favour of the continence nurse

*NCA refers to nurse continence advisor; RCT, randomized controlled trial.

The RCTs differed in study parameters such as intervention duration and intensity as well as the outcomes reported. In the 3 RCTs, the behavioural interventions delivered by NCAs in a clinic setting were multicomponent patient-directed behavioural techniques targeted at a mobile elderly population. The study by Moore et al. (52) used a comparator group of tertiary care, unlike the other 2 RCTs where the comparator was standard primary care. This difference in comparison group may partly explain why no significant difference between treatment groups was reported by Moore et al. (52) Overall, results from the 3 RCTs indicate that behavioural interventions led by NCAs or CNSs in a clinic setting are effective in improving incontinence outcomes in community-dwelling seniors and may also have the potential to result in reduced costs to the healthcare system.

A recent before/after Ontario-based study entitled *IC3: Improving Continence Care in the Community* was also included in this review; it was a report for the Ontario Health Performance Initiative of the Ontario Ministry of Health and Long-Term Care. (54) The objective of the study was to implement and evaluate a new interdisciplinary model consisting of NCA continence clinics for integrating continence care in the community. Table 12 presents specific information on the study.

Table 12: Before/After IC3 Project – Improving Continence Care in the Community*

Intervention	Methods	Participants	Outcomes	Results
A new interdisciplinary model consisting of NCA Continence Clinics for integrating continence care in the community	Participants recruited from 2 CCACs (Hamilton-Wentworth and Grey Bruce) 3 NCA continence clinic sites established in each CCAC region 9-month duration 3 clinic visits Behavioural interventions included: behaviour modification related to lifestyle options, PFMT, bowel program, fluid intake, weight reduction, personal hygiene changes, and incontinence product options	N=122, 84% female, mean age 74.5 y Majority had RAI continence scores of frequently or occasionally incontinent (58%) Primary diagnosis: 60% urge UI, 17% stress UI, and 16% mixed UI	Goal Attainment Score Quality of life Cost	Continence Goal Attainment Score: Of the 94 clients who completed at least 1 follow-up visit, there was a significant improvement in Continence Goal Attainment Scores at discharge (mean change in score from baseline 27.74 (score increases if client is able to work on their goals), $P < .001$) Incontinence Quality of Life Score (IQOL): There was a significant improvement in IQOL score for patients who completed the program (mean change 20.51, $P < .001$) Cost: The estimated cost of providing continence care in a clinic setting versus home visiting per individual client for an initial assessment followed by 2 follow-up visits is substantially lower ($120.83 per client in the clinic versus $233.33 per client in the home visit – a cost difference of $112.50). The major driver of this cost difference relates to the time involved in a home visit compared with a clinic visit. Dowell-Bryant Incontinence Cost Index (DBICI): Index measures personal costs related to incontinence. The mean annual cost of disposable products is reduced by 24% for each client who regains/improves his or her continence.

*CCAC refers to Community Care Access Centre; CNS, clinical nurse specialist; NCA, nurse continence advisor; RAI, resident assessment index; PFMT, pelvic floor muscle training; RCT, randomized controlled trial; UI, urinary incontinence.

The IC3 report concluded that NCA continence clinics reduced the physical and financial burden of incontinence, and improved patients' quality of life. The report also concluded that the clinics decreased the cost of incontinence to the system by decreasing overall product use and making the most appropriate use of health human resources. A major limitation of this study was the low referral rate. A post hoc

analysis conducted by the authors indicated that those not referred to the clinics had more physical and cognitive impairments that limited their ability to manage themselves.

Summary of Findings of Literature Review

Table 13: Summary of Evidence on Behavioural Interventions for the Treatment of Urinary Incontinence in Community-Dwelling Seniors

Intervention	Target Population	Interventions	Conclusions
Caregiver-dependent techniques (toileting assistance)	Medically complex, frail individuals at home with/without cognitive deficits and/or motor deficits Delivered by informal caregivers who are trained by NCA/CNS	• Prompted voiding • Habit retraining • Timed voiding	There is no evidence of effectiveness for habit retraining and timed voiding. Prompted voiding may be effective, but because of an inadequately powered study, effectiveness is difficult to substantiate. Resource implications and caregiver burden (usually informal caregiver) should be considered.
Patient-directed techniques	Mobile, motivated seniors Delivered by NCA/CNS	Multicomponent behavioural Interventions Includes a combination of: • bladder training • PFMT (with or without biofeedback) • bladder control strategies • education • self-monitoring	Significant reduction in the mean number of incontinent episodes per week (n=5 studies, WMD 3.63, 95% CI, 2.07–5.19) Significant improvement in patient's perception of UI (n=3 studies, OR 4.15, 95% CI, 2.70–6.37) Suggestive of beneficial impact on patient's health-related quality of life
		PFMT alone	Significant reduction in the mean number of incontinent episodes per week (n=1 study, WMD 10.50, 95% CI, 4.30–16.70)
Behavioural interventions led by an NCA/CNS in a clinic setting	Community-dwelling seniors	Behavioural interventions led by NCAs or CNSs	Overall, effective in improving incontinence outcomes (n=3 RCTs and 1 Ontario-based before/after study)

*CI refers to confidence interval; CNS, clinical nurse specialist; NCA, nurse continence advisor; OR, odds ratio; PFMT pelvic floor muscle training; RCT, randomized controlled trial; UI, urinary incontinence; WMD, weighted mean difference.

GRADE Quality of the Evidence

Table 14: Quality of Trials on Caregiver-Dependent Behavioural Techniques According to GRADE*

Intervention		No of Studies (+ 4 existing reviews)	Quality Assessment					Summary of Findings	Overall Quality
			Design	Quality†	Consis-tency	Direct-ness	Other modifying factors		
Caregiver-dependent techniques	Prompted voiding	1	RCT High	Moderate‡	Yes	Yes	Sparse data Inadequately powered study	There is no evidence of effectiveness for habit retraining and timed voiding. Prompted voiding may be effective but effectiveness is difficult to substantiate due to sparse data and an inadequately powered study.	Low
	Habit retraining	1	RCT High	Moderate§	Yes	Yes	Sparse data		
	Timed voiding	1	RCT High	Moderate ‖	Yes	Yes	Sparse data		

*RCT refers to randomized controlled trial.
†Blinding not possible owing to the nature of the intervention
‡Allocation concealment unclear
§Methods poorly described
‖Allocation concealment unclear and no intention-to-treat analysis

Limitations of the Evidence

For both caregiver-directed and patient-directed behavioural interventions, there was considerable variation in study populations and in the type and severity of participants' UI. Subjective outcome measures such as patient observations and symptoms are frequently reported in the UI literature. Information on anatomical and functional outcomes may be more difficult to collect in this population. Nevertheless, subjective outcomes provide valuable information on effectiveness in this area of study. (55) Although the primary outcome of interest was admission to an LTC home, this outcome was not reported in the UI literature. Also the number of eligible studies was low, and there were limited data on long-term follow-up. Owing to the nature of behavioural interventions, information on compliance and adherence would be important in assessing the effectiveness of interventions; however, the studies did not routinely collect this information. Lastly, it was not possible to capture data on behavioural interventions for UI in the Ontario Provincial Health Planning Database, which made it difficult to contextualize for the Ontario population in terms of assessing current access to treatment and the number of seniors currently seeking care for UI in Ontario.

Table 15: Quality of Trials on Patient-Directed Behavioural Techniques and the Role of the Nurse Continence Advisor / Clinical Nurse Specialist According to GRADE*

Intervention		No of Studies	Quality Assessment					Summary of Findings	Overall Quality
			Design	Quality†	Consis-tency	Directness	Other modifying factors		
Patient-directed Techniques	Multi-compo-nent	6 (+ 2 existing reviews)	RCT High	Moderate‡	Yes	Some uncertainty§	None	Significant reduction in the mean number of incontinent episodes per week (n=5 studies, WMD 3.63, 95% CI, 2.07–5.19)	Moderate
	PFMT Alone	2 (+ 2 existing reviews)	RCT High	Moderate§	Yes	Some uncertainty‖	None	No pooled estimate, because of heterogenous outcomes Overall, effective in improving incontinence outcomes (n=1 study, WMD 10.50, 95% CI, 4.30–16.70)	Moderate
Behavioural interventions led by an NCA/CNS in a clinic setting		3 RCTs +1 before/ after Ontario study (+ 1 existing review)	RCT High	Moderate	Yes	Yes	None	No pooled estimate, because of heterogenous outcomes Overall, effective in improving incontinence outcome	Moderate

*CI refers to confidence interval; CNS, clinical nurse specialist; NCA, nurse continence advisor RCT, randomized controlled trial; WMD, weighted mean difference.
†Blinding not possible owing to the nature of the intervention
‡Not always intention-to-treat and in most studies, allocation concealment unclear
§Allocation concealment not adequate in 2 studies
‖Only included female participants
¶1 out of 3 studies conducted in Ontario population

Economic Analysis

Disclaimer: The Medical Advisory Secretariat uses a standardized costing methodology for all of its economic analyses of technologies. The main cost categories and the associated methods from the province's perspective are as follows:

Hospital: Ontario Case Costing Initiative cost data are used for all in-hospital stay costs for the designated International Classification of Diseases-10 (ICD-10) diagnosis codes and Canadian Classification of Health Interventions procedure codes. Adjustments may need to be made to ensure the relevant case mix group is reflective of the diagnosis and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, the secretariat normally defaults to considering direct treatment costs only.

Non-hospital: These include physician services costs obtained from the Ontario Schedule of Benefits for physician fees, laboratory fees from the Ontario Laboratory Schedule of Fees, device costs from the perspective of local health care institutions, and drug costs from the Ontario Drug Benefit formulary list price.

Discounting: For all cost-effectiveness analyses, a discount rate of 5% is used as per the Canadian Agency for Drugs and Technologies in Health.

Downstream costs: All costs reported are based on assumptions of utilization, care patterns, funding, and other factors. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature. In cases where a deviation from this standard is used, an explanation has been given as to the reasons, the assumptions and the revised approach. The economic analysis represents an estimate only, based on assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied for the purpose of developing implementation plans for the technology.

Economic Analysis of Effective Behavioural Interventions for Urinary Incontinence

The Medical Advisory Secretariat systematic review demonstrated that caregiver-dependent and patient-directed (both multicomponent and single session) behavioural techniques were effective in reducing incontinence episodes in seniors living in the community. Therefore economic analysis to project total cost to implement program in the first year of implementation was calculated based on eligible seniors in the community and their respective caregivers who were willing to participate in behavioural technique sessions. Nurse continence advisors were considered as health care providers, while CNSs were excluded from this analysis as recommended by clinical expert opinion. Table 16 describes the cost to implement the program in the first year for these interventions.

Table 16: Cost to Implement Program (2008 Cdn $)

Parameter	Unit Cost ($)	Unit	Cost in the First Year ($)	Population	N	Total Cost in the First Year ($)
Caregiver-Dependent Behavioural Techniques*						
Nurse Continence Advisor	50.00	per hour	182.50	Frail, homebound, cognitively impaired willing to participate	50,521	9,220,119
Patient-Directed Behavioural Techniques						
Nurse Continence Advisor†	50.00	per hour	130.00	Mobile, independent seniors willing to participate	196,011	25,481,456
Physiotherapist‡	18.41	per session	184.10	Mobile, independent seniors willing to participate	196,011	36,085,662

*The intervention was administered in a home setting to 80% of patients and caregivers, and in a clinic setting to 20%. The intervention included 1 initial assessment (2 hour) + 2 follow-up sessions (1 hour each) with an NCA at home. (54) An occupational therapist might also have visited the home to scan for environmental/physical barriers; this was not factored into the analysis.
†The intervention was administered in a home setting to 20% of patients and in a clinic setting to 80%. The intervention consisted of a multi-component session with an NCA doing pelvic exercises, bladder training, etc., which included 1 initial assessment (1.25 hour) plus 2 follow-up sessions (30 minutes each). (54)
‡The single component included PFMT exercise with a trained physiotherapist providing 10 weekly instructional sessions. (54) Some clients may require follow-up visits a few years later for a refresher and some additional motivation and coaching; this was not factored into the analysis. Assumed a 20.5% (males) and 45.1% (females) prevalence of UI in seniors 65 years and older in Ontario (740,200 males and 945,500 females). (18) Assumed 4.5% of seniors over 65 are in an LTC setting and the remainder are in the community. (56) Assumed prevalence of eligible elders to be 50% for both caregiver-dependent and patient-directed techniques. (54) Assumed a participation rate of 18.3% for caregiver-dependent techniques. (54) Assumed a participation rate of 71% for patient-directed techniques. (54) Nurse continence advisor cost from IC3 report. (54) Physiotherapist cost from fee schedule. (57)

Note: This economic analysis was calculated for the first year after introduction of the interventions, from the perspective of the Ministry of Health and Long-Term Care, using prevalence data only. Prevalence estimates are for all levels of severity of UI (mild, moderate, severe) and all types of UI (stress, urge, mixed). Incidence and mortality rates were not factored in. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in Ontario, and assumptions on costs. Number refers to patients likely to access these interventions in Ontario based on assumptions stated below from the literature. Resource consumption was confirmed by the expert panel.

Assumptions

There were several assumptions made to calculate the annual budget impact:

- assumed a 20.5% (males) and 45.1% (females) prevalence of UI in seniors over 65 years in Ontario (740,200 males and 945,500 females); (18)
- assumed 4.5% of seniors greater than 65 are in an LTC setting and the remainder are in the community; (56)
- assumed prevalence of eligible seniors to be 50% for both caregiver-dependent and patient-directed techniques; (54)
- assumed a participation rate of 18.3% for caregiver-dependent techniques; (37)

- assumed a participation rate of 71% for patient-directed techniques; (54)
- assumed an NCA hourly cost of $50.00; (54)
- assumed a physiotherapist hourly cost of $18.41; (57)
- assumed for caregiver-dependent behavioural techniques to consist of 1 initial assessment (2 hour) plus 2 follow-up sessions (1 hour each) with an NCA – 80% of patients plus caregivers at home and 20% in a clinic; (54)
- assumed for patient-directed behavioural techniques to consist of either a multicomponent session with an NCA doing pelvic exercises, bladder training, etc. – 1 initial assessment (1.25 hour) plus 2 follow-up sessions (30 minutes each) – 20% of patients at home and 80% in a clinic; (54) and
- assumed a single session to consist of PFMT exercise with a trained physiotherapist providing 10 weekly instructional sessions. (54)

Because of the assumptions and the limited data available in the literature, the potential for uncertainty exists. If and when new evidence is presented, these economic results may change, allowing for a more accurate analysis.

Current Expenditures in the Province of Ontario

Currently the province of Ontario absorbs the cost for an NCA (delivered through the 42 Community Care Access Centres [CCACs] across the province of Ontario) in the home setting. The 2007 *Incontinence Care in the Community Report* estimated that a total of 500,000 clients would be referred to these 42 CCACs, and of these, 33.5% of clients would suffer from incontinence. This proportion was estimated from the Hamilton and Grey-Bruce CCAC minimal data set database. At a prevalence of 50% being capable of self-management, the number of potential incontinent clients would be 83,750 in the province of Ontario. The estimated cost of providing continence assessments is $233.33 per client in the home setting, the cost being absorbed by the public system. This cost estimate included resources such as personnel costs, physician communications, record keeping, and product costs. The total estimated expenditure in the province of Ontario is $19,541,387. The clinic cost was not included in this estimation because currently the clinic cost comes out of the global budget of the respective hospital, and very few continence clinics exist in the province. The economic analysis factored in a cost for the clinic setting assuming that the public system would absorb the cost with this new model of community care. Our analysis predicted a cost impact of $25,481,456 for patient-directed behavioural techniques administered by an NCA. If we compare this figure to the current expenditure in the province, the net impact of such a program is approximately $5,940,069. Please note, however, that this is a rudimentary estimate since resource consumption varied between both analyses.

Existing Guidelines

Several guidelines exist regarding the treatment and management of UI. Most guidelines are broad in scope and are not limited to community-dwelling seniors. Following is a list of select guidelines that are most relevant to the research question. Many guidelines have also been developed for individual techniques (e.g., prompted voiding) and have not been included in the list below.

- Canadian Consensus Conference on Urinary Incontinence. *Clinical Practice Guidelines for Adults,* 2001 (23)
- United States Agency for Healthcare Policy and Research (AHCPR), 1996 (22)
- Society of Obstetricians and Gynecologists of Canada. *Conservative Management of Urinary Incontinence*, 2006 (24)

Ontario Health System Impact Analysis

Considerations and Implications

An expert panel on aging in the community met on 3 occasions from January to May 2008, and in part, discussed treatment of UI in seniors in Ontario with a focus on caregiver-dependent and patient-directed behavioural interventions. In particular, it was discussed how treatment for UI is made available to seniors in Ontario and who provides the service. Comments from the panel are reported below.

1. Services/interventions that currently exist in Ontario offering behavioural interventions to treat UI are not consistent. There is a lack of consistency in the following:

- How seniors access UI services:
  - Seniors who are CCAC clients can access treatment for UI through home care services. There may be some inefficiencies with this model of care, given that not all seniors require treatment for UI in the home, and some may be able to seek treatment in a clinic setting instead.
  - Seniors may refer themselves to NCA continence clinics or be referred by their general practitioner, though there are only a few clinics in the province. Currently, the NCA continence clinics are being run as outpatient hospital clinics with costs being absorbed by the hospital global budget.
- Who manages seniors with UI:
  - Seniors with UI are managed by general practitioners, physician specialists (gynecologists, urologists), NCAs through CCAC home visits, and physiotherapists.
  - There is also a lack of physician knowledge on UI. A survey of Canadian family physicians indicated that only 46% of physicians clearly understood incontinence, and just 38% had an organized plan for incontinence problems. Almost half reported that they usually referred patients with incontinence. (19)
- How patients with UI are assessed and managed:
  - There was general consensus that the assessment and management of older people could be greatly improved.

2. Help-seeking behaviours should be taken into account.

- Help-seeking behaviours of seniors with UI are influenced by diverse and complex personal and societal variables such as
  - a lack of knowledge about cause and treatment options,
  - the perception that UI is not a serious problem and misconceptions about normal aging, and
  - the belief that surgery is the only option. (58)

3. Social stigma is associated with UI, and there is a need for public education and an awareness campaign.

- Urinary incontinence has the stigma of a socially unacceptable condition because of public lack of knowledge, misconceptions, and intolerance. This leads to personal isolation, social embarrassment, and delays in seeking medical advice. Additional efforts should be made to improve awareness and decrease social stigma of UI.
- A good example of an organization that has made efforts to improve awareness and decrease social stigma is the Continence Foundation of Australia. The Foundation's objectives are wide-ranging and include raising awareness, encouraging help-seeking, destigmatizing UI, educating community and clinicians, promoting better management, encouraging development of accessible services and information, supporting the development of self-help groups, and facilitating and/or funding

continence-related research. The Canadian Continence Foundation shares many of the same objectives as the Continence Foundation of Australia; however, there is potential for the Foundation to take on a more active role.

4. Other issues were highlighted by the panel:

- Cost of incontinent supplies
  - Each year, an individual with incontinence living at home will spend an average of $1,000 to $1,500 on incontinence supplies. Incontinence supplies are not covered by the provincial public health plans, nor by most private insurance companies, meaning that the full cost of supplies is borne by the individual.
- Health human resources and the availability of NCAs
  - Numbers of NCAs appear to be insufficient.
  - There are 100 NCAs trained in Ontario, but currently only 40 are working in this capacity.

The Canadian Continence Foundation also highlighted some additional policy issues relevant to UI in community-dwelling seniors in its 2007 report. (8) Some of the key points are outlined below.

- "Long wait times for care
  "If a patient overcomes their reticence and discusses their incontinence with their physician, they will often have to wait 6-9 months before they will see a specialist. Another 4-6 month wait is generally required to assess their incontinence, and if surgery is an option, patients can wait up to two years to receive the surgical treatment that they require.
- "Lack of availability of treatments and products
  "Many incontinence treatments (such as injectable bulking agents, which cost as much as $2,000 Cdn) are not covered by public or private health plans, meaning that the patient will need to cover the full cost of the treatment.
- "Lack of access to the newest medicines
  "Most of the drugs for overactive bladder (OAB) that are covered by provincial formularies are older and have negative side effects. Providing some relief to OAB sufferers are newer, more effective drugs. These are however, not covered on the public formularies, therefore if a person suffering from incontinence wants to use these newer, more effective treatments, they will have to pay for them out of their own pockets. As the prevalence of incontinence increases with age, it is often seniors living on fixed incomes who would want to take these medicines, but often lack the financial ability to do so."

Other Considerations

Although the scope of this review was limited to behavioural interventions for UI, the midurethral sling procedure is increasingly being used to treat women with stress UI. In February 2006, the Medical Advisory Secretariat completed a review entitled *Midurethral Slings for Women with Stress Urinary Incontinence*. (21) The analysis concluded, "The midurethral sling procedure is a minimally invasive procedure that is highly effective at reducing the symptoms associated with stress UI in women who have failed conservative treatments for stress UI." Based on the evidence, the Ontario Health Technology Advisory Committee recommended the expansion of the development of guidelines by Health Technology Utilization Guidelines of Ontario from the appropriate use of tension-free vaginal tape (TVT) to the appropriate use of midurethral slings, and that the introduction of a new Ontario Health Insurance Plan code specific to midurethral slings be explored.

Although a full systematic review on midurethral slings in senior women was not undertaken as part of this review, studies in elderly women suggest that age does not seem to be a significant factor for failure of midurethral sling procedures and that these procedures are associated with good clinical outcomes.

However, the risk of postoperative de novo urge incontinence as well as age-related morbidity may be increased. (59-65) Based on expert opinion, approximately 10% of senior women could potentially benefit from midurethral sling procedures.

Conclusions

There is moderate-quality evidence that the following interventions are effective in improving UI in mobile motivated seniors:

- multicomponent behavioural interventions including a combination of bladder training techniques, PFMT (with or without biofeedback), education on bladder control strategies, and self-monitoring; and
- pelvic floor muscle training alone.

There is moderate-quality evidence that when behavioural interventions are led by NCAs or CNSs in a clinic setting, they are effective in improving UI in seniors.

There is limited low-quality evidence that prompted voiding may be effective in medically complex, frail seniors with motivated caregivers.

There is insufficient evidence for the following interventions in medically complex, frail seniors with motivated caregivers:

- habit retraining, and
- timed voiding.

Glossary

Bladder diary: A document that records voiding times and voided volumes, incontinence episodes, pad usage and other information such as fluid intake, the degree of urgency, and the degree of incontinence.

Mixed urinary incontinence: Involuntary urine leakage associated with urgency and also with exertion, effort, sneezing, or coughing.

Nocturia: The complaint of having to wake at night 1 or more times to void.

Pelvic floor muscle training (PFMT): Repetitive selective voluntary contraction and relaxation of specific pelvic floor muscles.

Postvoid residual (PVR): The volume of urine left in the bladder immediately after voiding. This is usually diagnosed by bladder scan (ultrasound) or in-out catheterization. Abnormal volumes are variously defined by researchers as greater than a threshold that may range between 100 and 200 mL.

Stress urinary incontinence: Involuntary urine leakage on effort or exertion, or on sneezing or coughing.

Urge urinary incontinence: Involuntary urine leakage accompanied by or immediately preceded by a sudden compelling desire to pass urine, a desire that is difficult to defer.

Urinary incontinence: The complaint of any involuntary urinary leakage.

Appendix

Appendix 1: Literature Search

Search date: October 3, 2007
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, INAHTA/NHS EED

Database: Ovid MEDLINE(R) <1996 to September Week 3 2007>
Search Strategy:
---

1 exp Urinary Incontinence/ (9701)
2 (urin$ adj3 incontinen$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (11248)
3 1 or 2 (11248)
4 exp Aged/ (749903)
5 (elder$ or senior$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (71440)
6 4 or 5 (765611)
7 3 and 6 (4712)
8 limit 7 to (humans and english language and yr="2000 - 2007") (2863)
9 limit 8 to (controlled clinical trial or meta analysis or randomized controlled trial) (317)
10 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (54569)
11 exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (326025)
12 exp Double-Blind Method/ (48004)
13 exp Control Groups/ (493)
14 exp Placebos/ (8371)
15 RCT.mp. (1998)
16 or/9-15 (366984)
17 8 and 16 (506)

Database: EMBASE <1980 to 2007 Week 39>
Search Strategy:
---

1 exp Urine Incontinence/ (12477)
2 (urin$ adj3 incontinen$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (16445)
3 1 or 2 (16445)
4 Aged/ (906192)
5 (elder$ or senior$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (115074)
6 4 or 5 (944496)

7 3 and 6 (5172)
8 limit 7 to (human and english language and yr="2000 - 2008") (2594)
9 Randomized Controlled Trial/ (149282)
10 exp Randomization/ (24000)
11 exp RANDOM SAMPLE/ (792)
12 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).ti,mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (76601)
13 Double Blind Procedure/ (66657)
14 exp Triple Blind Procedure/ (8)
15 exp Control Group/ (1007)
16 exp PLACEBO/ (104532)
17 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (386635)
18 or/9-17 (511379)
19 8 and 18 (481)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to September Week 4 2007>
Search Strategy:
---
1 exp Urinary Incontinence/ (4189)
2 (urin$ adj3 incontinen$).mp. [mp=title, subject heading word, abstract, instrumentation] (4243)
3 1 or 2 (4590)
4 exp Aged/ (145207)
5 (elder$ or senior$).mp. [mp=title, subject heading word, abstract, instrumentation] (31642)
6 4 or 5 (152354)
7 3 and 6 (1655)
8 limit 7 to (english and yr="2000 - 2007") (929)
9 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (60536)
10 RCT.mp. (736)
11 exp Meta Analysis/ (5696)
12 exp "Systematic Review"/ (3320)
13 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (19960)
14 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (11524)
15 exp PLACEBOS/ (3799)
16 or/9-15 (78869)
17 8 and 16 (152)

References

(1) Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Am J Obstet Gynecol 2002; 187(1):116-26.

(2) Banaszak-Holl J, Fendrick AM, Foster NL, Herzog AR, Kabeto MU, Kent DM et al. Predicting nursing home admission: estimates from a 7 year follow-up of a nationally representative sample of older Americans. Alzheimer Dis Assoc Disorder 2004; 18(2):83-9.

(3) Lachs MS, Williams CS, O'Brien S, Pillemer KA. Adult protective service use and nursing home placement. Gerontologist 2002; 42(6):734-9.

(4) Andel R, Hyer K, Slack A. Risk factors for nursing home placement in older adults with and without dementia. J Aging Health 2007; 19(2):213-28.

(5) Thom DH, Haan MN, VanDenElden SK. Medically recognized urinary incontinence and risks of hospitalization, nursing home admission and mortality. Age Ageing 1997; 26(5):367-74.

(6) Nuotio M, Tammela TL, Luukkaala T, Jylha M. Predictors of institutionalization in an older population during a 13-year period: the effect of urge incontinence.[see comment]. Journals of Gerontology Series A-Biological Sciences & Medical Sciences 2003; 58(8):756-62.

(7) Morrison A, Levy R. Fraction of nursing home admissions attributable to urinary incontinence. Value Health 2006; 9(4):272-4.

(8) The Canadian Continence Foundation. Incontinence: a Canadian perspective [Internet]. [updated 2007; cited 2008 May 1]. Available from: http://www.continence-fdn.ca/pdf/Research_paper_August2007.pdf

(9) Cassel CK, Leipzig RM, Cohen HJ, Larson EB, Meier DE. Geriatric medicine: an evidence-based approach. 4th .ed.New York: Spring-Verlag; c2003. Chapter 63, Urinary incontinence; p. p. 931-56

(10) Tannenbaum C, Perrin L, Dubeau CE, Kuchel GA. Diagnosis and management of urinary incontinence in the older patient. Arch Phys Med Rehabil 2001; 82(1):134-8.

(11) Abrams P, Cardozo L, Khoury S, Wein A. Incontinence. 3rd .ed.Plymouth, UK: Health Publication Ltd; c2005. Chapter 18, Incontinence in the frail elderly; p. p. 1163-239

(12) Wyman JF. Treatment of urinary incontinence in men and older women: the evidence shows the efficacy of a variety of techniques. Am J Nurs 2003; Suppl:26-35.

(13) Herschorn S, Gajewski J, Schulz J, Corcos J. A population-based study of urinary symptoms and incontinence: the Canadian Urinary Bladder Survey. BJU Int 2008; 101(1):52-8.

(14) Irwin DE, Milsom I, Hunskaar S, Reilly K, Kopp Z, Herschorn S et al. Population-based survey of urinary incontinence, overactive bladder, and other lower urinary tract symptoms in five countries: results of the EPIC study. Eur Urol 2006; 50(6):1306-14.

(15) Statistics Canada. Canadian Community Health Survey [Internet]. [updated 2003; cited 2008 May 5]. Available from: http://www.statcan.ca/english/concepts/health/

(16) Ostbye T, Seim A, Krause KM, Feightner J, Hachinski V, Sykes E et al. A 10-year follow-up of urinary and fecal incontinence among the oldest old in the community: the Canadian Study of Health and Aging. Can J Aging 2004; 23(4):319-31.

(17) Swanson JG, Kaczorowski J, Skelly J, Finkelstein M. Urinary incontinence: common problem among women over 45. Can Fam Physician 2005; 51:84-5.

(18) Shamliyan T, Wyman J, Bliss D, Kane R, Wilt T. Prevention of fecal and urinary incontinence in adults. Evidence Report/ Technology Assessment No. 161 (Prepared by the Minnesota Evidence-based Practice Center under Contract No. 290-02-0009) [Internet]. Rockville, MD: Agency for Healthcare Research and Quality; [updated 2007; cited 2008 May 5]. Available from: http://www.ahrq.gov/downloads/pub/evidence/pdf/fuiad/fuiad.pdf

(19) Swanson JG, Skelly J, Hutchison B, Kaczorowski J. Urinary incontinence in Canada. National survey of family physicians' knowledge, attitudes, and practices. Can Fam Physician 2002; 48:86-92.

(20) Medical Advisory Secretariat. Sacral nerve stimulation for urinary urge incontinence, urgency-frequency, urinary retention, and fecal incontinence [Internet]. Ontario Ministry of Health and Long-Term Care; [updated 2005; cited 2008 May 5]. Available from: http://www.health.gov.on.ca/english/providers/program/ohtac/tech/reviews/pdf/rev_sns_030105.pdf

(21) Medical Advisory Secretariat. Midurethral slings for women with stress urinary incontinence [Internet]. Ontario Ministry of Health and Long-Term Care; [updated 2006; cited 2008 May 5]. Available from: http://www.health.gov.on.ca/english/providers/program/ohtac/tech/reviews/pdf/rev_mus_020106.pdf

(22) Agency for Health Care Policy and Research (AHCPR). Urinary incontinence in adults: Acute and chronic management. Clinical Practice Guideline No. 2. 96-0682. US Department of Health and Human Services. Public Health Service, AHCPR; 1996 Mar.

(23) The Canadian Continence Foundation. Canadian Consensus Conference on Urinary Incontinence: clinical practice guidelines for adults [Internet]. [updated 2001; cited 2008 May 5]. Available from: http://www.continence-fdn.ca/health-profs/clinicalpractice.html

(24) Robert M, Ross S, Farrel SA, Easton WA, Epp A, Girouard L et al. Conservative management of urinary incontinence. J Obstet Gynaecol Can 2006; 28(12):1113-25.

(25) Eustice S, Roe B, Paterson J. Prompted voiding for the management of urinary incontinence in adults. Cochrane Database Syst Rev 2000; Issue 2. Art. No.: CD002113. DOI: 10.1002/14651858.CD002113.

(26) Registered Nurses' Association of Ontario. Promoting continence using prompted voiding [Internet]. Toronto, Ontario: Registered Nurses' Association of Ontario; [updated 2005 Jan 1; cited 2007 Oct 5]. Available from: http://www.rnao.org/Storage/12/627_BPG_Continence_rev05.pdf

(27) Ostaszkiewicz J, Johnston L, Roe B. Habit retraining for the management of urinary incontinence in adults. Cochrane Database Syst Rev 2004; Issue 2. Art. No.: CD002801. DOI: 10.1002/14651858.CD002801.pub2.

(28) Ostaszkiewicz J, Johnston L, Roe B. Timed voiding for the management of urinary incontinence in adults. Cochrane Database Syst Rev 2004; Issue 1. Art. No.: CD002802. DOI: 10.1002/14651858.CD002802.pub2.

(29) Wallace SA, Roe B, Williams K, Palmer M. Bladder training for urinary incontinence in adults. Cochrane Database Syst Rev 2004; Issue 1. Art. No.: CD001308. DOI: 10.1002/14651858.CD001308.pub2.

(30) Choi H, Palmer MH, Park J. Meta-analysis of pelvic floor muscle training: randomized controlled trials in incontinent women. Nurs Res 2007; 56(4):226-34.

(31) Hay-Smith EJ, Dumoulin C. Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. Cochrane Database Syst Rev 2006; Issue 1. Art. No.: CD005654. DOI: 10.1002/14651858.CD005654.

(32) Goodman C. Literature searching and evidence interpretation for assessing health care practices. Sweden: The Swedish Council on Technology Assessment in Health Care; 1993

(33) Grade Working Group. Grade [Internet]. [updated 2006 Jun 15; cited 2008 May 1]. Available from: http://www.gradeworkinggroup.org/index.htm

(34) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490.

(35) Jirovec MM, Templin T. Predicting success using individualized scheduled toileting for memory-impaired elders at home. Res Nurs Health 2001; 24(1):1-8.

(36) Engberg S, Sereika SM, McDowell BJ, Weber E, Brodak I. Effectiveness of prompted voiding in treating urinary incontinence in cognitively impaired homebound older adults. J Wound Ostomy Continence Nurs 2002; 29(5):252-65.

(37) Colling J, Owen TR, McCreedy M, Newman D. The effects of a continence program on frail community-dwelling elderly persons. Urol Nurs 2003; 23(2):117-31.

(38) Teunissen TA, de Jonge A, van Weel C, Lagro-Janssen AL. Treating urinary incontinence in the elderly--conservative therapies that work: a systematic review. J Fam Pract 2004; 53(1):25-30.

(39) Johnson TM, Burgio KL, Redden DT, Wright KC, Goode PS. Effects of behavioral and drug therapy on nocturia in older incontinent women. J Am Geriatr Soc 2005; 53(5):846-50.

(40) Burgio KL, Goode PS, Locher JL, Umlauf MG, Roth DL, Richter HE et al. Behavioral training with and without biofeedback in the treatment of urge incontinence in older women: a randomized controlled trial. JAMA 2002; 288(18):2293-9.

(41) Goode PS, Burgio KL, Locher JL, Umlauf MG, Lloyd LK, Roth DL. Urodynamic changes associated with behavioral and drug treatment of urge incontinence in older women. J Am Geriatr Soc 2002; 50(5):808-16.

(42) Burgio KL, Locher JL, Goode PS, Hardin JM, McDowell BJ, Dombrowski M et al. Behavioral vs drug treatment for urge urinary incontinence in older women: a randomized controlled trial. JAMA 1998; 280(23):1995-2000.

(43) Dougherty MC, Dwyer JW, Pendergast JF, Boyington AR, Tomlinson BU, Coward RT et al. A randomized trial of behavioral management for continence with older rural women. Res Nurs Health 2002; 25(1):3-13.

(44) Subak LL, Quesenberry CP, Posner SF, Cattolica E, Soghikian K. The effect of behavioral therapy on urinary incontinence: a randomized controlled trial. Obstet Gynecol 2002; 100(1):72-8.

(45) McFall SL, Yerkes AM, Cowan LD. Outcomes of a small group educational intervention for urinary incontinence: episodes of incontinence and other urinary symptoms. J Aging Health 2000; 12(2):250-67.

(46) McFall SL, Yerkes AM, Cowan LD. Outcomes of a small group educational intervention for urinary incontinence: health-related quality of life. J Aging Health 2000; 12(3):301-17.

(47) Burns PA, Pranikoff K, Nochajski TH, Hadley EC, Levy KJ, Ory MG. A comparison of effectiveness of biofeedback and pelvic muscle exercise treatment of stress incontinence in older community-dwelling women. J Gerontol 1993; 48(4):M167-M174.

(48) Miller JM, Ashton-Miller JA, DeLancey JO. A pelvic muscle precontraction can reduce cough-related urine loss in selected women with mild SUI. J Am Geriatr Soc 1998; 46(7):870-4.

(49) Bo K, Kvarstein B, Nygaard I. Lower urinary tract symptoms and pelvic floor muscle exercise adherence after 15 years. Obstet Gynecol 2005; 105(5:Pt 1):999-1005.

(50) Du Moulin MFMT, Hamers JPH, Paulus A, Berendsen C, Halfens R. The role of the nurse in community continence care: a systematic review. Int J Nurs Stud 2005; 42(4):479-92.

(51) Borrie MJ, Bawden M, Speechley M, Kloseck M. Interventions led by nurse continence advisers in the management of urinary incontinence: a randomized controlled trial. CMAJ 2002; 166(10):1267-73.

(52) Moore KH, O'Sullivan RJ, Simons A, Prashar S, Anderson P, Louey M. Randomised controlled trial of nurse continence advisor therapy compared with standard urogynaecology regimen for conservative incontinence treatment: efficacy, costs and two year follow up. BJOG 2003; 110(7):649-57.

(53) Williams KS, Assassa RP, Cooper NJ, Turner DA, Shaw C, Abrams KR et al. Clinical and cost-effectiveness of a new nurse-led continence service: a randomised controlled trial. Br J Gen Pract 2005; 55(518):696-703.

(54) Skelly J. Improving continence care in the community. IC3 final report. Ontario Health Performance Initiative, Ministry of Health and Long-Term Care; 2008

(55) Fonda D, Resnick NM, Colling J, Burgio K, Ouslander JG, Norton C et al. Outcome measures for research of lower urinary tract dysfunction in frail older people. Neurourol Urodyn 1998; 17(3):273-81.

(56) Long-term care home system report as of March 31, 2007. Toronto: Ministry of Health and Long- Term Care; Long-Term Care Planning and Renewal Branch; 2007

(57) Workplace Safety and Insurance Board. Physiotherapy. Fee schedule [Internet]. [updated 2008; cited 2008 May 1]. Available from: http://www.wsib.on.ca/wsib/wsibobj.nsf/LookupFiles/DownloadableFilePhysiotherapy/$File/2714A.pdf

(58) Milne J. The impact of information on health behaviors of older adults with urinary incontinence. Clin Nurs Res 2000; 9(2):161-76.

(59) Ku JH, Oh JG, Shin JW, Kim SW, Paick JS. Age is not a limiting factor for midurethral sling procedures in the elderly with urinary incontinence. Gynecol Obstet Invest 2006; 61(4):194-9.

(60) Sevestre S, Ciofu C, Deval B, Traxer O, Amarenco G, Haab F. Results of the tension-free vaginal tape technique in the elderly. Eur Urol 2003; 44(1):128-31.

(61) Karantanis E, Fynes MM, Stanton SL. The tension-free vaginal tape in older women. BJOG 2004; 111(8):837-41.

(62) Gordon D, Gold R, Pauzner D, Lessing JB, Groutz A. Tension-free vaginal tape in the elderly: is it a safe procedure? Urology 2005; 65(3):479-82.

(63) Liapis A, Bakas P, Christopoulos P, Giner M, Creatsas G. Tension-free vaginal tape for elderly women with stress urinary incontinence. Int J Gynaecol Obstet 2006; 92(1):48-51.

(64) Dalpiaz O, Primus G, Schips L. SPARC sling system for treatment of female stress urinary incontinence in the elderly. Eur Urol 2006; 50(4):826-30.

(65) Lo TS, Huang HJ, Chang CL, Wong SY, Horng SG, Liang CC. Use of intravenous anesthesia for tension-free vaginal tape therapy in elderly women with genuine stress incontinence. Urology 2002; 59(3):349-53.

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 4

Caregiver- and Patient-Directed Interventions for Dementia

An Evidence-Based Analysis

October 2008

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. Caregiver- and patient-directed interventions for dementia: an evidence-based analysis. *Ontario Health Technology Assessment Series* 2008;8(4).

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to MASinfo.moh@ontario.ca.

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-7289-0 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee (OHTAC).

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

List of Figures

Abbreviations

ADL	Activities of daily living
AMPS	Assessment of motor and process skills
BPSD	Behavioural and psychological symptoms of dementia
CCAC	Community Care Access Centres
CI	Confidence interval
CST	Cognitive stimulation therapy
HTA	Health technology assessment
IADL	Instrumental activities of daily living
INAHTA/CRD	International Agency for Health Technology Assessment / Centre for Reviews and Dissemination
IVR	Interactive voice response
LTC	Long-term care
NCCDSO	National Co-ordinating Centre for National Health Service Service Delivery and Organisation Research and Development
NHS	National Health Service
NSAID	Nonsteroidal anti-inflammatory drug
OT	Occupational therapy
PSW	Personal support worker
QOL	Quality of life
RCT	Randomized controlled trial
RH	Relative hazard
SF-36	Short Form 36 Health Survey Questionnaire

Executive Summary

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

This report features the evidence-based analysis on caregiver- and patient-directed interventions for dementia and is broken down into 4 sections:

1. Introduction
2. Caregiver-Directed Interventions for Dementia
3. Patient-Directed Interventions for Dementia
4. Economic Analysis of Caregiver- and Patient-Directed Interventions for Dementia

Caregiver-Directed Interventions for Dementia

Objective

To identify interventions that may be effective in supporting the well-being of unpaid caregivers of seniors with dementia living in the community.

Clinical Need: Target Population and Condition

Dementia is a progressive and largely irreversible syndrome that is characterized by a loss of cognitive function severe enough to impact social or occupational functioning. The components of cognitive function affected include memory and learning, attention, concentration and orientation, problem-solving, calculation, language, and geographic orientation. Dementia was identified as one of the key predictors in a senior's transition from independent community living to admission to a long-term care (LTC) home, in that approximately 90% of individuals diagnosed with dementia will be institutionalized before death. In addition, cognitive decline linked to dementia is one of the most commonly cited reasons for institutionalization.

Prevalence estimates of dementia in the Ontario population have largely been extrapolated from the Canadian Study of Health and Aging conducted in 1991. Based on these estimates, it is projected that there will be approximately 165,000 dementia cases in Ontario in the year 2008, and by 2010 the number of cases will increase by nearly 17% over 2005 levels. By 2020 the number of cases is expected to increase by nearly 55%, due to a rise in the number of people in the age categories with the highest prevalence (85+). With the increase in the aging population, dementia will continue to have a significant economic impact on the Canadian health care system. In 1991, the total costs associated with dementia in Canada were $3.9 billion (Cdn) with $2.18 billion coming from LTC.

Caregivers play a crucial role in the management of individuals with dementia because of the high level of dependency and morbidity associated with the condition. It has been documented that a greater demand is faced by dementia caregivers compared with caregivers of persons with other chronic diseases. The increased burden of caregiving contributes to a host of chronic health problems seen among many informal caregivers of persons with dementia. Much of this burden results from managing the behavioural and psychological symptoms of dementia (BPSD), which have been established as a predictor of institutionalization for elderly patients with dementia.

It is recognized that for some patients with dementia, an LTC facility can provide the most appropriate care; however, many patients move into LTC unnecessarily. For individuals with dementia to remain in the community longer, caregivers require many types of formal and informal support services to alleviate the stress of caregiving. These include both respite care and psychosocial interventions. Psychosocial interventions encompass a broad range of interventions such as psychoeducational interventions, counseling, supportive therapy, and behavioural interventions.

Assuming that 50% of persons with dementia live in the community, a conservative estimate of the number of informal caregivers in Ontario is 82,500. Accounting for the fact that 29% of people with dementia live alone, this leaves a remaining estimate of 58,575 Ontarians providing care for a person with dementia with whom they reside.

Description of Interventions

The 2 main categories of caregiver-directed interventions examined in this review are respite care and psychosocial interventions. Respite care is defined as a break or relief for the caregiver. In most cases, respite is provided in the home, through day programs, or at institutions (usually 30 days or less). Depending on a caregiver's needs, respite services will vary in delivery and duration. Respite care is carried out by a variety of individuals, including paid staff, volunteers, family, or friends.

Psychosocial interventions encompass a broad range of interventions and have been classified in various ways in the literature. This review will examine educational, behavioural, dementia-specific, supportive, and coping interventions. The analysis focuses on behavioural interventions, that is, those designed to

help the caregiver manage BPSD. As described earlier, BPSD are one of the most challenging aspects of caring for a senior with dementia, causing an increase in caregiver burden. The analysis also examines multicomponent interventions, which include at least 2 of the above-mentioned interventions.

Methods of Evidence-Based Analysis

A comprehensive search strategy was used to identify systematic reviews and randomized controlled trials (RCTs) that examined the effectiveness of interventions for caregivers of dementia patients.

Questions

Section 2.1

- Are respite care services effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Do respite care services impact on rates of institutionalization of these seniors?

Section 2.2

- Which psychosocial interventions are effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Which interventions reduce the risk for institutionalization of seniors with dementia?

Outcomes of Interest

- any quantitative measure of caregiver psychological health, including caregiver burden, depression, quality of life, well-being, strain, mastery (taking control of one's situation), reactivity to behaviour problems, etc.;
- rate of institutionalization; and
- cost-effectiveness.

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology and GRADE Working Group. As per GRADE the following definitions apply:

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Summary of Findings

Conclusions in Table 1 are drawn from Sections 2.1 and 2.2 of the report.

Executive Summary Table 1: Summary of Conclusions on Caregiver-Directed Interventions

Section	Intervention	Conclusion
2.1	Respite care for dementia caregivers	Assessing the efficacy of respite care services using standard evidence-based approaches is difficult. ▪ There is limited evidence from RCTs that respite care is effective in improving outcomes for those caring for seniors with dementia. ▪ There is considerable qualitative evidence of the perceived benefits of respite care. ▪ Respite care is known as one of the key formal support services for alleviating caregiver burden in those caring for dementia patients. ▪ Respite care services need to be tailored to individual caregiver needs as there are vast differences among caregivers and patients with dementia (severity, type of dementia, amount of informal/formal support available, housing situation, etc.)
2.2A	Behavioural interventions (individual ≥ 6 sessions)	▪ There is moderate- to high-quality evidence that individual behavioural interventions (≥ 6 sessions), directed towards the caregiver (or combined with the patient) are effective in improving psychological health in dementia caregivers.
2.2B	Multicomponent interventions	▪ There is moderate- to high-quality evidence that multicomponent interventions improve caregiver psychosocial health and may affect rates of institutionalization of dementia patients.

RCT indicates randomized controlled trial.

Patient-Directed Interventions for Dementia

Objective

The section on patient-directed interventions for dementia is broken down into 4 subsections with the following questions:

3.1 Physical Exercise for Seniors with Dementia – Secondary Prevention

What is the effectiveness of physical exercise for the improvement or maintenance of basic activities of daily living (ADLs), such as eating, bathing, toileting, and functional ability, in seniors with mild to moderate dementia?

3.2 Nonpharmacologic and Nonexercise Interventions to Improve Cognitive Functioning in Seniors With Dementia – Secondary Prevention

What is the effectiveness of nonpharmacologic interventions to improve cognitive functioning in seniors with mild to moderate dementia?

3.3 Physical Exercise for Delaying the Onset of Dementia – Primary Prevention

Can exercise decrease the risk of subsequent cognitive decline/dementia?

3.4 Cognitive Interventions for Delaying the Onset of Dementia – Primary Prevention

Does cognitive training decrease the risk of cognitive impairment, deterioration in the performance of basic ADLs or instrumental activities of daily living (IADLs),[1] or incidence of dementia in seniors with good cognitive and physical functioning?

[1] Activities of Daily Living (ADL) are basic but important general tasks required for day to day living such as bathing, dressing, grooming, eating, and toileting. Instrumental Activities of Daily Living (IADL) are activities that need to be done but on a less time sensitive schedule. These are activities related to

Clinical Need: Target Population and Condition

Secondary Prevention[2]

Exercise

Physical deterioration is linked to dementia. This is thought to be due to reduced muscle mass leading to decreased activity levels and muscle atrophy, increasing the potential for unsafe mobility while performing basic ADLs such as eating, bathing, toileting, and functional ability.

Improved physical conditioning for seniors with dementia may extend their independent mobility and maintain performance of ADL.

Nonpharmacologic and Nonexercise Interventions

Cognitive impairments, including memory problems, are a defining feature of dementia. These impairments can lead to anxiety, depression, and withdrawal from activities. The impact of these cognitive problems on daily activities increases pressure on caregivers.

Cognitive interventions aim to improve these impairments in people with mild to moderate dementia.

Primary Prevention[3]

Exercise

Various vascular risk factors have been found to contribute to the development of dementia (e.g., hypertension, hypercholesterolemia, diabetes, overweight).

Physical exercise is important in promoting overall and vascular health. However, it is unclear whether physical exercise can decrease the risk of cognitive decline/dementia.

Nonpharmacologic and Nonexercise Interventions

Having more years of education (i.e., a higher cognitive reserve) is associated with a lower prevalence of dementia in crossectional population-based studies and a lower incidence of dementia in cohorts followed longitudinally. However, it is unclear whether cognitive training can increase cognitive reserve or decrease the risk of cognitive impairment, prevent or delay deterioration in the performance of ADLs or IADLs or reduce the incidence of dementia.

Description of Interventions

Physical exercise and nonpharmacologic/nonexercise interventions (e.g., cognitive training) for the primary and secondary prevention of dementia are assessed in this review.

---

independent living and include preparing meals, managing money, shopping, doing housework, and using a telephone.

[2] Secondary prevention covers all activities to take care of early symptoms of a disease and to preclude the development of possible irreparable medical conditions.

[3] Primary prevention covers all activities designed to preclude the development of a disease.

Evidence-Based Analysis Methods

A comprehensive search strategy was used to identify systematic reviews and RCTs that examined the effectiveness, safety and cost effectiveness of exercise and cognitive interventions for the primary and secondary prevention of dementia.

Questions

Section 3.1: What is the effectiveness of physical exercise for the improvement or maintenance of ADLs in seniors with mild to moderate dementia?
Section 3.2: What is the effectiveness of nonpharmacologic/nonexercise interventions to improve cognitive functioning in seniors with mild to moderate dementia?
Section 3.3: Can exercise decrease the risk of subsequent cognitive decline/dementia?
Section 3.4: Does cognitive training decrease the risk of cognitive impairment, prevent or delay deterioration in the performance of ADLs or IADLs, or reduce the incidence of dementia in seniors with good cognitive and physical functioning?

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology. As per GRADE the following definitions apply:

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Summary of Findings

Table 2 summarizes the conclusions from Sections 3.1 through 3.4.

Executive Summary Table 2: Summary of Conclusions on Patient-Directed Interventions*

Section	Intervention	1° or 2° Prevention	Conclusion
3.1	Physical exercise for seniors with dementia	2° Prevention	Physical exercise is effective for improving physical functioning in patients with dementia.
3.2	Nonpharmacologic and nonexercise interventions to improve cognitive functioning in seniors with dementia	2° Prevention	▪ Previous systematic review indicated that "cognitive training" is not effective in patients with dementia. ▪ A recent RCT suggests that CST (up to 7 weeks) is effective for improving cognitive function and quality of life in patients with dementia.
3.3	Physical exercise for delaying onset of dementia	1° Prevention	<u>Long-term outcomes</u> ▪ Regular leisure time physical activity in midlife is associated with a reduced risk of dementia in later life (mean follow-up 21 years). <u>Short-term 0utcomes</u> ▪ Regular physical activity in seniors is associated with a reduced risk of cognitive decline (mean follow-up 2 years). ▪ Regular physical activity in seniors is associated with a reduced risk of dementia (mean follow-up 6–7 years).
3.4	Nonpharmacologic and nonexercise interventions for delaying onset of dementia	1° Prevention	<u>For seniors with good cognitive and physical functioning:</u> ▪ Evidence that cognitive training for specific functions (memory, reasoning, and speed of processing) produces improvements in these specific domains. ▪ Limited inconclusive evidence that cognitive training can offset deterioration in the performance of self-reported IADL scores and performance assessments.

*1° indicates primary; 2°, secondary; CST, cognitive stimulation therapy; IADL, instrumental activities of daily living; RCT, randomized controlled trial.

Benefit/Risk Analysis

As per the GRADE Working Group, the overall recommendations consider 4 main factors:

- the trade-offs, taking into account the estimated size of the effect for the main outcome, the confidence limits around those estimates, and the relative value placed on the outcome;
- the quality of the evidence;
- translation of the evidence into practice in a specific setting, taking into consideration important factors that could be expected to modify the size of the expected effects such as proximity to a hospital or availability of necessary expertise; and
- uncertainty about the baseline risk for the population of interest.

The GRADE Working Group also recommends that incremental costs of health care alternatives should be considered explicitly alongside the expected health benefits and harms. Recommendations rely on judgments about the value of the incremental health benefits in relation to the incremental costs. The last column in Table 3 reflects the overall trade-off between benefits and harms (adverse events) and incorporates any risk/uncertainty (cost-effectiveness).

Executive Summary Table 3: Overall Summary Statement of the Benefit and Risk for Patient-Directed Interventions*

	Intervention	Quality	Benefits	Risks/Burden	Overall Strength of Recom-mendation
Section 3.1: Physical Exercise for Seniors with Dementia – Secondary Prevention	Exercise – mix	Moderate	Improvement in functional, cognitive and behavioural outcomes	Short-term follow-up and heterogeneity in studies Unclear if leads to delayed institutionalization	Moderate
Section 3.2. Nonpharmacologic & Nonexercise Interventions to Improve Cognitive Functioning in Seniors with Dementia – Secondary Prevention	Cognitive training	Very low	None	Intervention does not offer significant benefit (possible type 2 error) Unclear if leads to delayed institutionalization	Very low
	Cognitive stimulation therapy (CST)	Moderate/Low	Increased cognition and quality of life	Unclear how CST compares with past terminologies and methodologies. Short-term results. Role and extent of maintenance CST. Unclear how CST may impact functional dependence. Unclear if leads to delayed institutionalization.	Low
Section 3.3. Physical Exercise for Delaying the Onset of Dementia – Primary Prevention	Exercise – walking only	High/Moderate	Short-term decreased incidence of dementia	Unknown if leads to delayed institutionalization.	High/Moderate
	Exercise – mix	High/Moderate	Short-term reduced risk of subsequent cognitive decline	Unknown if leads to delayed diagnosis of dementia or institutionalization.	High/Moderate
	Exercise – mix	Moderate	Long-term decreased incidence of dementia	Unknown if leads to delayed institutionalization.	Moderate
Section 3.4. Nonpharmacologic & Nonexercise Interventions for Delaying the Onset of Dementia – Primary Prevention	Cognitive interventions	Low	Cognitive improvements sustained after 5 years *(however, none of these improvements had effects beyond the specific cognitive domains of the intervention)*	Results addressing functional outcomes unclear. Need more than 5-year follow-up. No evidence to determine if cognitive training leads to: 1) delayed diagnosis of dementia 2) delayed institutionalization	Very low

Economic Analysis

Budget Impact Analysis of Effective Interventions for Dementia

Caregiver-directed behavioural techniques and patient-directed exercise programs were found to be effective when assessing mild to moderate dementia outcomes in seniors living in the community. Therefore, an annual budget impact was calculated based on eligible seniors in the community with mild and moderate dementia and their respective caregivers who were willing to participate in interventional home sessions. Table 4 describes the annual budget impact for these interventions.

Executive Summary Table 4: Annual Budget Impact (2008 Canadian Dollars)

Parameter	Unit Cost ($ Cdn)	Unit	Annual Cost ($ Cdn)	Population*	No. of Patients	Annual Impact ($ Cdn)
Caregiver-Directed Behavioural Techniques†						
Occupational Therapist	120.22	1 hour session - 12 total	1,442.64	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	81,695,125
Nurse	82.12	1 hour session - 12 total	985.44	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	55,804,389
Patient-Directed Exercise Program‡						
Occupational Therapist	120.22	1 hour session - 32 total	3,847.04	Seniors with mild to moderate dementia who are willing to participate	38,696	148,866,672
Physiotherapist	108.49	1 hour session - 32 total	3,471.68	Seniors with mild to moderate dementia who are willing to participate	38,696	134,341,585
Personal Support Worker	30.48	1 hour session - 32 total	975.36	Seniors with mild to moderate dementia who are willing to participate	38,696	37,742,939
Recreation Therapist	25.85	1 hour session - 32 total	827.20	Seniors with mild to moderate dementia who are willing to participate	38,696	32,009,678
Caregiver- and Patient-Directed Behavioural Techniques§						
Occupational Therapist	120.22	1 hour session - 10 total	1,202.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	68,079,271
Nurse	82.12	1 hour session - 10 total	821.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	46,503,658

*Assumed 7% prevalence of dementia aged 65+ in Ontario.
†Assumed 8 weekly sessions plus 4 monthly phone calls.
‡Assumed 12 weekly sessions plus biweekly sessions thereafter (total of 20).
§Assumed 2 sessions per week for first 5 weeks. Assumed 90% of seniors in the community with dementia have mild to moderate disease. Assumed 4.5% of seniors 65+ are in long-term care, and the remainder are in the community. Assumed a rate of participation of 60% for both patients and caregivers and of 41% for patient-directed exercise. Assumed 100% compliance since intervention administered at the home. Cost for trained staff from Ministry of Health and Long-Term Care data source. Assumed cost of personal support worker to be equivalent to in-home support. Cost for recreation therapist from Alberta government Website.
Note: This budget impact analysis was calculated for the first year after introducing the interventions from the Ministry of Health and Long-Term Care perspective using prevalence data only. Prevalence estimates are for seniors in the community with mild to moderate dementia and their respective caregivers who are willing to participate in an interventional session administered at the home setting. Incidence and mortality rates were not factored in. Current expenditures in the province are unknown and therefore were not included in the analysis. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the province, and assumptions on costs. The number of patients was based on patients likely to access these interventions in Ontario based on assumptions stated below from the literature. An expert panel confirmed resource consumption.

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

This report features the evidence-based analysis on caregiver and patient-directed interventions for dementia and is broken down into 4 sections:

1. Introduction
2. Caregiver-Directed Interventions for Dementia
3. Patient-Directed Interventions for Dementia
4. Economic Analysis of Caregiver and Patient-Directed Interventions for Dementia

1. Introduction

Objective

To assess the effectiveness of patient- and caregiver-directed interventions in supporting seniors with dementia and their caregivers in the community.

Clinical Need: Target Population and Condition

Dementia Identified as a Predictor of Long-Term Care Home Admission

Dementia is a progressive and largely irreversible syndrome that is defined as the "loss of intellectual abilities (medically called cognitive function) of sufficient severity to interfere with social or occupational functioning". (1) The components of cognitive function affected include memory and learning, attention, concentration and orientation, problem-solving, calculation, language, and geographic orientation. Dementia was identified as one of the key predictors in a senior's transition from independent community living to admission to a long-term care (LTC) home since approximately 90% of individuals diagnosed with dementia will be institutionalized before death. (2) In addition, the cognitive decline linked to dementia is one of the most commonly cited reasons for institutionalization. (3) A study published in 2004 found a strong predictive effect, with a hazard ratio (HR) of 2.3 (95% confidence interval [CI]: 1.8-2.8) for severe dementia versus no dementia. (4)

Several patient and caregiver factors have been established as predictors of institutionalization for elderly patients with dementia. Factors identified from the Canadian Study of Health and Aging included type of dementia (Alzheimer's disease), problematic behaviours, and severity of disabilities [activities of daily living (ADL) dependencies]. Caregiver factors included level of caregiver burden, old age, poor physical health, no first-degree kinship of the caregiver with the patients, use of services, and desire to institutionalize. (5) The study found that caregiver burden often resulted from the patient's behavioural problems and that caregiver burden was associated with the caregiver's depressive mood. (5)

The decision to institutionalize, however, is impacted by many other factors. Contextual and psychosocial factors such as family dynamics, interactions with health care professionals, and the caregiver's perception of their ability to provide care, play a large role in explaining a caregiver's decision to institutionalize (Figure 1).

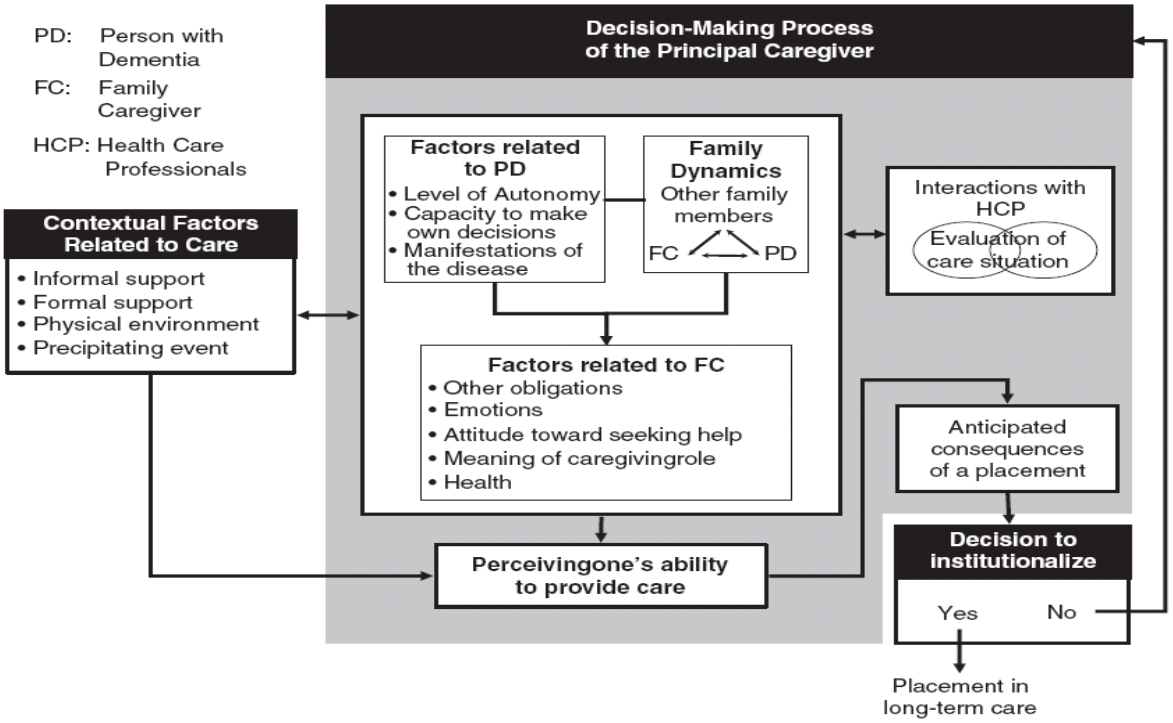


Figure 1: Emerging Theoretical Model Explaining Caregivers' Decision to Institutionalize an Older Relative Living with Dementia (from Caron et al, 2006) (3)

Epidemiology of Dementia

Dementia has a significant global impact. It is estimated that there are 24.3 million people with dementia worldwide with 4.6 million new cases presenting each year. (6)In Canada, the most reliable prevalence estimates come from the Canadian Study of Health and Aging, a population-based survey conducted in 1991. Table 1 displays the dementia prevalence by 5-year age groups in the Canadian population in 1994. Based on these estimates, it is projected that there will be approximately 165, 000 dementia cases in Ontario in the year 2008, and by 2010 the number of cases will increase by nearly 17% over 2005 levels. (7) By 2020 the number of dementia cases is expected to increase by nearly 55%, due to a rise in the number of people in the age categories with the highest prevalence (85+). The increase in dementia cases will cause a greater demand on health care resources including LTC, medical, social, and recreational services.

Table 1: Canada Dementia Prevalence by 5-Year Age Groups (1994)

Age Group	Prevalence, %
65–69	1.4
70–74	2.8
75–79	5.6
80–84	11.1
85+	24

Types of Dementia

Dementia can arise from a number of causes however the 2 most common are Alzheimer's disease and vascular dementia, accounting for approximately 64% and 20%, respectively, of all dementia cases in Canada. (8;9) Other diseases and conditions identified to cause symptoms of dementia include Lewy body dementia, Huntington's disease, Creutzfeld-Jakob Disease, Human Immunodeficiency Virus (HIV) dementia, alcohol-related dementia, Parkinson's disease, stroke, and nutritional deficiencies.

The most common symptoms of dementia include confusion, agitation, forgetfulness, and sleep disturbance.

Less than 10% of cases are reversible. (10) As dementia progresses individuals are often disoriented with respect to time, place, and people they encounter. Dementia is often confused with delirium and other mental illnesses. Managing the cognitive and noncognitive symptoms of dementia is demanding and challenging. Individuals with moderate and advanced dementia typically require a full-time caregiver to help them with daily tasks such as eating, bathing, and dressing. Caregivers must also ensure that individuals with dementia are not harmful to themselves or others.

Dementia Risk Factors

Several risk factors have been identified that put one at a higher risk for developing dementia. These include age, genetics/family history, smoking, heavy alcohol use, abnormally high levels of plasma homocysteine, Down syndrome, diabetes, and mild cognitive impairment. Both atherosclerosis and hypercholesterolemia are significant risk factors for vascular dementia. (11)

Prevention of Dementia

Since the exact cause of dementia is not known, it is difficult to engage in prevention. Furthermore, few definitive studies exist and the majority of these focus on prevention of Alzheimer's disease, making generalizability difficult to other dementias. However, factors which may possibly contribute to the prevention of Alzheimer's include: lowering homocysteine, treatment of high blood pressure, lowering cholesterol, exercise, education, controlling inflammation, and the long-term use of non steroidal anti-inflammatory drugs (NSAIDS). Prevention of vascular dementia requires modification of lifestyle factors closely related to stroke including: maintaining a healthy weight, treatment of high blood pressure, smoking cessation, and lowering cholesterol. (11) Currently, researchers are investigating other preventative measures such as leisure activities (reading, playing board games, playing musical instruments, and dancing). (12) A few studies have also suggested that light to moderate alcohol use may reduce the risk of dementia in older people. (13;14)

Treatment and Management of Dementia

Pharmacological Treatment

While there are no drugs available to stop the progression of dementia, cholesterolase inhibitors are widely used to improve symptoms and slow its progression. Drug treatment may also enhance the quality of life (QOL) of dementia patients and ease the level of caregiver burden, thus potentially delaying admission to LTC. Other drugs such as antidepressants or antipsychotics may be prescribed to aid with the Behavioural and Psychological Symptoms of Dementia (BPSD) such as depression, anxiety, agitation, aggression, sleep disorders, and psychotic symptoms. (11)

Psychosocial Treatment

Due to the complex and challenging nature of dementia, treatment and management of patients goes well beyond pharmacological therapy. Both the cognitive features and noncognitive symptoms of the syndrome cause immense stress to both patients and caregivers. Psychosocial interventions designed to alleviate the burden and stress of caring are essential for caregivers in the management of dementia. These include respite care services, psychoeducational interventions, and counseling, as well as a host of other supportive services. Since BPSD is highly correlated with caregiver burden and in turn a major influence in a caregiver's decision to institutionalize, interventions to help manage BPSD are essential to the caregiver. Typically, environmental and behavioural interventions are used to manage BPSD, and drugs are prescribed only if these are inadequate.

Use of Community Services

People with dementia who have severe functional disability receive far more services than those with mild to moderate disability. And, although the needs of patients and caregivers of dementia increase with increasing levels of patient disability, services remain underutilized in this population. Only 3.4% of dementia caregivers use respite services, a service identified by caregivers as a key formal support to alleviate the stress of caring. It has been documented that spousal caregivers use fewer support services than caregivers who are adult children. Despite the decreased utilization in services, dementia has a significant economic burden on the Canadian health care system. A main driver for these costs is the cost associated with caring for a dementia patient in LTC. In 1991, the total net costs of dementia in Canada were $ 3.9 billion (Cdn) with 2.18 billion coming from LTC (Table 2).

Table 2: Total Net Costs of Dementia in Canada From the Canadian Study on Health Aging (15)

Source of Costs	Total Annual Net Costs, $ million
Long-term care	2,180
Community	1,250
Paid services	*615*
Unpaid services	*636*
Drugs	60.6
Hospitals*	0
Diagnosis	13.5
Research	9.8
People < 65 years	389

*Costs did not differ significantly between dementia and control subjects

Role of the Caregiver for Dementia Patients

Caregivers play a crucial role in the management of dementia patients due to the high levels of dependency and morbidity that are associated with dementia. Although caregivers can be formal (paid), much of the burden of caregiving is often placed on informal (unpaid) caregivers, typically family caregivers. A family caregiver is defined a person who considers themselves to be a primary caregiver and who is providing care because of a prior relationship with the client. (16;17) They may be members of a biological family or friends, partners, and neighbours.

Data from the Canadian Study of Health and Aging provides us with caregiving patterns for seniors with dementia across Canada. According to the report, approximately 50% of seniors with dementia live in the community (at home); 97% of these people have a caregiver, 2.4% have no caregiver, 29% live alone but typically have a daughter living close by, and 8% have only 1 caregiver for support. (18)

Over 70% of informal caregivers are women, most often wives (24%) or adult daughters (29%). Half of the informal caregivers are over the age of 60 with 36% being over the age of 70. Ninety-two percent of people with dementia living in the community have 2 or more relatives or friends beyond their primary caregiver who provide assistance. Finally, spousal caregivers are less likely to have back-up support than others and yet are more likely to be caring for a person with severe dementia. (18)

It has been documented that there is a greater demand faced by dementia caregivers when they are compared with caregivers of persons with other chronic diseases. The increased burden of caregiving attributes to chronic health problems seen among informal dementia caregivers. According to the Canadian Study of Health and Aging, 16% of people caring for someone with mild dementia in the community report symptoms of depression. The rate is more than double for those caring for someone with moderate dementia (40%). The prevalence of depression in dementia caregivers is nearly twice that of caregivers of persons with other chronic diseases. (18)

Based on prevalence estimates from the Canadian Study of Health and Aging, it is projected that there will be approximately 165,000 dementia cases in Ontario in the year 2008. (7) Assuming that 50% of persons with dementia live in the community, (18)a conservative estimate of the number of informal caregivers is 82,500. Recognizing that 29% of people with dementia live alone(18), results in an estimate of 58,575 Ontarians providing care for a person with dementia with whom they co-reside.

Support for Seniors With Dementia and Their Caregivers in the Community

While it is recognized that some seniors with dementia will receive the best and appropriate care for their situation in a LTC home, there are many seniors with dementia who transition to LTC unnecessarily. These patients often have caregivers who are overburdened by the demands of caregiving and lack the support services required to manage the patient. Keeping seniors with dementia in the community requires a network of formal and informal support services for both the caregiver and patient.

The 2 main categories of interventions for dementia caregivers are respite care and psychosocial interventions. Respite care is identified by caregivers as one of the key formal supports to alleviate the stress of caring. (19) Respite care is defined as a break or relief for the caregiver. In most cases, respite is provided in the home, through day programs or at institutions (usually 30 days or less). Depending on a caregivers needs, respite services will vary in delivery and duration. A number of individuals carry out respite care including paid staff, volunteers, family, or friends.

Psychosocial interventions encompass a broad range of interventions and have been classified in various ways in the literature. They may include educational, behavioural, dementia-specific, supportive, and coping interventions. Multicomponent interventions may also be used which include at least 2 of the above-mentioned interventions. Patient interventions may be focused on promoting independence and maintaining cognitive function. In addition to pharmacological treatment to slow the progression of dementia, nonpharmacological interventions including occupational therapy (OT), physical therapy, exercise, and cognitive therapy may be explored.

It is hoped that by optimizing support services, we can improve the QOL and psychological health of seniors with dementia and their caregivers living in the community.

2. Caregiver-Directed Interventions for Dementia

2.1. Respite Care for Caregivers of Seniors With Dementia

Clinical Need: Target Population and Condition

Caregivers play a crucial role in the management of seniors with dementia due to the high level of dependency and morbidity that is associated with this condition. It has been documented that there is a greater demand faced by dementia caregivers as compared with caregivers of persons with other chronic diseases. Furthermore, the increased burden of caregiving attributes to a host of chronic health problems seen among many informal dementia caregivers. Much of this burden results from managing BPSD, which has been established as a predictor of institutionalization for elderly patients with dementia. (5) As dementia progresses, individuals typically require a full-time caregiver to help them with daily tasks such as eating, bathing, and dressing. Caregivers must also ensure that individuals are not harmful to themselves or others.

Respite care is a service identified by carers as one of the key formal supports to alleviate the stress of caring. (19) Respite care is defined as a break or relief for the caregiver. (20) In most cases, respite is provided in the home, through day programs or at institutions (usually 30 days or less). Depending on caregivers needs, respite services will vary in delivery and duration. A number of individuals may carry out respite care including paid staff, volunteers, family, or friends.

Evidence-Based Analysis of Effectiveness

Questions

- Are respite care services effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Do respite care services impact on rates of institutionalization of these seniors?

Methods

Inclusion Criteria

- English-language articles (January 2000–November 2007),
- journal articles that report primary data on the effectiveness or cost-effectiveness of respite care services for dementia caregivers of seniors living in the community,
- study design and methods must be clearly described,
- systematic reviews, meta-analyses, or RCTs, and
- primary outcome includes at least 1 measure of caregiver psychological health.

Exclusion Criteria

- studies that are duplicate publications (superseded by another publication by the same investigator group, with the same objective and data),
- non-English articles,

- studies with less than 10 patients, and
- formal (paid) carers.

Literature Search

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, The Cochrane Library, PsycINFO, and the International Agency for Health Technology Assessment/Centre for Reviews and Dissemination (INAHTA/CRD) for studies published between January 2000 and November 2007 (Appendix 1). Abstracts were reviewed by a single author, and studies meeting the inclusion criteria were obtained. Reference lists were also checked for relevant studies.

Outcomes of Interest

- caregiver: burden, depression, QOL, mood, and
- care recipient: rate of institutionalization, functional outcomes, QOL.

Results of Literature Search

The search identified 530 articles published from January 1, 1998 to November 1, 2007. Of the 530 citations identified, 2 met the inclusion criteria. These were both systematic reviews evaluating the effectiveness of respite care for dementia caregivers and are outlined below:

- one systematic review conducted in the United Kingdom and prepared for the National Co-ordinating Centre for National Health Service (NHS) Service Delivery and Organisation Research and Development (NCCSDO), and (21)
- one systematic review completed by the Cochrane Collaboration. (22)

Summary of Existing Evidence

NCCSDO - Arskey et al. 2004

The objective of this review was to evaluate the effectiveness and cost-effectiveness of respite care or short term breaks for caregivers of people with dementia. The review encompassed a broad spectrum of literature (published and grey literature) and included studies with both quantitative and qualitative designs. Out of the 45 studies examined, only 5 were RCTs (Table 3) and the majority of studies examined day care programs. Due to the heterogeneity in studies and quality of the trials, a narrative review was conducted to synthesize the evidence. In addition, the authors consulted with various stakeholders, including organizations offering respite services and dementia caregivers, to better understand the components of an effective respite care service.

Table 3: Numbers of Studies According to Research Design and Type of Respite Care and Short-Term Break for Carers for People with Dementia* (n=51)†

	RCTs	Quasi-Experimental	Before and After	Survey/ Postrespite Intervention	Qualitative interviews	Mixed Methods	Other
Day care	2	3	2	7		7	
Institutional respite			5	1		6	
In-home respite		1		3	2	2	
Multi-dimensional carer-support packages	3	1					
Respite programmes		1	2				
Host-family respite					1		
Video respite						1	1
Total	5	6	9	11	3	16	1

Adapted from Arskey H. et al. 2004 (21)
*RCT indicates randomized controlled trials.
†Note: Studies add up to 51 because 5 studies in the review evaluated 2 or more forms of respite.

Summary of Effectiveness and Cost-Effectiveness

Effectiveness

The primary outcomes of interest were the health and well-being of the caregiver and care recipient, dementia-related symptoms (care recipient), impact on use of other services, and cost-effectiveness. The findings were reported according to type of respite service including day care, in-home respite, host-family respite, institutional/overnight respite, respite programmes, multidimensional caregiver-support packages, and video respite. The authors concluded that the evidence on the effectiveness and cost-effectiveness of respite care services for dementia caregivers is limited. However, the review reported considerable qualitative evidence from carers (and some care recipients) of the perceived benefits of the use of respite services.

Delay of Entry Into Long-Term Care

The only studies to show a postponement in the entry into LTC of seniors with dementia in the study groups compared with those in the control groups were the 3 studies on multisupport caregiver packages. The length of the delays varied, and ranged between an average of 22 days (23) and 7 weeks. (24;25) Since respite care was offered as part of a package, it is difficult to discern the individual effects of services. Moreover, although multidimensional support packages seemed to delay entry into LTC, they did not necessarily impact the caregivers' psychosocial health in terms of anxiety or QOL.

One of the major challenges with assessing the effectiveness of respite care using standard evidence-based practices is the lack of high-quality trials conducted in this field. Therefore, any conclusions must be interpreted with caution. However, the authors did find RCT evidence to suggest that the complex needs of dementia carers may be better addressed by multidimensional packages that allow carers access to a wide range of community-based services.

Cost-Effectiveness

There were 5 economic reports included in the NCCSDO review. Four of the reports examined day care services compared to standard care. All of these studies reported potential benefits of respite care offered through day care services; however, there was a discrepancy among the studies with respect to the costs associated with these benefits. Two of the 4 studies suggested that the benefits associated with day care services come at a higher cost than standard care and 2 of the 4 studies reported that the benefits come at a lower cost. With the exception of 1 of the 4 reports, there were no statistically significant differences found in the costs and benefits across groups in any of these studies; thus, findings must be interpreted with caution.

The fifth economic report included in the review examined the cost-effectiveness of multi-dimensional carer-support packages compared to standard community nursing care. The authors reported that the multi-dimensional carer-support packages were associated with higher benefits for the caregiver at a higher cost; however, differences were not statistically significant.

Limitations

There are several limitations described in detail by the authors of this review. Firstly, although 45 studies were included in the review, few were of high methodological quality. In addition, only a few studies assessed the medium- to long-term effects of respite care. The lack of significant findings is also attributable to the heterogeneity in studies with respect to outcome measures, patient and caregiver populations, duration of studies, amount and type of respite, timescales, weaknesses in study design, and inadequate or lack of control groups.

Cochrane Review – Lee et al. 2004

The objective of the review was to assess the effects of respite care for people with dementia and their caregivers, in particular the effects of respite care on rates of institutionalization. The review examined 3 RCTs but included only 2 in the analysis (Table 4).

Table 4: Summary of Key Characteristics of Studies Examined in the Cochrane Review of Respite Care

	Grant et al. 2003 (26) (n=55)	Lawton et al. 1989 (23) * (n=632)	Wishart et al. 2000 (27) (n=24)
Type of respite	In-home	In-home, day-care, institutional† Funding was provided as needed	Visiting/ walking programme
Duration	2 weeks	1 year	6 weeks
Intensity	60 hours (no more than 6 hrs/day)	As requested	2.5 hrs/week
Delivered by	Trained professionals	Varied	Trained volunteer
Controls	No respite	No respite‡	Wait-list

*Not included in the Cochrane analysis.
†Not mutually exclusive.
‡Had higher use of respite services than intervention group.

Conclusions

The authors concluded that there are no significant effects of respite on caregiver outcomes; however, this is due to the lack of high-quality research in this area and thus, current evidence does not allow one to make any reliable conclusions about the efficacy of respite care for people with dementia and their caregivers.

Limitations

A lack of significant findings can be attributed to the many limitations of the studies included in the review. As seen in Table 4, there is much heterogeneity among the 3 studies with respect to type of respite, duration, intensity and delivery of intervention. The 2 studies used in the analysis of the review (Grant et al. 2003 (26) and Wishart et al. 2000 (27)), both had small sample sizes (55 and 24 respectively). Both studies also had extremely short durations (2 and 6 weeks), so it is questionable whether the effects of respite care could be observed and evaluated in such a short time. Furthermore, with the exception of Grant et al. (26), the studies had inadequate control groups. In the Lawton et al. study (23), the control group had a higher use of respite services than the intervention group, making evaluation of the effectiveness of respite impossible. Wait-list controls were used in the Wishart et al. study (27), which are often questioned for their appropriateness in caregiver intervention studies. It is possible that any improvement in caregiver outcomes observed in the intervention arm of the study were not significant because caregivers in the control group knew that they would be receiving respite care services and thus had higher values of caregiver health at baseline.

Updates to Published Health Technology Assessments

There were no updates to these published health technology assessments (HTAs).

Ontario Health Systems Impact Analysis

Considerations and Implications

An expert panel on aging in the community met on February 29, 2008, and May 16, 2008 and discussed, in part, respite care for seniors with dementia in Ontario. In particular, the expert panel commented on the gaps in current understanding and delivery of respite care and methodological difficulties with evaluating respite care services for the senior population. Comments from the panel are found below.

Methodological and Quality Issues With Studies

- Respite care is difficult to define.
- Randomized controlled trials are very challenging to conduct in this population.
- Caregivers of seniors with dementia have complex and diverse needs.
- Patients differ greatly with respect to type of dementia, severity of disease, and limits in ADLs and IADLs.
- Caregivers differ greatly with respect to characteristics, age, health status, relationship to care recipient, amount of formal or informal support available, and use/access of other supportive services.
- Outcomes measured may not be sensitive/appropriate measures to detect effectiveness of respite.
- Interventions are heterogeneous (type of respite, duration, intensity).
- Study duration is typically short; therefore, it is difficult to assess medium- to long-term effects.
- There are many forms of respite that are effective but have not been studied (i.e., respite provided through religious groups). One must be careful with how the results of the respite care literature are reported.

Current Delivery

- Community Care Access Centres (CCACs) provide respite care in 3 ways:
  - informal in-home, 1-on-1 care for a couple of hours per day,
  - referral to community-support programs, and
  - referral to short-term nursing home stays.
- Hours of respite are coordinated by CCACs and delivered by personal support workers (PSWs).
- Informal agencies and religious groups provide some respite services (congregate driving, meals on wheels, and friendly visiting).
- What seems to be useful is someone taking the senior with dementia for a walk for 1 to 2 hours per day since this gives the caregiver free time. This is often organized by a PSW from a CCAC.
- In general, a short-term stay in a nursing home has less positive effects than other forms of respite since there is disruption of routine for the patient/ caregiver.

System Pressures

- Problem: not enough hours of respite provided by PSWs from CCACs.
- Other issues are: high turnaround of staff, lack of flexibility, lack of knowledge to manage behavioural challenges, inconsistency in delivery of services.
- Individuals with dementia need a familiar face and an individualized approach.
- Large issue in evaluating effectiveness of interventions in the dementia population.
- Often, informal arrangements are made (i.e., with neighbours/friends, etc.) to alleviate the burden of the caregiver.

Future Research/Direction

- There exist caregiver-support programs that define the number of hours in-home and flexibility benchmarks for caregiver-support interventions.
- In nursing homes, spouses of people with dementia support one another and help with the caregiving requirements, which is a form of respite for these caregivers.
- Not enough research is done into what happens to caregivers once the care receiver dies.

Overall Summary Statement of the Efficacy of Respite Services

There is poor-quality and inconclusive evidence from RCTs surrounding the effectiveness and cost-effectiveness of respite care services. Due to the methodological difficulties with studying respite services, especially within an RCT design, alternate forms of research may need to be explored such as interviews with focus groups and organizations providing respite services to determine effectiveness and identify the caregiver population who would most benefit from these services. Consultation with experts reveals the value and importance of respite care services to caregivers in alleviating the burden associated with caring for seniors with dementia and the need to optimize current services.

2.2A. Psychosocial Interventions for Caregivers of Seniors With Dementia

Clinical Need: Target Population and Condition

Caregivers of seniors with dementia are often overburdened by the demands of caregiving and lack the support services they require. Keeping patients in the community requires the extension of formal and informal support services. In addition to respite care services, psychosocial interventions are essential to caregivers in the management of patients with dementia. Psychosocial interventions encompass a broad range of interventions including psychoeducational interventions, counseling, supportive therapy, and behavioural management interventions, as well as a host of other supportive services. Many studies have examined the effects of psychosocial interventions on caregivers' psychological health, especially as it relates to caregiver burden and depression, which are key predictors of institutionalization of seniors with dementia. (5)

Evidence-Based Analysis of Effectiveness

Questions

- Which psychosocial interventions are effective in supporting the well-being of unpaid caregivers of seniors with dementia in the community?
- Which interventions reduce the risk for institutionalization of seniors with dementia?

Comparisons of Interest (and for which evidence of these comparisons exist)

Psychosocial intervention versus no intervention (control group receiving routine care or minimal support).

Methods

Inclusion Criteria

- English-language articles (1996 – February 2008),
- journal articles that report primary data on the effectiveness of dementia caregiver interventions,*
- study design and methods must be clearly described, and
- systematic reviews, meta-analyses, RCTs.

*including respite interventions

Exclusion Criteria

- studies that are duplicate publications (superseded by another publication by the same investigator group, with the same objective and data),
- nonsystematic reviews, letters, and editorials,
- studies with less than 10 patients, and
- formal (paid carers).

Literature Search

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, The Cochrane Library, PsycINFO, and INAHTA/CRD for studies published between January 1996 and February 2008 (Appendix 2). Abstracts were reviewed by a single author, and studies meeting the inclusion criteria outlined above were obtained. Reference lists were also checked for relevant studies.

Outcomes of Interest

Caregiver: Burden, depression, reactivity to behaviour problems, QOL, mood, mastery, anxiety, physical health

Care recipient: Rate of institutionalization, functional outcomes, frequency of problem behaviours, QOL

Results of Literature Search

The Cochrane and INAHTA/CRD databases yielded 7 systematic reviews/meta-analyses on caregiver interventions for dementia caregivers.

Summary of Existing Evidence

Table 5: Summary of Systematic Reviews and Meta-Analyses on Dementia Caregiver Interventions*

Author, Year, Type of Study (# of trials)	Interventions Examined	Outcome(s) †	Conclusion
Peacock et al. 2003 (28) Systematic review (n=11)	▪ Education ▪ Case management (CM) ▪ Psychotherapy ▪ Computer networking	▪ Well-being ▪ Depression ▪ Strain ▪ Other	▪ Few significant effects. ▪ Case management increased likelihood of using formal support services. ▪ An education intervention was able to decrease depression among caregivers at 3-months follow-up. ▪ Psychotherapy for caregivers delayed institutionalization of care recipient. ▪ Use of computer networking improved decision-making confidence.
Brodaty et al. 2003 (29) Meta-analysis (n=30)	▪ CG interventions excluding respite care	▪ Psychological morbidity ▪ Burden	▪ Modest but significant benefits on CG knowledge, psychological morbidity and coping skills. ▪ Statistically significant findings included structured programs involving the patients in addition to the CG.
Thompson et al. 2007 (30) Systematic review (n=44)	▪ Information ▪ Support	▪ QOL ▪ Physical & Mental health ▪ Burden ▪ Satisfaction ▪ ADL or behaviours (CR) ▪ Economic outcomes	▪ No evidence that information and support-based interventions for CG are uniformly effective. ▪ Statistically significant evidence that group-based supportive interventions impact positively on psychological morbidity.
Acton et al. 2001 (31) Meta-analysis (n=24)	▪ Support group ▪ Education ▪ Psychoeducation ▪ Counseling ▪ Respite care ▪ Multicomponent	▪ Burden	▪ Collectively the interventions had no effect on caregiver burden. ▪ Only multicomponent interventions significantly reduced caregiver burden.
Pusey et al. 2001 (32) Systematic review (n=30)	▪ Psychosocial interventions ▪ Technology ▪ Group ▪ Individual ▪ Service configuration	▪ Psychological health ▪ Physical health ▪ QOL	▪ Individualized interventions that utilized problem solving and behaviour management demonstrated the best evidence of effectiveness.
Pinquart et al. 2006 (33) Meta-analysis (n=127)	▪ Psychoeducational ▪ Cognitive-behavioural therapy ▪ Counseling /CM ▪ General support ▪ Respite ▪ Training of the CR ▪ Multicomponent	▪ Burden ▪ Depression ▪ Subjective well-being ▪ Knowledge ▪ Coping abilities ▪ CR symptoms ▪ Institutionalization	▪ Interventions had on average significant but small effects on CG burden, depression, subjective well-being, ability/knowledge and symptoms of CR ▪ Psychoeducational interventions involving active participation of CGs had the broadest effects ▪ Only multicomponent interventions reduced the risk for institutionalization ▪ Effect sizes varied by caregiver gender and year of publication.
Selwood et al. 2007 (34) Systematic review (n=62)	▪ Education ▪ Dementia-specific therapy ▪ Coping strategies ▪ Behavioural management techniques ▪ Supportive therapy	▪ Psychological health (quantitative measures)	▪ Excellent evidence for the efficacy of individual behavioural management therapy centered on the CR's behaviour in alleviating CG symptoms both immediately and for up to 32 months. ▪ Teaching CGs coping strategies (group or individual) appeared effective in improving psychological health both immediately and for some months after. ▪ Group interventions were less effective than individual interventions. ▪ Education about dementia by itself, group behavioural therapy, and supportive therapy were not effective CG interventions.

*ADL indicates activities of daily living; CG, caregiver; CR, care receiver; QOL, quality of life.
†Caregiver outcomes unless otherwise specified.

Despite the heterogeneity in outcomes and interventions examined in the reviews on caregiver interventions, there were common findings that emerged.

Ineffective interventions included:
- education about dementia by itself,
- supportive therapy, and
- group behavioural therapy.

Effective interventions included:
- reaching caregivers problem solving/coping strategies,
- involving patients in addition to caregivers,
- individual behavioural management therapy (≥6 sessions), and
- multicomponent interventions.

The Medical Advisory Secretariat review intended to update behavioural management interventions and multicomponent interventions. The reasons are 3-fold:

1. Given the time frame of the project, an analysis of these 2 caregiver interventions was reasonable.
2. Evidence from the literature demonstrates that caregiver burden largely attributed to managing BPSD is an established predictor of institutionalization for elderly patients with dementia.
3. According to the systematic reviews and meta-analyses on caregiver interventions, multicomponent interventions are the only interventions to reduce the risk of institutionalization.

Upon confirmation of the scope with expert consultants, the Medical Advisory Secretariat performed an update to the most recent review examining behavioural management techniques. According to Selwood et al. 2007 (34), 6 sessions is the therapeutic minimum required for these interventions to be effective; therefore, this requirement was included in the search strategy.

Updates to Published Health Technology Assessments

Four RCTs were found, all of which focused on behavioural management therapy directed at the caregiver or both the caregiver and the care receiver.

Summary of Updated Studies

The first study retrieved involved behavioural management therapy directed at both the caregiver and patient, and was carried out by an occupational therapist. Details of the study are shown in Table 6.

Table 6: Summary of Randomized Controlled Trial by Graff et al. 2006, 2007 (35;36)

Study/ Year	Population	Description of Intervention	Outcome/ Follow-Up	Results	Limitations
Graff et al. (35) 2006 Graff et al. (36) 2007	N=135 Mild to moderate dementia	Intervention: 10 1-hour sessions of occupational therapy (OT) over 5 weeks (including cognitive and behavioural interventions) Total time: 18 hrs per patient and CG together Control: no OT	CG burden Patients' daily functioning assessment (determined by assessment of motor and process skills [AMPS] and interview of deterioration in daily activities in dementia [IDDD]) Baseline, 6 weeks, and 3 months Outcomes(36) CG: ▪ QOL ▪ Health status ▪ Mood ▪ Control over life (mastery)	CGs: At 6 wks CGs who received OT felt significantly more competent than those who did not Mean competence score (assessed by sense of competence questionnaire [SCQ]) Difference at 6 weeks 11.0 (9.2–12.8) statistically and clinically significant Number needed to treat: 2.5 (2.3–2.7) Outcomes remained at 12 weeks Patient: At 6 weeks, patients in the OT group significantly improved in daily functioning and outcomes remained significant at 3 months Results(36) At 6 weeks, CGs in the OT group had significantly improved outcomes for overall quality of life, health status, depression, and mastery than those in the control group ($P < .0001$). Outcomes remained significant at 3 months.	Generalizability of results, due to recruitment of patients from a memory clinic and day clinic of a university hospital. Short study duration (12 weeks). Unclear if controls were on wait-list. Intervention was directed at patients and CGs – unclear. In 18% of cases (n=21) the assessors knew the treatment allocation.

*CG indicates caregiver; QOL, quality of life.

Table 7: Outcomes in Patients with Dementia and Caregivers in Intention-to-Treat Population at 6- and 12-week Time Points*

	6 Weeks			12 Weeks		
	AMPS Process	IDDD Performance	Competence (SCQ)	AMPS Process	IDDD Performance	Competence (SCQ)
Covariate adjusted treatment difference (95% CI)	1.5 (1.3–1.7)	−11.7 (−13.6 to −9.7)	11.0 (9.2–12.8)	1.6 (1.3–1.8)	−13.6 (−15.8 to −11.3)	9.6 (4.7–14.5)
Difference in clinically relevant improvement	75%	66%	40%	66%	72%	24%
Number needed to treat (95% CI)	1.3 (1.2–1.4)	1.5 (1.4–1.6)	2.5 (2.3–2.7)	1.5 (1.4–1.6)	1.4 (1.3–1.5)	4.2 (4.0–4.4)
P value	< .0001	< .0001	< .0001	< .0001	<. 0001	< .0001
Effect size	2.5	2.3	1.2	2.7	2.4	0.8

Adapted from Graff et al. 2006 (35)
*AMPS indicates assessment of motor and process skills; CI, confidence interval; IDDD, interview of deterioration in daily activities in dementia; SCQ, sense of competence questionnaire.

Table 7 shows the results of the study at 6- and 12-week time points. At 6 weeks, caregivers in the OT group felt significantly more competent than those who did not (treatment difference 11.0; 95% CI, 9.2–12.8). Outcomes remained significant at 12 weeks. In addition, at 6 weeks, patients in the OT group significantly improved in daily functioning, and outcomes remained significant at 12 weeks.

Table 8: Additional Caregiver Outcomes at 6 Weeks*

Caregiver Outcomes	Covariate-Adjusted Treatment Difference (95% CI)	*P* value	Effect Size
Dqol overall	0.7 (0.5–0.9)	< .0001	1.2
Dqol aesthetics	4.1 (3.1–5.0)	< .0001	1.6
Dqol positive affect	1.3 (0.1–2.5)	.0270	0.4
Dqol negative affect	−1.9 (−3.9 to 0.2)	.0690	NS
Dqol feelings of belonging	1.0 (0.5–1.5)	< .0001	1.0
Dqol self-esteem	3.7 (3.0–4.3)	< .0001	2.1
GHQ-12	−4.6 (−6.0 to −3.2)	< .0001	1.3
CES-D	−7.6 (−9.7 to −5.4)	< .0001	1.3
Mastery scale	3.5 (2.7–4.4)	< .0001	1.6

Adapted from Graff et al. 200 (36)
*CI indicates confidence interval; CES-D, Center for Epidemiologic Studies Depression Scale; Dqol, Dementia Quality of Life Instrument; GHQ, General Health Questionnaire; NS, not significant.

Table 9: Additional Caregiver Outcomes at 12 Weeks*

Caregiver Outcomes	Covariate-Adjusted Treatment Difference (95% CI)	*P* Value	Effect Size
Dqol overall	0.9 (0.6–1.1)	< .0001	1.5
Dqol aesthetics	4.0 (3.4–4.6)	< .0001	1.3
Dqol positive affect	0.9 (−0.4 to 2.3)	.163	NS
Dqol negative affect	−2.0 (−2.1 to −1.9)	.069	NS
Dqol feelings of belonging	0.8 (0.1–1.5)	.022	0.5
Dqol self-esteem	3.8 (2.9–4.8)	< .0001	1.6
GHQ-12	−4.9 (−6.6 to −3.3)	< .0001	1.1
CES-D	−8.4 (−11 to −5.8)	< .0001	1.3
Mastery scale	4.1 (3.2–4.9)	< .0001	2.0

Adapted from Graff et al. 2007 (36)
*CI indicates confidence interval; CES-D, Center for Epidemiologic Studies Depression Scale; Dqol, Dementia Quality of Life Instrument; GHQ, General Health Questionnaire; NS, not significant.

As seen in Table 8, at 6 weeks, caregivers in the OT group had significantly improved outcomes for overall QOL, health status, depression and mastery than those in the control group ($P < .0001$). Outcomes remained significant at 12 weeks (Table 9).

Limitations

Overall the study had very good methodological design. Limitations of the study have been outlined in Table 6.

The next study identified was conducted by Teri et al. (37) and examined a standardized dementia management intervention in 95 caregivers designed to provide strategies for modifying consequences of problem behaviours (Table 10).

Table 10: Summary of Randomized Controlled Trial by Teri et al., 2005 (37)*

Study / Year	Population	Description of Intervention	Outcome/ Follow-Up	Results
Teri et al. 2005 (37)	N=95 Alzheimer's patients Moderate cognitive impairment Diagnosis: probable or possible Alzheimer's disease Caregiver: Spouse or adult relative	Intervention: 8 weekly sessions (average duration of ~ 1 hour); in-home visit followed by 4 monthly phone calls (Standardized dementia-management intervention-strategies for modifying consequences of problem behaviours) Delivered by consultants (Masters or equivalent in counseling, psychology, and social work) Control: Routine medical care	Main CG outcomes: ▪ Depression ▪ Stress ▪ Burden ▪ Sense of Competence ▪ Sleep Quality Main CR outcomes: ▪ Behavioural disturbance ▪ QOL Baseline, 2 mos. (posttreatment), 6 months follow-up	At 2 months: CGs in intervention group had significantly ($P < .05$) greater reductions in self-reported depression, subjective burden and reactivity to behaviour problems than CGs in routine medical group. Results remained significant at 6 months. Depression at 2 months (CES-D) (self-reported) Baseline 2 months INT 43% 29% Control 34% 37% At 6 months: Additional significant outcomes - reductions in self-reported sleep problems - decreases in depression on the Hamilton Depression Rating Scale (interview-based)

*CES-D indicates Center for Epidemiologic Studies Depression Scale; CG, caregiver; CR, care receiver; INT, intervention; QOL, quality of life.

The authors found positive effects of the intervention on caregiver outcomes. At 2 months, caregivers in the intervention group had significantly greater reductions in self-reported depression, subjective burden, and reactivity to behaviour problems than caregivers in the control group. Results remained significant at 6 months. Additional significant outcomes at 6 months were: decreases in depression (Hamilton Depression scale (P = .041)), and a reduction in self-reported sleep problems (P = .033). When examining problem behaviours of the care recipient, overall 62% of the caregivers in the intervention group had improvement in caregiver-reactivity scores, 57% had reductions in frequency of problem occurrence, and 52% were reported to have reductions in problem severity.

Limitations

Consultants carrying out the intervention were heavily supervised, which may not reflect typical practice. In addition the study had a relatively small sample size. Follow-up was of only 6 months duration, making assessment of longer term effects difficult.

Mahoney et al.(38) report on a study which provided caregivers with 12-month access to an interactive voice response (IVR) mediated system designed to assist the caregiver in managing the BPSD of the patient (Table 11).

Table 11: Summary of Mahoney et al., 2003 (38)*

Study / Year	Population	Description of Intervention	Outcome/ Follow-Up	Results
Mahoney et al. (38) 2003	N=100 Alzheimer's Disease (AD) CG: Provided 4 or more hr/day of assistance or supervision for a minimum of 6 months to a family member with AD	Intervention: Information technology: 12-month access to an interactive voice response (IVR) mediated system, which was designed to assist CG managing persons with disruptive behaviours related to AD Participants chose the type of component, freq, duration and timing Control: usual care (reference booklet containing similar content to module 1 of the intervention (strategies)	Bothersome nature of CR disruptive behaviours ▪ Anxiety ▪ Depression Mediating effect of CG mastery was also examined Baseline, 6, 12, and 18 months	At 18 months: No significant main effect of the intervention in reducing bother scores, depression scores, or state anxiety.

*CG indicates caregiver; CR, care recipient.

The authors found no significant main effect of the intervention in reducing bother scores, depression scores, or state anxiety at 18 months. Stratified analysis showed a significant intervention effect for caregivers with low- to mid-mastery at baseline ($P < .05$) for all 3 outcomes relative to controls. A significant effect was also found when caregivers were stratified by relationship status of the caregiver to care recipient. There was a significant reduction in bother scores for caregivers who were wives ($P = .023$).

It is important to note that there exist many models of information technology for caregiver interventions. This study only employed 1 model, which many not have been ideal for this population. The main limitation of this study is that it was inadequately powered. In addition, the intensity of the intervention differed greatly among users, and there was a possible floor effect as caregivers had low bother scores and depression scores at baseline.

Burgio et al. (39) investigated the use of a skills training program in 140 caregivers of patients with Alzheimer's disease and related disorders (Table 12).

Table 12: Summary of Burgio et al. 2003 (39)*

Study / Year	Population	Description of Intervention	Outcome/ Follow-Up	Results	Comment
Burgio et al. (39) 2003	N=140 Analysis sample N=118 White (n=70) African American (n=48) AD and related disorders	Intervention: Skills training condition – 3-hour group workshop followed by 16 in-home (1 hr) treatment sessions over 12 months Culturally appropriate (targets improvement of CG behaviour management skills, problem solving skills, and cognitive restructuring) Control: minimal support condition (general telephone support and written information)	CR problem behaviours, CG appraisal, CG social support and activity CG well-being Desire to institutionalize Baseline, 6 months (at 6 months, CG has received 8 home visits and 2 therapeutic phone calls)	There were no significant main effects for treatment condition on the covariate adjusted 6-month outcome scores for any variable ($P > .10$).	No blinding of study personnel to group assignment Study duration: 6 months Difficult to separate effects of group versus individual sessions

*AD indicates Alzheimer's disease; CG, caregiver, CR, care receiver.

The authors found that at 6 months, there were no significant main effects of the intervention on any of the outcomes ($P > .10$). Other findings were that spouses reported a significantly reduced number of problem behaviours in the care recipients as compared with nonspouses. In addition, white caregivers showed the most improvement in the minimal support group whereas African American caregivers showed greatest improvement in the intervention group. Caregivers in both groups reported significantly fewer problem behaviours, less behaviour bother, and an increase in satisfaction with leisure activities. The findings of this study suggest that cultural and relationship factors may be important considerations when designing caregiver interventions.

Limitations of the study can be seen in Table 12.

Summary of Findings

As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence. The overall quality of the evidence is shown in Tables 13 and 14.

- High: further research is very unlikely to change our confidence in the estimate of effect,
- Moderate: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate,
- Low: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate, and
- Very low: any estimate of effect is very uncertain.

Table 13: Quality of Individual Behavioural Intervention Trials According to GRADE*

Outcome	Studies	Design	Quality	Consistency	Directness	Overall Quality
CG burden and CG depression	Graff et al., 2006; 2007 (35;36)	RCT	No limitations High	Consistent High	Some uncertainty on directness† Moderate	Moderate/High
	Teri et al. 2005 (37)	RCT				

*CG indicates caregiver; RCT, randomized controlled trial
†In 1 RCT, patients were recruited from a memory clinic; in 1 RCT consultants were heavily supervised.

Table 14: Quality of Individual Behavioural Intervention Trials According to GRADE*

Outcome	Studies	Design	Quality	Consistency	Directness	Overall Quality
Other outcomes of CG psychosocial health	Mahoney et al. 2003 (38)	RCT	Some limitations†	Not consistent	Direct	Low
	Burgio et al. 2003 (39)	RCT	Moderate	Low	Low	

*CG indicates caregiver; RCT, randomized controlled trial
† One RCT was inadequately powered; 1 RCT had no blinding of outcome assessors; participants had low bother scores and low depression scores at baseline.

Conclusion

Previous systematic reviews and meta-analyses suggest that 6 or more sessions of individual behavioural management therapy centered on the care recipient's behaviour can alleviate caregiver symptoms both immediately and for up to 32 months.

A recent RCT supports these findings concluding that individual behavioural interventions (≥ 6 sessions) directed at the caregiver (or combined with the patient) are effective in improving psychological health in dementia caregivers.

2.2B. Multicomponent Interventions for Caregivers of Seniors With Dementia

Clinical Need: Target Population and Condition

As mentioned previously, existing evidence from systematic reviews and meta-anlayses show that multicomponent interventions can significantly reduce caregiver burden (31) and the risk for institutionalization. (33) Moreover, dementia caregivers have complex needs, which may require a variety of interventions to provide adequate support.

A 2006 systematic review of multicomponent interventions by Pinquart et al.(33) was identified and a literature search was conducted in order to identify any RCTs subsequently published.

Evidence-Based Analysis of Effectiveness

Research Questions

- Does new evidence since the last systematic review support existing findings that multicomponent interventions reduce caregiver burden?
- Does new evidence support existing findings that multicomponent interventions delay entry into LTC settings?

Methods

Inclusion Criteria

- English-language articles published after the search date (2005) of the systematic review by Pinquart et al.(33),
- randomized controlled trials that report primary data on the effectiveness of multicomponent interventions (2 or more psychosocial interventions) for dementia caregivers of seniors with dementia living in the community,
- study design and methods must be clearly described,
- control group = routine care, and
- primary outcome = any measure of caregiver psychological health (i.e., burden, depression, stress, QOL).

Exclusion Criteria

- studies that are duplicate publications (superseded by another publication by the same investigator group, with the same objective and data),
- studies with less than 10 patients, and
- formal (paid carers).

Literature Search

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, The Cochrane Library, PsycINFO, and INAHTA/CRD for studies published between January 2005 and February 2008 (Appendix 2). Abstracts were reviewed by a single author, and studies meeting the inclusion criteria outlined above were obtained. Reference lists were also checked for relevant studies.

Results of Literature Search (Update To Existing Evidence)

The search identified 1 RCT on multicomponent interventions. Belle et al. (40) evaluated the effects of a structured multicomponent intervention on caregivers of 3 diverse racial groups. Five target areas of the intervention were: depression, burden, self-care and healthy behaviours, social support, and problem behaviours. The study was carried out in 642 caregivers of individuals with Alzheimer's disease or related disorders (Table 15).

Table 15: Summary of Belle et al. 2006 (40)*

Study / Year	Population	Description of Intervention	Outcome/ Follow-Up	Results	Comment
Belle et al. 2006	N=642 Hispanic (n=212) White (n=219) Black (n=211) Alzheimer's disease or related disorders 5 US cities	Intervention: Strategies: provision of information, role playing, problem solving, telephone support, etc. 5 target areas: depression, burden, self-care and healthy behaviours, social support, problem behaviours Delivered by interventionist with at least a BA 12 sessions (9 in-home [1.5 hrs. each] and 3 telephone sessions [30 min. each]), and 5 structured telephone support group sessions over 6 months Control: mailed basic info, 2 brief telephone calls at 3 and 5 months	Primary outcomes: ▪ CG ▪ Depression ▪ Burden ▪ Self-care ▪ Social support ▪ Problem behaviours Secondary outcomes: ▪ Institutional placement of CR ▪ Prevalence of CG clinical depression	<u>Hispanic CGs</u>: ▪ Net improvement across all 5 domains was greater in the intervention group than in the control group (45.1% vs. 6.9%; difference 38.2% [CI, 11.2%–64.4%]. ▪ Clinically significant changes depression scores report of problem behaviours. <u>White CGs:</u> ▪ Clinical meaningful differences favoured the INT for social support. <u>Black CGs:</u> ▪ No overall statistically significant effects. ▪ Exploratory analysis – ▪ clinically meaningful differences that favoured the intervention for black spouses when all domains were combined. Secondary outcomes: Prevalence of clinical depression was significantly greater among CGs in the control group than those in INT group (22.7% vs. 12.6%; *P* = .001); difference remained significant after adjustment for race & ethnicity. Number of CRs institutionalized did not differ statistically significantly between groups (7.2% control vs. 4.3% intervention). - no significant differences between groups in any racial or ethnic group.	Loss to follow-up: 60% completed all 12 sessions; 5% did not complete any session. Long-term efficacy unknown. Assessing effects of the intervention on institutional placement typically requires 1-yr follow-up or longer. Larger effects seen in Hispanic CGs – probably due to the availability of intervention in Spanish versus otherwise limited access to community resources that are culturally appropriate.

*BA indicates Bachelor of Arts; CG, caregiver; CI, confidence interval; CR, care recipient; INT, intervention.

Results of the study were reported by ethnic group in each of the 5 domains examined: burden, depression, self-care, social support, and problem behaviour. In Hispanic participants, the net improvement across all 5 domains was greater in the intervention group than in the control. Clinically significant differences in net improvement in the Hispanic participants favoured the intervention for

depression and problem behaviours, as 39% of participants in the intervention group lowered their depression scores compared with 0% in the control group. In the intervention group, 32% of participants experienced a clinically significant decrease in problem behaviours versus 5% of participants who reported a net increase in problem behaviours in the control group. In white or Caucasian participants, differences in net improvement favoured the intervention for social support. For black or African American participants there were no significant differences between the groups for any of the 5 domains.

The larger effects seen in Hispanic caregivers may be due to the fact that this intervention was delivered in Spanish (with translated materials) to a population of caregivers that may otherwise have limited access to community resources that are culturally appropriate.

Table 16: Clinical Depression of Caregivers and Institutional Placement of Care Recipients at 6-Month Follow-Up*

	Combined (Hispanic or Latino, White or Caucasian, Black or African American)	
	Control	**Intervention**
Caregivers at follow-up, n	289	293
Caregivers with clinical depression* at follow-up, n%	65 (22.7)	37 (12.6)
Care recipient randomization, n	319	323
Care recipients institutionalized, n (%)	23 (7.2)	14 (4.3)

Adapted from Belle et al. 2006 (40)
*Clinical depression was defined as a CES-D score ≥15. CES-D indicates Center for Epidemiologic Studies Depression scale.
Note: 3 participants were missing CES-D scores.

Secondary outcomes examined in this study (Table 16) were the prevalence of clinical depression and institutional placement of care recipients. At 6 months, the prevalence of clinical depression was significantly greater among caregivers in the control group than those in the intervention group (22.7% vs. 12.6%; $P = .001$).

There was no significant effect of the intervention on the number of care recipients institutionalized (7.2% control vs. 4.3% intervention; $P = .118$), and also no significant difference between the groups in any racial or ethnic group. However it must be noted that assessing the effects of an intervention on institutional placement typically requires 1-year follow-up or longer and thus this study was not adequately designed to assess this outcome.

Limitations

Since this study was of 6 months duration, the long-term efficacy is unknown. However, most studies conducted in seniors with dementia and caregiver populations assess short- to medium-term effects. Also, only 60% of participants completed all 12 sessions of the intervention and 5% of participants did not complete any sessions.

Summary of Findings

Table 17: Quality of Multicomponent Intervention Trials According to GRADE*

Outcome	Study	Design	Quality	Consistency	Directness	Quality
Caregiver burden	Belle et al. 2006	RCT	No limitations High	Not consistent† Moderate	Direct High	Moderate/High

*RCT indicates randomized controlled trial.
†Although the results of this study were not consistent with previous studies reporting a reduction in caregiver burden associated with multicomponent interventions, the current study shows that other measures of caregiver psychosocial health showed improvement such as depression, problem behaviours, and social support.

Ontario Health Systems Impact Analysis

Considerations and Implications

An expert panel on aging in the community met on May 16, 2008, and discussed in part, behavioural management interventions for seniors with dementia in Ontario. In particular, the expert panel commented on the challenges with conducting studies on caregiver interventions and the lack of programs/tools available to caregivers to help them manage BPSD. Comments from the panel are found below.

Behavioural Management Interventions

Current Delivery

- Two groups generally provide behavioural management interventions: community occupational therapists and psychogeriatric nurses.
- Psychogeriatric nurses counsel caregivers, and occupational therapists make environmental modifications to the home and provide case management.
- Physicians are reluctant to prescribe medications to seniors with dementia for problem behaviours; however, when caregivers have major difficulties with managing the care recipient (i.e., wandering, sleep disruptions), physicians will prescribe medication.

Systems Pressures

- Programs/tools are needed which will give caregivers the skills to manage and provide relief.
- It is difficult to co-ordinate funding of technology and of research.
- There are fundamental problems with studying caregiver interventions for dementia.

Future Research/Direction

- Examine the research being done at the OT department at the University of Toronto around family caregivers and outcome measures; identify which interventions are most effective.
- Field evaluations are required as different models and evaluations are needed.
- Technological interventions such as websites and online networking for care providers can be effective.

- It is important to focus on characteristics of people requiring services since response to interventions greatly differs according to type and severity.

Overall Conclusions for Caregiver-Directed Interventions

Respite Care

- Assessing the efficacy of respite care services using standard evidence-based approaches is difficult.
- There is limited evidence from RCTs that respite care is effective in improving caregiver outcomes for those caring for seniors with dementia.
- There is considerable qualitative evidence of the perceived benefits of respite care.
- Respite care is known as one of the key formal support services for alleviating caregiver burden in those caring for dementia patients.
- Respite care services need to be tailored to individual caregivers needs since there are vast differences between caregivers and patients of dementia (severity, type of dementia, amount of informal/formal support available, housing situation, etc.)

Psychosocial Interventions – Behavioural Management Interventions

- There is moderate- to high-quality evidence that individual behavioural interventions (≥ 6 sessions), directed at the caregiver (or combined with the patient) are effective in improving psychological health in dementia caregivers.

Multicomponent Interventions

- There is moderate- to high-quality evidence that multicomponent interventions improve caregiver psychosocial health and may impact rates of institutionalization of dementia patients.

3. Patient-Directed Interventions for Dementia

Objective

This section on patient-directed interventions for dementia is broken down into 4 subsections with the following questions:

3.1 Physical Exercise for Seniors with Dementia – Secondary Prevention
What is the effectiveness of physical exercise for the improvement or maintenance of basic activities of daily living (ADLs), such as eating, bathing, toileting, and functional ability, in seniors with mild to moderate dementia?

3.2 Nonpharmacologic and Nonexercise Interventions to Improve Cognitive Functioning in Seniors With Dementia – Secondary Prevention
What is the effectiveness of nonpharmacologic interventions to improve cognitive functioning in seniors with mild to moderate dementia?

3.3 Physical Exercise for Delaying the Onset of Dementia – Primary Prevention
Can exercise decrease the risk of subsequent cognitive decline/dementia?

3.4 Cognitive Interventions for Delaying the Onset of Dementia – Primary Prevention
Does cognitive training decrease the risk of cognitive impairment, deterioration in the performance of basic ADLs or instrumental activities of daily living (IADLs),[4] or incidence of dementia in seniors with good cognitive and physical functioning?

3.1. Physical Exercise for Seniors With Dementia – Secondary Prevention

Clinical Need: Target Population and Condition

Dementia is a general loss of cognitive abilities, including impairment of memory as well as 1 or more of the following: speech disorders; loss of ability to carry out familiar, purposeful movements; loss of the power to recognize the meaning of sensory stimuli; or disturbed planning, organizing, and abstract thinking abilities. Causes include a large number of conditions that result in widespread cerebral damage or dysfunction. The most common cause is Alzheimer's disease (50%–60%) followed by cerebrovascular disease (20%).
Dementia adversely affects cognitive, emotional, and behavioural functioning. (41) There are also a number of studies that link dementia with physical deterioration. (42-46) Compared with age-matched

[4] Activities of Daily Living (ADL) are basic but important general tasks required for day to day living such as bathing, dressing, grooming, eating, and toileting. Instrumental Activities of Daily Living (IADL) are activities that need to be done but on a less time sensitive schedule. These are activities related to independent living and include preparing meals, managing money, shopping, doing housework, and using a telephone.

controls, patients with Alzheimer's disease show more signs of undernutrition (42), a higher risk of falls and fractures, (43-46) and more rapid decline on measures of mobility. (47;48) Once injured, patients with Alzheimer's disease are at greater risk of subsequent injury than age- and sex-matched controls. (43)

Reduced muscle mass has been associated with loss of independence. (49) Decreased activity levels can lead to muscle atrophy, increasing the potential for unsafe mobility while performing the basic ADLs such as eating, bathing, toileting, and functional ability. (50)

Improved physical conditioning for seniors with dementia may extend their independent mobility and maintain performance of ADL. (51)

Evidence-Based Analysis of Effectiveness

Question

What is the effectiveness of physical exercise for the improvement or maintenance of ADLs in seniors with mild to moderate dementia?

Comparisons of Interest (and for which evidence of these comparisons exist)

- physical exercise versus no physical exercise, and
- physical exercise versus usual care.

Methods

Literature Review

A standard Medical Advisory Secretariat literature review was undertaken (Appendix 3).

Inclusion Criteria

- elderly patients (≥65 years) with mild to moderate dementia,
- inpatients or outpatients,
- patients receive any type of physical exercise as the intervention,
- systematic reviews, RCTs, and
- primary outcome = any measure of physical functioning.

Exclusion Criteria

- patients less than 65 years of age,
- studies with less than 10 patients,
- studies that examine the effectiveness of multitherapies (e.g., physical exercise + behavioural therapy),
- studies that do not report physical exercise as the intervention.

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology and GRADE Working Group (52) As per GRADE the following definitions apply:

- High: further research is very unlikely to change our confidence in the estimate of effect,
- Moderate: further research is likely to have an important impact on our confidence in the estimate of

effect and may change the estimate,
- Low: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate, and
- Very low: any estimate of effect is very uncertain.

Results of Literature Search

A literature search from January 2003 to April 2008 (including OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, International Agency for Health Technology Assessment/Centre for Review and Dissemination) identified 2 systematic reviews.

Heyn et al. (53) conducted a systematic review/meta-analysis to determine whether physical exercises are beneficial for people with dementia and related cognitive impairments. Law et al. from the Occupational Therapy Evidence-Based Practice Research Group at McMaster University (54) systematically reviewed the effectiveness of activity programs in improving occupational performance (i.e., participation in self-care, productivity, and leisure) and/or performance components (physical, affective, and cognitive).

Of 6 studies identified that were published after the most recent systematic review, 6 were excluded (patients did not have dementia; observational studies; multimodal therapy).

Summary of Existing Evidence

Summary of Systematic Reviews

Table 18 summarizes the 2 systematic reviews that were identified in the literature search.

Table 18: Summary of Systematic Reviews for Physical Activity in Seniors with Dementia*

Study/Year/Country	Type of Study	Objective	Outcomes	Results	Comment
Heyn et al. (53) 2004 United States	Meta-analysis (fixed effects)	To determine whether physical exercises are beneficial for people with dementia and related cognitive impairments	▪ Physical fitness ▪ Physical functioning ▪ Cognition ▪ Behaviour	30 RCTs met inclusion criteria Mix of community dwelling and LTC residents. N=2,020 <u>Results (Summary Effect Size and 95% CI)</u> Fitness 0.69 (0.58–0.80) Cognitive 0.57 (0.38–0.75) Functional 0.59 (0.43–0.76) Behaviour 0.54 (0.36–0.72) Overall 0.62 (0.55–0.70)	Intervention delivered via occupational therapists Short-term studies Methodological issues (heterogeneity) Unclear whether patients maintained the intensity throughout or if additional devices were used to enhance motivation
Occupational Therapy Evidence-Based Practice Research Group, McMaster University (54) 1999 Canada Grey literature	Systematic review	To determine effectiveness of <u>activity</u> programs in improving occupational performance (i.e., participation in self-care, productivity, and leisure) and or performance components (physical, affective, and cognitive)	"Occupational performance(participation in daily activities)" This was based on: Performance component areas (physical/psychological/cognitive) Environmental factors (family/caregiver perspectives)	4 RCTs met inclusion criteria; each had 4 different activity programs (planned walking, mental stimulation, physical activation, and purposeful activities). N=164; Mix of inpatients and outpatients Statistically significant results favoured the treatment group in all 4 studies. "They support the use of activity groups for older persons with dementia for improving their wellbeing, communication, mental status, and emotional state. Future research is needed in this area due to the small amount of evidence available."	Intervention delivered via occupational therapists Activity outcomes "include some sort of activity which may be physical, social cognitive or psychological behavioural in nature" Heterogeneity

*CI indicates confidence interval; LTC, long-term care; N, number; RCT, randomized controlled trial.

Economic Analysis

Literature Review

No economic analyses were identified that examined the cost-effectiveness of exercise programs for seniors with dementia.

Summary of Findings for Physical Activity in Seniors With Dementia

The overall quality of the evidence was determined by using GRADE (52) as shown in Table 19.

Table 19: Quality of Trials According to GRADE

Outcome	Design	Quality	Consistency	Directness	Overall Quality
Physical functioning	Meta-analysis	Moderate (heterogeneity - variation in frequency intensity, duration of interventions)	Consistent (mostly short-term follow-up)	Mix of community dwelling and long-term care residents	Moderate

Ontario Health Systems Impact Analysis

Considerations and Implications

An expert panel on aging in the community met on February 29, 2008, and, in part, discussed physical exercise for seniors in Ontario. In particular, it was discussed how physical exercise is made available to seniors and who provides the service. Comments from the panel are found below.

Long-Term Care Facilities

- In-house occupational/physiotherapists and recreational therapists provide physical exercise interventions.

In the Community

- Community Care Access Centres can provide referrals for occupational therapists, physiotherapists, and personal support workers to go to homes.
- Community recreation centres – recreationalists can teach caregiver and client exercise programs.
- Community agencies and religious groups offer exercise programs – volunteer-led informal exercise groups (e.g., "mall walkers").
- Exercise programs often provided in/around supportive housing units.
- Exercise activities often organized outside of the formal health system.
- Municipality websites often list services available within the area.

Benefit/Risk Analysis

As per the GRADE Working Group (52), the strength of a recommendation to use exercise as an intervention to improve functional outcomes is shown in Table 20.

Table 20: Overall Summary Statement of the Benefit and Risk

Outcome	Quality	Benefits	Risks/Burden	Overall Strength of Recommendation
Physical functioning	Moderate	Improvement in functional, cognitive, and behavioural outcomes	Short-term follow-up and heterogeneity in studies. Unclear if leads to delayed institutionalization.	Moderate

Conclusion

Physical exercise is effective for improving physical functioning in patients with dementia and the strength of a recommendation in this regard is moderate when weighing risks and benefits.

3.2. Nonpharmacologic & Nonexercise Interventions to Improve Cognitive Functioning in Seniors with Dementia – Secondary Prevention

Clinical Need: Target Population and Condition

Cognitive impairments, including memory problems, are a defining feature in patients with dementia. These impairments can have a major impact on the patient leading to anxiety, depression, and withdrawal from activities. (55) In addition, caregivers can be affected due to the practical impact of cognitive problems on daily activities.(55) Cognitive interventions aim to improve these impairments in people with mild to moderate dementia.

General reality orientation was first described in 1966 as a technique to improve the QOL of confused elderly people, although its origins lie in attempts to rehabilitate severely disturbed war veterans. (56) General reality orientation approaches were shown to produce improvements in cognition in a systematic review by Spector et al. (56); however, the overall quality of the studies was poor (6 studies; N=125; study publication range 1979 to 1994)). Most studies did not provide enough information to draw conclusions about contamination and blinding. Dropouts were not described well in some studies. A therapeutic protocol was not mentioned in any of the studies. Many studies used 1970s concepts of the neuropsychology of dementia. (56)

Progress in understanding the operation of memory and related cognitive functions, and of mechanisms of learning, has allowed the development of more specific approaches designed to help maintain or enhance cognitive functioning for people with dementia. (55) These include cognitive training and individualized cognitive rehabilitation. These are defined as follows:

Cognitive Training: Guided practice on a set of standard tasks designed to improve particular cognitive functions (e.g., memory, attention, problem solving). The underlying assumption is that practice has potential to improve or at least maintain functioning in the given domain and that any effects of practice will generalize beyond the immediate training context. (55)

Cognitive Rehabilitation: More individualized approach to help people with cognitive impairments in which those affected, and their families, work together with health care professionals to identify personally relevant goals and devise strategies for addressing these. Emphasis is not on enhancing performance on cognitive tasks, but on improving functioning in the everyday context. (55)

Cognitive training and rehabilitation have been used interchangeably in the literature. Some examples include:

- memory therapy/retraining/support/stimulation; or
- cognitive training/retraining/remediation/support/stimulation.

Evidence-Based Analysis of Effectiveness

Question

What is the effectiveness of nonpharmacologic interventions to improve cognitive functioning in seniors with mild to moderate dementia?

Comparisons of Interest (and for which evidence of these comparisons exist)

- cognitive training versus usual care,
- cognitive rehabilitation versus usual care, and
- cognitive training versus cognitive rehabilitation.

Methods

Inclusion Criteria

- elderly patients (≥65 years) with mild to moderate dementia,
- inpatients or outpatients,
- patients receiving cognitive or memory training/therapy/retraining/stimulation/support/remediation as intervention targeting cognitive functioning,
- systematic reviews, RCTs, and
- outcome being any measures of memory or other aspects of cognitive functioning for seniors with mild to moderate dementia.

Exclusion Criteria

- studies with fewer than 10 patients.

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology. (52)

Results of Literature Search

A literature search from January 2006 to December 2007 (Appendix 4; including OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, International Agency for Health Technology Assessment/Centre for Review and Dissemination) identified 1 Cochrane review that evaluated the effectiveness and impact of cognitive training and cognitive rehabilitation interventions aimed at improving memory and other aspects of cognitive functioning for people in the early stages of Alzheimer's disease or vascular dementia (inpatients or outpatients). (55)

Of 7 studies identified that were published after the Cochrane review, 6 were excluded (N < 10 patients; patients did not have dementia; subgroup analysis of previous study). One RCT by Spector et al. (57) was included in this report.

The quality of the included article is presented below (Table 21).

Table 21: Quality of Evidence of Included Studies*

Study Design	Level of Evidence	Number of Eligible Studies
Large RCT, systematic reviews of RCTs	1	1
Large RCT, unpublished but reported to an international scientific meeting	1(g)	
Small RCT	2	
Small RCT, unpublished but reported to an international scientific meeting	2(g)	
Nonrandomized study with contemporaneous controls	3a	
Nonrandomized study with historical controls	3b	
Nonrandomized study presented at international conference	3(g)	
Surveillance (database or register)	4a	
Case series (multi-site)	4b	
Case series (single site)	4c	
Retrospective review, modeling	4d	
Case series presented at international conference	4(g)	

For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. (58) An additional sesignation “g” was added for preliminary reports of studies that have been presented at international scientific meetings.

Summary of Existing Evidence

Summary of Systematic Reviews

Table 22 summarizes the systematic review by Clare et al. (55) which concluded that there were no significant benefits associated with cognitive training. No RCTs of cognitive rehabilitation met the inclusion criteria.

Table 22: Summary of Systematic Reviews for Nonpharmacologic Interventions to Improve Cognitive Functioning in Seniors With Mild to moderate Dementia*

Study/Year/Country	Type of Study	Objective	Outcomes	Results	Comment
Clare et al. (55) 2003 United Kingdom	Cochrane systematic review	To evaluate the effectiveness and impact of cognitive training and cognitive rehabilitation interventions aimed at improving memory and other aspects of cognitive functioning for people in the early stages of Alzheimer's disease or vascular dementia	Any outcomes for the person with dementia and/or the family caregiver	9 RCTs reporting cognitive training No RCTs of cognitive rehabilitation The diversity of outcome measures used in the studies did not allow meta-analysis. There were no significant positive effects of cognitive training.	"Further well-designed studies of cognitive training and cognitive rehabilitation are required to provide more definitive evidence." Consistency regarding type of therapies (Clare et al. terminology vs. original paper terminologies) Small sample sizes – possible type 2 errors No age restrictions Frequency / intensity / duration of interventions Baseline differences between studies

*RCT indicates randomized controlled trial.

Updated Studies

Table 23 shows the results of the RCT by Spector et al. (57) The authors concluded that cognitive stimulation therapy (CST) significantly improved cognitive function in people with dementia.

Table 23: Results of the Randomized Controlled Trial by Spector et al. (57)*

Study/Year/Country	Type of Study	Objective	Outcomes	Results	Comments
Spector et al. (57) 2003 United Kingdom	RCT Single blind Multicentre ITT N=201	To determine if cognitive stimulation therapy (CST) for older people with dementia is effective in improving cognition and quality of life. CST based on "reality orientation" and cognitive stimulation. Also based largely on a trial (Breuil et al. 1994) that was identified as having the most significant results.	Primary outcome: ▪ Change in cognitive function Secondary outcomes: ▪ ADAS-Cog ▪ Quality of life ▪ Communication ▪ Behaviour ▪ Depression ▪ Anxiety	CST: n=115 Control: n=86 Patients from day care centres or residential homes CST= 2 sessions a week for 7 weeks Primary outcome: CST had significantly higher scores on cognitive function testing Secondary outcomes: CST had significantly higher scores on ADAS-Cog and quality of life than the control group No significant differences for communication, behaviour, depression or anxiety (Possible Type 2 errors)	Powered to detect a difference in means of 2 points for cognitive functioning testing Study not powered to detect differences in secondary outcomes. Role of maintenance CST unclear Largest sample size to date

*ADAS-Cog indicates Alzheimer's disease assessment scale – cognitive subscale; ITT, intention-to-treat; n, number; RCT, randomized controlled trial.

Economic Analysis

One study was identified that examined the cost-effectiveness of an evidence-based CST programme for people with dementia as part of a RCT. (59)

Ninety-one people with dementia, living in care homes or the community, received a group CST intervention twice weekly for 8 weeks. Seventy people with dementia received treatment as usual. A cost-effectiveness analysis was conducted with cognition as the primary outcome and QOL as the secondary outcome.

Cognitive stimulation therapy had benefits for cognition and QOL in dementia and costs were not different between the groups. According to Knapp et al. (59), under reasonable assumptions, there is a high probability that CST is more cost-effective than treatment as usual for both the primary and secondary outcomes.

Summary of Findings for Nonpharmacologic and Nonexercise Interventions to Improve Cognitive Functioning in Seniors With Dementia

The overall quality of the evidence as per GRADE (52) is shown in Table 24.

Table 24: Quality of Trials According to GRADE*

Outcome	Technique/Design	Quality	Consistency	Directness	Overall Quality
Cognitive function	Cognitive training Systematic review of RCTs	Low	Not consistent (Diversity of outcome measures)	Mix of community dwelling and long-term care residents	Very low
Cognitive function	Cognitive stimulation therapy RCT	High	Not applicable (1 trial)	Mix of community dwelling and long-term care residents	Moderate/Low

*RCT indicates randomized controlled trial.

Ontario Health Systems Impact Analysis

Considerations and Implications

An expert in cognitive interventions for people with dementia stated:

- He was not aware of any provider in Ontario who was offering CST to people with mild to moderate dementia.
- A variety of nonpharmacologic interventions to improve cognitive function in seniors with mild to moderate dementia are probably being used in the province.
- Nonpharmacologic interventions to improve cognitive function in seniors with mild to moderate dementia are in the "artisan" stage (moving to becoming more evidence-based).

Benefit/Risk Analysis

As per the GRADE Working Group (52), the strength of a recommendation to use cognitive training, rehabilitation or CST as an intervention to improve cognitive functioning is shown in Table 25.

Table 25: Overall Summary Statement of Benefit and Risk

Outcome/Technique	Quality	Benefits	Risks/Burden	Overall Strength of Recommendation
Cognitive functioning Cognitive training	Very low	None	Intervention does not offer significant benefit (possible type 2 error) Unclear if leads to delayed institutionalization	Very low
Cognitive functioning Cognitive stimulation therapy (CST)	Moderate /Low	Increased cognition and quality of life	Unclear how CST compares with past terminologies and methodologies Short-term results Role and extent of maintenance Unclear how CST may impact functional dependence Unclear if leads to delayed institutionalization	Low

Conclusion

- Previous systematic review indicated that "cognitive training" is not effective in patients with dementia.
- Recent RCT suggests CST (up to 7 weeks) is effective for improving cognitive function and QOL in patients with dementia.
  However:
  - unclear how CST compares with past terminologies and methodologies,
  - short-term results,
  - role and extent of maintenance CST unclear, and
  - unclear how CST may impact functional dependence.

3.3. Physical Exercise for Delaying the Onset of Dementia – Primary Prevention

Clinical Need: Target Population and Condition

Various vascular risk factors have been found to contribute to the development of dementia (e.g., hypertension, hypercholesterolemia, diabetes, overweight). (60;61)

Physical exercise is important in promoting overall and vascular health. (62) However, it is unclear if physical exercise can decrease the risk of cognitive decline/dementia. A possible biological basis for how physical exercise might preserve brain function includes improved cerebral blood flow and oxygen delivery. (63)

Evidence-Based Analysis of Effectiveness

Question

Can exercise decrease the risk of subsequent cognitive decline/dementia?

Comparisons of Interest (and for which evidence of these comparisons exist)

- physical activity versus no physical activity, and
- physical activity versus usual care.

Methods

Inclusion Criteria
- elderly patients (≥65 years) without dementia,
- patients participate in physical activity,
- systematic reviews, RCTs, and
- outcome = cognitive decline/dementia.

Exclusion Criteria
- patients less than 65 years of age,
- less than 10 patients, and
- studies that do not report physical activity as the intervention.

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology. (52)

Results of Literature Search

A literature search from January 2003 to April 2008 (Appendix 5; including OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, International Agency for Health Technology Assessment/Centre for Review and Dissemination) failed to identify any RCTs. Since no RCTs were identified, prospective observational studies were considered for inclusion. Five prospective observational studies were identified. (64-68) Four of these studies included seniors 65 years of age and older who were followed up for a short-term duration (mean ~5 year follow-up). (64-67) One study included seniors who had a mean age of 51 years at study onset. (68) The mean follow-up period for these participants was 21 years. (68)

Although the observational study by Rovio et al. (68) did not fit the a priori inclusion criteria because it included patients less than 65 years of age, it was included in this systematic review since it is the only study identified to date that investigated whether there may be a long-term association between midlife leisure activity and subsequent risk of dementia.

The quality of the included articles is presented below (Table 26).

Table 26: Quality of Evidence of Included Studies*

Study Design	Level of Evidence	Number of Eligible Studies
Large RCT, systematic reviews of RCTs	1	
Large RCT, unpublished but reported to an international scientific meeting	1(g)	
Small RCT	2	
Small RCT, unpublished but reported to an international scientific meeting	2(g)	
Nonrandomized study with contemporaneous controls	3a	5
Nonrandomized study with historical controls	3b	
Nonrandomized study presented at international conference	3(g)	
Surveillance (database or register)	4a	
Case series (multi-site)	4b	
Case series (single site)	4c	
Retrospective review, modeling	4d	
Case series presented at international conference	4(g)	

For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. (58) An additional sesignation “g” was added for preliminary reports of studies that have been presented at international scientific meetings.

Summary of Existing Evidence

Summary of Short-Term Observational Studies

Two studies examined cognitive decline (64;67) as an endpoint, and 2 studies assessed incidence of dementia as the endpoint. (65;66)

Effects of Exercise on Cognitive Decline

Lytle et al. (64) showed that "high exercise" defined by the authors as "aerobic exercise ≥30 min duration ≥3 times per week" or defined by the Surgeon General as "aerobic exercise >30 min duration >5 times per week," was associated with a significantly reduced risk of cognitive decline over a 2-year follow-up (Table 11). According to the authors' definition of high exercise, low exercise was not associated with a significantly reduced risk of cognitive decline. According to the Surgeon General's definition, low exercise was marginally significant in terms of a reduced risk of cognitive decline (Table 11).

Weuve et al. (67) showed that over a 2-year follow-up, higher levels of activity were associated with less cognitive decline in women who participated in a substudy of the Nurses Health Study (Table 27).

Table 27: Summary of Observational Studies That Examine the Effect of Exercise on Cognitive Decline*

Study, Year Country	Type of Study	Patients	Outcomes	Results
Lytle et al., 2004 (64) United States	Longitudinal analysis. Objective: Examine incidence, risk, and protective factors and outcomes of cognitive impairment and dementia among community-dwelling seniors (65+) Seniors assessed at study entry and at follow-up waves every 2 years using a cognitive battery Self-reported exercise data collected only at Waves 3 & 4 This study focused on people who survived to participate in Wave 3 and Wave 4	Initially N=1681 Mean age 72.9 years Wave 3 n=1146 Mean age 76.8 years Wave 4 n=929 Mean age 76.2 years	Whether exercise level at Wave 3 associated with "cognitive decline" between Waves 3 and 4 Decline = decrease of ≥3 MMSE points <u>Exercise stratification</u> High exercise (authors): aerobic exercise of ≥30 min duration ≥3 times per week High exercise (Surgeon General): aerobic exercise of >30 min duration >5 times per week Low exercise Aerobic exercise <30 min duration <3 times per week No exercise	After controlling for age, sex and education, Wave 3 MMSE score and self-rated health, logistic regression showed: ≥30 Min ≥3 Times Per Week: High exercise associated with reduced risk of subsequent cognitive decline at Wave 4. OR=0.39; 95% CI (0.19–0.78) Low exercise not significant. OR=0.69; 95% CI (0.43–1.10) >30 Min >5 Times Per Week: High exercise OR=0.45 95% CI (0.22–0.95) Low exercise OR=0.63 95% CI (0.39–0.99) Did not assess development of dementia
Weuve et al., 2004 (67) United States Nurses Health Study	Prospective: Women reported participation in leisure physical activities on biennial mailed questionnaires starting in 1986. Each activity assigned a metabolic equivalent value. Overall activity assessed by average energy expenditure per week. Analyses based on average of energy expenditures from 1986 questionnaire through the questionnaire immediately preceding the baseline cognitive assessment.	16,466 women aged 70 to 81 years	Validated telephone assessments of cognition administered twice ~ 2 years apart for participants ≥70 years 1995 to 2001 Cognition Test #1 1997 to 2003 Cognition Test #2	Higher levels of activity associated with less cognitive decline Did not assess development of dementia

*CI indicates confidence interval; MMSE, Mini Mental State Exam; OR, odds ratio.

Effects of Exercise on Incidence of Dementia

Larson et al. (65) examined whether regular exercise in seniors was associated with a reduced risk for dementia. Table 12 shows that after a mean follow-up of 6.2 years, seniors who exercised <u>at least</u> 3 times per week (≥15 min at time during the past year) had a high probability of being dementia-free compared with those who exercised less than 3 times per week (HR 0.62, 95% CI 0.44–0.86, $P = .03$).

Abbott et al. (66) examined the association between self-reported walking in elderly men living in Honolulu and future risk of dementia (Table 28).

Table 28: Summary of Observational Studies That Examine the Effect of Exercise on the Incidence of Dementia

Study/Year/Country	Type of Study	Patients	Outcomes	Results
Larson et al., 2006 (65) United States	Prospective cohort study Objective: To determine whether regular exercise is associated with a reduced risk for dementia	N=1740 >65 years No cognitive impairment; and scored above the 25th percentile on Cognitive Ability Screening Instrument (CASI) in the Adult Changes in Thought (ACT) study. (reduce potential effect related to "prodromal phase of dementia")	Patients followed biennially to identify incident dementia Exercise determined by asking participants the number of days/week they did activities ≥15 min at time during the past year *Analysis compared participants in the lowest quartile of frequency of exercise (<3 times/week) with those in the top 3 quartiles ≥3 times per week).*\	Mean follow-up 6.2 years Dementia free: n=1185 (mean age at baseline=73.2 years) Dementia: n=158 (mean age at baseline=78.2 years) Alzheimer's disease: n=107 Vascular dementia: n=33 Other types of dementia: n=18 Participants who exercised ≥3 times per week had a high probability of being dementia free compared to those who exercised <3 times per week: HR=0.62 95% CI (0.44–0.86), *P* = .004 When potential confounders were simultaneously adjusted for, HR was 0.68 95% CI (0.48–0.96), *P* = .030)
Abbott et al., 2004 (66) United States	Prospective cohort Honolulu Aging Study launched as an expansion of the Honolulu Heart Program Objective: To examine the association between self-reported walking and future risk of dementia in older men	N=2257 men (80% of the survivors in the original Honolulu Heart Program) 71 to 93 years Japanese ancestry Physically capable of walking and retired.	Incident dementia Follow-up based on neurological assessment at 2 repeat exams.	158 cases of dementia identified Mean time from baseline exam to diagnosis = 4.7 years with ~7 years of follow-up Mean age at baseline: <0.25 miles/day (n=600) 77.4 years 0.25 to 1 miles/day (n=769) 77.3 years >1 to 2 miles/day (n=433) 76.7 years >2 miles/day (n=455) 76.0 years Why the men walked unknown (e.g., domestic needs or leisure)

Overall, exercise was associated with a reduced incidence of dementia. (66) After adjusting for age, men who walked the least (<0.25 mile per day) experienced a 1.8-fold excess of total dementia compared with those who walked more than 2 miles per day (17.8 vs. 10.3/1000 person-years; relative hazard [RH] 1.77; 95% CI 1.04–3.01). Compared with men who walked the most (>2 miles per day), an excess of dementia was also observed in those who walked 0.25 to 1 mile per day (17.6 vs. 10.3/1000 person-years; RH 1.71; 95% CI 1.02–2.86).

After adjustment, a 1.9-fold excess risk for total dementia occurred in men who walked less than 0.25 miles per day compared with men who walked more than 2 miles per day (RH 1.93; 95% CI, 1.11–3.34). Compared with the most active men, those who walked 0.25 to 1 mile per day experienced a 1.7-fold excess in dementia risk (RH 1.75; 95% CI, 1.03–2.99).

Summary of Long-Term Observational Studies

Rovio et al. (68) examined the association between leisure time physical activity at midlife and subsequent development of dementia. Overall, exercise at midlife was associated with a reduced risk of developing dementia (Table 29).

Table 29: Results from Roivio et al. (68)

Study/Year/Country	Type of Study	Patients	Outcomes	Results
Roivo et al., 2005 (68) Finland	Prospective cohort Investigate association between leisure time physical activity at midlife and subsequent development of dementia "Active" = participated in activity at least twice a week "Sedentary" = less than twice a week	Having been examined once at midlife, 1499 people (72.5%) aged 65–79 years participated in the re-examination in 1998 (mean follow-up 21 years).	Development of dementia Leisure time assess on questionnaire	Mean age at midlife exam was 50.6 years (range 39–64) Mean age at re-examination was 71.6 years (range 65–79) 115 people had dementia and 76 had Alzheimer's disease Ascertained dementia cases from re-examination as well as hospital records for nonparticipants Comments: No follow-up measurements to assess changes occurring in physical activity

In the final model, participants in the active group had 53% lower odds of dementia compared with the sedentary group.

One limitation to the study was that there were no follow-up measurements to assess any changes that may have occurred in physical activity.

Economic Analysis

No economic analyses were identified that examined the cost-effectiveness of exercise programs specifically for the primary prevention of dementia.

Munro et al. (69) assessed the cost-effectiveness of a community-based exercise program, as a population public health intervention for seniors via a pragmatic, cluster-randomized, community intervention trial. Participants were all those aged 65 and over in the least active four-fifths of the population responding to a baseline survey in the United Kingdom. Eligible candidates were invited to free locally held exercise classes made available for 2 years.

Twenty-six percent of the intervention group attended 1 or more exercise sessions. (69) There were no significant differences in mortality rates, survival times, or hospital admissions. After adjusting for baseline characteristics, seniors in the intervention group had a lower decline in health status, although this was statistically significant for only 1 out of 9 of the Short Form 36 Health Survey Questionnaire

(SF-36) health dimension scores, and 2 out of 3 composite scores. The incremental average quality-adjusted life year gain of 0.011 per person in the intervention group resulted in an incremental cost per quality-adjusted life year ratio of €17,174 (95% CI €8,300–€87,120). (69)

Summary of Findings

As per the GRADE Working Group (52), the overall quality of the evidence is shown in Table 30.

Table 30: Quality of Trials According to GRADE

Outcome	Design	Quality	Consistency	Directness	Overall Quality
Short term Incidence of dementia	Prospective cohort 2 studies	High/Moderate*	Consistent	Direct (target population elderly)	High/Moderate
Short term Cognitive decline	Prospective cohort 2 studies	High/Moderate†	Consistent	Direct (target population elderly)	High/Moderate
Long term Incidence of dementia	Prospective cohort 1 study	Moderate‡	Consistent (1 study but results consistent with short-term results)	Not direct (middle aged)	Moderate

* Purpose of walking unknown (e.g., related to domestic needs or modifiable decision to walk for leisure). (66)
† Sample size varied across cognitive tests because more tests were added over the years. (67)
‡ No information about exercise during follow-up. (68)

Ontario Health Systems Impact Analysis

Considerations and Implications

There is uncertainty regarding what type, frequency, intensity, or duration of physical activity is most beneficial in preventing cognitive deterioration.

There are implications for preventative health care for both seniors and pre-seniors:
- There is evidence that regular exercise by seniors is associated with a reduced risk of cognitive decline and dementia.
- There is evidence that regular midlife exercise is associated with a reduced risk of the development of dementia.

An expert panel on aging in the community met on February 29, 2008, and in part, discussed physical exercise for seniors in Ontario. In particular, it was discussed how physical exercise is made available to seniors and who provides the service. Comments from the panel are found below.

Long-Term Care Facilities

- In-house occupational/physiotherapists and recreational therapists provide physical exercise interventions.

In the Community

- Community Care Access Centres can provide referrals for occupational therapists, physiotherapists and personal support workers to go to homes.

- Community recreation centres – recreationalists can teach caregiver and client exercise programs.
- Community Agencies (e.g., SPRINT) and religious groups off exercise programs – volunteer led informal exercise groups (e.g., "mall walkers").
- Exercise programs often provided in/around supportive housing units.
- Exercise activities often organized outside of the formal health system.
- Municipality websites often list services available within the area.

Benefit/Risk Analysis

As per the GRADE Working Group (52), the strength of a recommendation to use physical activity as an intervention to reduce the risk of cognitive decline or dementia is shown in Table 31.

Table 31: Overall Summary Statement of Benefit and Risk

Outcome	Quality	Benefits	Risks/Burden	Overall Strength of Recommendation
Short term Incidence of dementia	High/Moderate	Decreased incidence of dementia	Unknown if leads to delayed institutionalization	High/Moderate
Short term Cognitive decline	High/Moderate	Reduced risk of subsequent cognitive decline	Unknown if leads to delayed diagnosis of dementia or institutionalization	High/Moderate
Long term Incidence of dementia	Moderate	Decreased incidence of dementia	Unknown if leads to delayed institutionalization	Moderate

Conclusion

Long-Term Outcomes

- Regular leisure time physical activity in midlife is associated with a reduced risk of dementia in later life (mean follow-up 21 years).

Short-Term Outcomes

- Regular physical activity in seniors is associated with a reduced risk of cognitive decline (mean follow-up 2 years).
- Regular physical activity in seniors is associated with a reduced risk of dementia (mean follow-up 6–7 years).

3.4. Nonpharmacologic & Nonexercise Interventions for Delaying the Onset of Dementia – Primary Prevention

Clinical Need: Target Population and Condition

Cognitive impairments, including memory problems, are a defining feature in patients with dementia. (55) Declines in specific cognitive domains (e.g., memory, executive functions) are predictive of deficits in the performance of IADLs in older adults. (70;71)

Having more years of education (i.e., a higher cognitive reserve) is associated with a lower prevalence of dementia in crossectional population based studies and to a lower incidence of dementia in cohorts followed longitudinally. (72;73) However, it is unclear whether cognitive training can increase cognitive reserve or decrease the risk of cognitive impairment, deterioration in the performance of ADLs or IADLs, or incidence of dementia. (74)

Evidence Based Analysis of Effectiveness

Question

Does cognitive training decrease the risk of cognitive impairment, deterioration in the performance of ADLs or IADLs or incidence of dementia in seniors with good cognitive and physical functioning?

Comparisons of Interest (and for which evidence of these comparisons exist)

- Cognitive training versus usual care/activity.

Methods

Inclusion Criteria

- elderly patients (≥65 years) without dementia,
- patients receive cognitive intervention targeting cognitive functioning,
- systematic reviews, RCTs, and
- outcome being any measures of cognitive functioning/ADL/IADL/incidence of dementia.

Exclusion Criteria

- patients <65 years of age,
- N < 10 patients, and
- studies that do not report cognitive exercises as the intervention.

Assessment of Quality of Evidence

The quality of the evidence was assessed as High, Moderate, Low, or Very low according to the GRADE methodology and GRADE Working Group at www.Gradeworkinggroup.org. (52)

Results of Literature Search

A literature search from January 2006 to December 2007 (Appendix 4) including OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library,

INAHTA/Centre for Review and Dissemination identified no systematic review that evaluated the effectiveness of cognitive training interventions to decrease the risk of cognitive impairment, deterioration in the performance of ADLs or IADLs or incidence of dementia in seniors with good cognitive and physical functioning

Two publications of a singe RCT were identified. (75;76) Ball et al. (75) examined whether 3 cognitive training interventions improved mental abilities and daily functioning in older independent living adults. Willis et al.(76) conducted a 5-year extension follow-up of the original trial by Ball et al. (75)

The quality of the included article is presented below (Table 32).

Table 32: Quality of Evidence

Study Design	Level of Evidence	Number of Eligible Studies
Large RCT, systematic reviews of RCTs	1	1 + 1 (original + extension)
Large RCT, unpublished but reported to an international scientific meeting	1(g)	
Small RCT	2	
Small RCT, unpublished but reported to an international scientific meeting	2(g)	
Nonrandomized study with contemporaneous controls	3a	
Nonrandomized study with historical controls	3b	
Nonrandomized study presented at international conference	3(g)	
Surveillance (database or register)	4a	
Case series (multi-site)	4b	
Case series (single site)	4c	
Retrospective review, modeling	4d	
Case series presented at international conference	4(g)	

For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. (58) An additional sesignation “g” was added for preliminary reports of studies that have been presented at international scientific meetings.

Summary of Existing Evidence

Randomized Controlled Trials

The RCT reported by Bell et al. (75) tested if a 10-session training intervention for specific cognitive functions (memory, reasoning, and speed of processing) produced immediate improvements in these domains compared with a nonintervention control group (Table 33).

Cognitive improvements were sustained after 5 years of follow-up, but none of these improvements had effects beyond the specific cognitive domains of the intervention (Table 33). (76)

Results addressing the investigators’ primary hypothesis (cognitive training would delay declines in functional status measured by self-reported IADL scores and performance assessments) were unclear. (76)

- Only participants who underwent reasoning training (verbal episodic) self-reported significantly higher IADL functioning compared with the control group.

- The remaining 2 intervention groups had higher, but nonsignificant, self-reported IADL scores than the control group.
- None of the groups demonstrated significant improvements in the performance-based measures (everyday problem solving and everyday speed of processing).

Table 33: Summary of the 2 Randomized Controlled Trials

Study/Year/Country	Type of Study	Patients	Objective	Outcomes	Results
Ball et al. (75) 2002 United States	RCT Single blind 4 arms 2 year follow-up Intervention conducted in small group settings in ten 60–75 min sessions over 5–6 weeks.	N=2,802 Patients had good cognitive/functional status at enrollment Mean age (SD) = 73.6 (5.9) Range 65–94 years Age groups: 65–74 years 60.1% 75–84 years 35.0% >85 years 4.9%	To evaluate whether 3 cognitive training interventions (memory, speed of processing, reasoning) improve mental abilities and daily functioning in older independent living adults Training lasted 10 sessions for each group	Basic measures of cognition and on measures of cognitively demanding daily activities (e.g., food preparation, driving, medication use, financial management)	Tests of cognitive abilities given immediately after training showed significant improvement on the particular cognitive skill on which the individual had been trained, but no transfer to the other 2 cognitive domains. No significant training effects on everyday function were detected at 2 years.
Willis et al. (76) 2006 United States	RCT Single blind 4 arms 5-year follow-up	67% completed 5 year follow-up	To determine effects of cognitive training on daily function and durability of training on cognitive abilities	Self-reported and performance based measures of daily function and cognitive abilities	Training on cognitive abilities showed significant improvement on particular cognitive skill on which person was trained. No transfer to other domains. Training on functional abilities (IADLs; everyday problem solving; everyday speed of processing). No significant differences in functional outcomes for memory or speed processing training. Reasoning significantly improved IADL, but not the other 2 abilities)

IADL, instrumental activities of daily living; RCT, randomized controlled trial; SD, standard deviation.

Comments/Limitations Regarding the Randomized Controlled Trials

- Primary outcome (functional activities) versus proximal outcome (cognitive abilities): (75;76)

- Prior studies showed cognitive interventions improve cognitive abilities in normal seniors but have not included functional outcome measures and have been limited by small homogenous samples and lack of randomization.
- Authors expected to see transfer of training effects to affect functioning (e.g., IADL). (75;76)

- Vast majority of patients remained functionally independent over the course of the 24-month observation period.
- Study was powered to show an effect size of 0.20 at 95% power with a sample of 2,832, which should have been sufficient power to detect a significant effect of the cognitive training on functional outcomes. (75)
- Why no transfer to functional outcomes?
  - A proportion of patients were already functioning at ceiling levels (43% had no room for improvement) on the daily functional composite. (75)
  - Strong practice or retest effects in the control group. Approximately 25% of control patients showed reliable gain on cognitive and functional composites. (75)
  - The control group did not experience functional decline over the 2-year follow-up. (75)
  - Individuals with functional or cognitive decline were screened out of the study. Study focused on patients whose future decline rates were likely to mimic or be less than rates for the general elderly population.
  - Prior longitudinal research on cognitively demanding measures of everyday functioning indicates that age related decline occurs later for these tasks than for more basic abilities that were the focus of training. (76) Age-related decline on everyday problem-solving tasks shown not to occur until mid-seventies. Declines on basic abilities such as reasoning and memory typically occur in mid-sixties.
- Since the patients were functionally independent at baseline, the authors hypothesized that observations of training effects on IADL functioning would be delayed until the control group began to experience significant functional decline (not stated in the original 2002 study). This was observed at the 5-year follow-up.
- Full extent of daily function would take longer than 5 years to observe in a population that was highly functioning at enrollment.
- No information about physical activity of patients.

Economic Analysis

No economic analyses were identified that examined the cost-effectiveness of cognitive training for the primary prevention of dementia.

Summary of Findings

As per the GRADE Working Group (52), the overall quality of the evidence is shown in Table 34.

Table 34: Quality of Trials According to GRADE

Outcome	Design	Quality	Consistency	Directness	Overall Quality
Cognitive functioning and performance of ADL	RCT	Moderate	Not consistent (1 RCT)	No People with functional or cognitive decline were screened out along with people with medical conditions associated with "imminent functional decline or death."	Low

ADL indicates activities of daily living; RCT, randomized controlled trial.

Ontario Health Systems Impact Analysis

Considerations and Implications

The full extent of daily function would take longer than 5 years to observe in a population that was highly functioning at enrollment as was the case with the study by Ball et al. and Willis et al. (75;76)

According to Ball et al. (75), the 3 training interventions (memory, reasoning, and speed of processing) were selected because they showed the most promise in smaller laboratory studies and had been related to IADL. It is unclear if these particular cognitive training exercises encapsulate cognitive measures of importance for clinical settings.

The cognitive training results are very specific to the skills that are trained. It is unknown whether there is any effect on when or whether an individual develops dementia. (74)

Benefit/Risk Analysis

As per the GRADE Working Group (52), the strength of a recommendation to use cognitive training as an intervention to reduce the risk of cognitive decline is shown in Table 35.

Table 35: Overall Summary Statement of Benefit and Risk*

Outcome	Quality	Benefits	Risks/Burden	Overall Strength of Recommendation
Cognitive functioning and performance of ADL	Low	Cognitive improvements sustained after 5 years (however, none of these improvements had effects beyond the specific cognitive domains of the intervention)	Results addressing functional outcomes unclear Need more than 5-year follow-up No evidence to determine if cognitive training leads to: 1) delayed diagnosis of dementia 2) delayed institutionalization	Very low

*ADL indicates activities of daily living.

Conclusion

For seniors with good cognitive and physical functioning, there is:

- evidence that cognitive training for specific functions (memory, reasoning, and speed of processing) produces improvements in these specific domains, and
- limited inconclusive evidence that cognitive training can offset deterioration in the performance of self-reported IADL scores and performance assessments.

Overall Summary of Results for Patient-Directed Interventions for Dementia

Summary

Table 36 summarizes the conclusions from Sections 3.1 through 3.4.

Table 36: Overall Conclusions on Patient-Directed Initiatives

Intervention	Target Population	1° or 2° Prevention	Conclusion	Overall Quality (GRADE)
Physical exercise	Seniors with mild to moderate dementia	2°	Physical exercise is effective for improving physical functioning in patients with dementia.	Moderate
Physical exercise	Seniors with good cognitive functioning (no dementia)	1°	Long-term outcomes ▪ Regular leisure time physical activity in midlife is associated with a reduced risk of dementia in later life (mean follow-up 21 years)	Moderate
			Short-term outcomes ▪ Regular physical activity in seniors is associated with a reduced risk of cognitive decline (mean follow-up 2 years) ▪ Regular physical activity in seniors is associated with a reduced risk of dementia (mean follow-up 6–7 years)	High/Moderate High/Moderate
Nonpharmacologic and nonexercise interventions	Seniors with mild to moderate dementia	2°	Previous systematic review indicated that "cognitive training" is not effective in patients with dementia. Recent RCT suggests CST (up to 7 weeks) is effective for improving cognitive function and quality of life in patients with dementia.	Low
Nonpharmacologic and nonexercise interventions	Seniors with good cognitive functioning (no dementia)	1°	For seniors with good cognitive and physical functioning: ▪ Evidence that cognitive training for specific functions (memory, reasoning, and speed of processing) produces improvements in these specific domains ▪ Limited inconclusive evidence that cognitive training can offset deterioration in the performance of self-reported IADL scores and performance assessments	Low

*CST indicates cognitive stimulation therapy; IADL, instrumental activities of daily living, RCT, randomized controlled trial.

Benefit/Risk Analysis

The last column in Table 37 is the overall trade-off between benefits and harms, and incorporates any risk/uncertainty.

Table 37: Overall Summary Statement of the Benefit and Risk for Patient-Directed Initiatives*

Intervention	Target Population	1° or 2° Prevention	Overall Quality (GRADE)	Benefits	Risks/Burden	Overall Strength of Recommendation (GRADE)
Physical exercise	Seniors with mild to moderate dementia	2°	Moderate	Improvement in functional, cognitive, and behavioural outcomes	▪ Short-term follow-up and heterogeneity in studies ▪ Unclear if leads to delayed institutionalization	Moderate
Physical exercise *Short-term Cognitive decline*	Seniors with good cognitive functioning (no dementia)	1°	High/ Moderate	Reduced risk of subsequent cognitive decline	▪ Unknown if leads to delayed diagnosis of dementia or institutionalization	High/Moderate
Short-term Incidence of dementia			High/ Moderate	Decreased incidence of dementia	▪ Unknown if leads to delayed institutionalization	High/Moderate
Long-term Incidence of dementia			Moderate	Decreased incidence of dementia	▪ Unknown if leads to delayed institutionalization	Moderate
Nonpharmacologic and nonexercise interventions *Cognitive training*	Seniors with mild to moderate dementia	2°	Very low	None	▪ Intervention not offer significant benefit (possible type 2 error) ▪ Unclear if leads to delayed institutionalization	Very low
Cognitive stimulation therapy (CST)			Moderate/Low	Increased cognition and quality of life	▪ Unclear how CST compares with past ▪ terminologies and methodologies ▪ Short-term results ▪ Role and extent of maintenance ▪ Unclear how CST may impact functional dependence ▪ Unclear if leads to delayed institutionalization	Low
Nonpharmacologic and nonexercise interventions	Seniors with good cognitive functioning (no dementia)	1°	Low	Cognitive improvements sustained after 5 years, but none of these improvements had effects beyond the specific cognitive domains of the intervention)	▪ Results addressing functional outcomes unclear ▪ Need more than 5-year follow-up ▪ No evidence to determine if cognitive training leads to 1) delayed diagnosis of dementia 2) delayed institutionalization.	Very low

*1° indicates primary; 2°, secondary; CST, cognitive stimulation therapy; IADL, instrumental activities of daily living; RCT, randomized controlled trial.

4. Economic Analysis

Literature Review

No economic analyses were identified that examined the cost-effectiveness of exercise programs for seniors with dementia.

Ontario-Based Economic Analysis

Disclaimer: The Medical Advisory Secretariat uses a standardized costing methodology for all of its economic analyses of technologies. The main cost categories and the associated methods from the province's perspective are as follows:
Hospital: Ontario Case Costing Initiative cost data are used for all in-hospital stay costs for the designated International Classification of Diseases-10 diagnosis codes and Canadian Classification of Health Interventions procedure codes. Adjustments may need to be made to ensure the relevant case mix group is reflective of the diagnosis and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, the Medical Advisory Secretariat normally defaults to considering direct treatment costs only.
Nonhospital: These include physician services costs obtained from the Ontario Schedule of Benefits for physician fees, laboratory fees from the Ontario Laboratory Schedule of Fees, device costs from the perspective of local health care institutions, and drug costs from the Ontario Drug Benefit formulary list price.
Discounting: For all cost-effective analyses, a discount rate of 5% is used as per the Canadian Agency for Drugs and Technologies in Health.
Downstream costs: All costs reported are based on assumptions of utilization, care patterns, funding, and other factors. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature. In cases where a deviation from this standard is used, an explanation has been given as to the reasons, the assumptions, and the revised approach. The economic analysis represents an estimate only, based on assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied for the purpose of developing implementation plans for the technology.

Budget Impact Analysis of Effective Interventions for Dementia

Caregiver-directed behavioural techniques and patient-directed exercise programs were found to be effective when assessing mild to moderate dementia outcomes in seniors living in the community. Therefore, an annual budget impact was calculated based on eligible seniors in the community with mild and moderate dementia and their respective caregivers who were willing to participate in interventional home sessions. Table 38 describes the annual budget impact for these interventions.

Table 38: Annual Budget Impact (2008 Cdn Dollars)

Parameter	Unit Cost ($ Cdn)	Unit	Annual Cost ($ Cdn)	Population*	No. of Patients	Annual Impact ($ Cdn)
Caregiver-Directed Behavioural Techniques†						
Occupational Therapist	120.22	1 hour session - 12 total	1,442.64	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	81,695,125
Nurse	82.12	1 hour session - 12 total	985.44	Caregivers of seniors with mild to moderate dementia who are willing to participate	56,629	55,804,389
Patient-Directed Exercise Program‡						
Occupational Therapist	120.22	1 hour session - 32 total	3,847.04	Seniors with mild to moderate dementia who are willing to participate	38,696	148,866,672
Physiotherapist	108.49	1 hour session - 32 total	3,471.68	Seniors with mild to moderate dementia who are willing to participate	38,696	134,341,585
Personal Support Worker	30.48	1 hour session - 32 total	975.36	Seniors with mild to moderate dementia who are willing to participate	38,696	37,742,939
Recreation Therapist	25.85	1 hour session - 32 total	827.20	Seniors with mild to moderate dementia who are willing to participate	38,696	32,009,678
Caregiver- and Patient-Directed Behavioural Techniques§						
Occupational Therapist	120.22	1 hour session - 10 total	1,202.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	68,079,271
Nurse	82.12	1 hour session - 10 total	821.20	Caregivers and seniors with mild to moderate dementia willing to participate	56,629	46,503,658

*Assumed 7% prevalence of dementia aged 65+ in Ontario. (Numbers in Ontario from Statistics Canada and prevalence of dementia from Alzheimer's Disease International April 1999.) (42)
†Assumed 8 weekly sessions plus 4 monthly phone calls. (77)
‡Assumed 12 weekly sessions plus biweekly sessions thereafter (total of 20). (51)
§Assumed 2 sessions per week for first 5 weeks. (35) Assumed 90% of seniors in the community with dementia have mild to moderate disease. (78) Assumed 4.5% of seniors 65+ are in long-term care, and the remainder are in the community. (79) Assumed a rate of participation of 60% for both patients and caregivers (36) and of 41% for patient-directed exercise. (51) Assumed 100% compliance since intervention administered at the home. Cost for trained staff from Ministry of Health and Long-Term Care data source. (Personal communication, June 2008) Assumed cost of personal support worker to be equivalent to in-home support. Cost for recreation therapist from Alberta government Website. (80)
Note: This budget impact analysis was calculated for the first year after introducing the interventions from the Ministry of Health and Long-Term Care perspective using prevalence data only. Prevalence estimates are for seniors in the community with mild to moderate dementia and their respective caregivers who are willing to participate in an interventional session administered at the home setting. Incidence and mortality rates were not factored in. Current expenditures in the province are unknown and therefore were not included in the analysis. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the province, and assumptions on costs. The number of patients was based on patients likely to access these interventions in Ontario based on assumptions stated below from the literature. An expert panel confirmed resource consumption.

Assumptions

There were several assumptions made to calculate the annual budget impact:

- Assumed 7% prevalence of dementia in 65+ seniors in Ontario. (81)
- Assumed 90% of seniors in the community with dementia have mild to moderate disease. (78)
- Assumed 4.5% of seniors 65+ are in LTC facilities – the remainder are in the community. (36)
- Assumed a participation rate of 60% for both caregivers and patients. (36)
- Assumed a participation rate of 41% for patient directed exercise.(51)
- Assumed 100% compliance.
- Assumed an occupational therapist hourly cost of $120.22, a physiotherapist hourly cost of $108.49, a nurse hourly cost of $82.12, and a personal support worker hourly cost of $30.48 from the Ministry of Health and Long-Term Care data source for homecare costs (Personal communication, June 2008) and an hourly cost for a recreation therapist of $25.85 from the government of Alberta. (80) Assumed 8 weekly sessions plus 4 monthly phone calls thereafter for caregiver directed behavioural techniques. (77)
- Assumed 12 weekly sessions plus biweekly sessions thereafter (20 in total) for patient-directed exercise program. (51)
- Assumed 2 sessions per week for the first 5 weeks for combination therapy. (35)

As a result of these assumptions and due to the limited data available in the literature, uncertainty becomes an issue; if/when new evidence is presented, these results may change and may better predict health outcomes over time allowing for a more accurate analysis.

Appendices

Appendix 1: Literature Search – Respite Care

Search date: January 3, 2008
Databases searched: MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, INAHTA/CRD, CINAHL, Cochrane Library

Database: Ovid MEDLINE(R) <1996 to November Week 2 2007>
Search Strategy:

1	exp Dementia/ or exp Memory Disorders/ or exp Cognition Disorders/ (68097)
2	(alzheimer$ or dementia$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (57020)
3	1 or 2 (81807)
4	exp Caregivers/ (9236)
5	exp Home Nursing/ (2604)
6	exp Day Care/ (1134)
7	exp Community Health Services/ or exp Social Support/ (181196)
8	(daycare$ or day care$ or respite or caregiver$ or care giver$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (19925)
9	or/4-8 (195118)
10	3 and 9 (5708)
11	limit 10 to (humans and english language and yr="2005 - 2008") (1530)
12	limit 11 to (controlled clinical trial or meta analysis or randomized controlled trial) (130)
13	exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ (29765)
14	(meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (56269)
15	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (332772)
16	exp Double-Blind Method/ (48766)
17	exp Control Groups/ (503)
18	exp Placebos/ (8499)
19	RCT.mp. (2098)
20	or/12-19 (397969)
21	11 and 20 (241)

Database: EMBASE <1980 to 2008 Week 01>
Search Strategy:

1	exp Dementia/ (98803)
2	exp Memory Disorder/ (21803)
3	(alzheimer$ or dementia$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (91427)
4	or/1-3 (125576)
5	exp caregiver/ (12536)

6 exp Home Care/ (14957)
7 exp Day Care/ (2942)
8 exp Community Care/ (21986)
9 exp Social Support/ (14769)
10 exp Caregiver Support/ (181)
11 exp caregiver burden/ (442)
12 (daycare$ or day care$ or respite or caregiver$ or care giver$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (21809)
13 or/5-12 (68161)
14 4 and 13 (5360)
15 limit 14 to (human and english language and yr="2005 - 2008") (1308)
16 Randomized Controlled Trial/ (152795)
17 exp Randomization/ (24783)
18 exp RANDOM SAMPLE/ (903)
19 exp Biomedical Technology Assessment/ or exp Evidence Based Medicine/ (276427)
20 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (55130)
21 Double Blind Procedure/ (67702)
22 exp Triple Blind Procedure/ (8)
23 exp Control Group/ (1257)
24 exp PLACEBO/ (108318)
25 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (395692)
26 or/16-25 (601733)
27 15 and 26 (305)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to December Week 1 2007>
Search Strategy:
---
1 exp DEMENTIA/ (14991)
2 exp Memory Disorders/ (1529)
3 exp Cognition Disorders/ (4710)
4 1 or 2 or 3 (19857)
5 exp Caregivers/ (7601)
6 exp Caregiver Support/ (1551)
7 exp Caregiver Burden/ (3201)
8 exp Day Care/ or exp Respite Care/ (1722)
9 exp Home Nursing/ (1588)
10 exp Community Health Services/ (131553)
11 exp Support, Psychosocial/ (18842)
12 (daycare$ or day care$ or respite or caregiver$ or care giver$).mp. [mp=title, subject heading word, abstract, instrumentation] (18799)
13 or/5-12 (159864)
14 4 and 13 (4272)
15 limit 14 to (english and yr="2005 - 2007") (1253)
16 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (62969)
17 RCT.mp. (785)

18 exp Meta Analysis/ (5947)
19 exp "Systematic Review"/ (3456)
20 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (20908)
21 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (11977)
22 exp PLACEBOS/ (3902)
23 exp Medical Practice, Evidence-Based/ (3919)
24 health technology assessment.mp. (345)
25 or/16-24 (85257)
26 15 and 25 (143)

Appendix 2: Literature Search – Caregiver Support

Search date: March 3, 2008
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, Cochrane Library, INAHTA/CRD, PsycINFO

Database: Ovid MEDLINE(R) <1996 to February Week 3 2008>
Search Strategy:

1	exp Dementia/ (48778)
2	exp Memory Disorders/ (8295)
3	(dementia or demented or alzheimer$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (58996)
4	or/1-3 (71134)
5	exp Caregivers/ (9550)
6	exp Spouses/ (3084)
7	exp Family/ (73561)
8	(carer$ or caregiv$ or care-giv$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (20224)
9	or/5-8 (88930)
10	4 and 9 (4208)
11	exp Self-Help Groups/ (3315)
12	exp Adaptation, Psychological/ (35597)
13	exp behavior therapy/ or cognitive therapy/ (15601)
14	exp Psychotherapy/ (37496)
15	exp Counseling/ (10892)
16	exp Problem Solving/ (7134)
17	exp Social Support/ (21185)
18	exp Intervention Studies/ (2987)
19	exp Home Nursing/ (2671)
20	exp Teaching/ (22494)
21	((caregiv$ or carer$ or spouse or spousal or psyhological or psychosocial or education$ or psychoeducational or program$) adj4 (support$ or intervenion$)).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (8243)
22	exp Stress, Psychological/th [Therapy] (1019)
23	exp Anxiety/th [Therapy] (871)
24	or/11-23 (133233)
25	10 and 24 (1297)
26	limit 25 to (english language and humans and yr="2003 - 2008") (549)
27	limit 26 to (controlled clinical trial or meta analysis or randomized controlled trial) (89)
28	exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ (31137)
29	(meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (58887)
30	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (343549)
31	exp Double-Blind Method/ (50073)
32	exp Control Groups/ (528)
33	exp Placebos/ (8685)

34 RCT.mp. (2210)
35 or/27-34 (411588)
36 26 and 35 (126)

Database: EMBASE <1980 to 2008 Week 09>
Search Strategy:
---

1 exp Dementia/ (100182)
2 exp Memory Disorder/ (22176)
3 (dementia or demented or alzheimer$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (93182)
4 or/1-3 (127770)
5 exp Caregiver/ or exp Caregiver Burden/ (13106)
6 exp SPOUSE/ (3204)
7 exp FAMILY/ (96271)
8 (carer$ or caregiv$ or care-giv$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (20420)
9 or/5-8 (111876)
10 4 and 9 (5928)
11 exp Self Help/ (2994)
12 exp Coping Behavior/ (18583)
13 exp Stress Management/ (253)
14 exp Behavior Modification/ or exp Behavior Therapy/ (24577)
15 exp PSYCHOTHERAPY/ or exp Distress Syndrome/th [Therapy] (73612)
16 exp counseling/ or exp Problem Solving/ (51165)
17 exp Social Support/ or exp Adaptation/ or exp Adaptive Behavior/ (54601)
18 exp Education Program/ or exp Intervention Study/ (25232)
19 exp Support Group/ (3626)
20 exp Caregiver Support/ or exp Home Care/ (15348)
21 exp Teaching/ (11165)
22 exp home mental health care/ or exp psychosocial care/ (5265)
23 ((caregiv$ or care-giv$ or carer$ or spouse or spousal or psyhological or psychosocial or education$ or psychoeducational or program$) adj4 (support$ or intervenion$)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (9243)
24 exp Stress Management/ (253)
25 exp ANXIETY/th [Therapy] (2)
26 exp Behavior Disorder/th [Therapy] (9429)
27 or/11-26 (240510)
28 10 and 27 (1855)
29 Randomized Controlled Trial/ (154967)
30 exp Randomization/ (25139)
31 exp RANDOM SAMPLE/ (990)
32 exp Biomedical Technology Assessment/ or exp Evidence Based Medicine/ (280024)
33 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (56485)
34 Double Blind Procedure/ (68397)
35 exp Triple Blind Procedure/ (8)
36 exp Control Group/ (1462)
37 exp PLACEBO/ (110517)

38 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (401372)
39 or/29-38 (610648)
40 28 and 39 (343)
41 limit 40 to (human and english language and yr="2003 - 2008") (219)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to February Week 4 2008>
Search Strategy:
---
1 exp Dementia/ (15489)
2 exp Memory Disorders/ (1631)
3 (dementia or demented or alzheimer$).mp. [mp=title, subject heading word, abstract, instrumentation] (16853)
4 or/1-3 (18563)
5 exp Caregivers/ (7792)
6 exp Caregiver Burden/ (3223)
7 exp Spouses/ (2754)
8 exp FAMILY/ (54157)
9 (carer$ or caregiv$ or care-giv$).mp. [mp=title, subject heading word, abstract, instrumentation] (19962)
10 or/5-9 (68755)
11 4 and 10 (3862)
12 exp Support Groups/ (4075)
13 exp ADAPTATION, PSYCHOLOGICAL/ (7260)
14 exp Psychotherapy/ (44148)
15 exp Counseling/ (8177)
16 exp Learning/ (18675)
17 exp Support, Psychosocial/ (19251)
18 exp Caregiver Support/ (1562)
19 exp Home Nursing/ (1602)
20 ((caregiv$ or carer$ or spouse or spousal or psyhological or psychosocial or education$ or psychoeducational or program$) adj4 (support$ or intervenion$)).mp. [mp=title, subject heading word, abstract, instrumentation] (27902)
21 Stress, Psychological/th [Therapy] (269)
22 exp Stress Management/ (2995)
23 exp Role Stress/th [Therapy] (1)
24 exp ANXIETY/th [Therapy] (532)
25 exp Coping/ (11410)
26 exp Behavior Modification/ (10092)
27 exp Problem Solving/ (3026)
28 or/12-27 (90851)
29 11 and 28 (1485)
30 limit 29 to (english and yr="2003 - 2008") (589)
31 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (65853)
32 RCT.mp. (826)
33 exp Meta Analysis/ (6098)
34 exp "Systematic Review"/ (3495)
35 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (21778)

36 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (12919)
37 exp PLACEBOS/ (4067)
38 or/31-37 (86049)
39 30 and 38 (71)

Appendix 3: Literature Search – Exercise Therapy

Search date: May 13, 2008
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, Cochrane Library, CINAHL; INAHTA/CRD

Database: Ovid MEDLINE(R) <1996 to April Week 5 2008>
Search Strategy:

1	exp Dementia/ (49790)
2	exp Cognition Disorders/ (24181)
3	(dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (60527)
4	or/1-3 (81338)
5	exp Exercise/ or exercise$.mp. or physical activit$.mp. or walk$.mp. or run$.mp. or yoga.mp. or tai chi.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (154985)
6	exp Physical Fitness/ or exp Motor Activity/ (45134)
7	5 or 6 (178167)
8	4 and 7 (1946)
9	limit 8 to (english language and humans and yr="2003 - 2008") (801)
10	limit 9 to (controlled clinical trial or meta analysis or randomized controlled trial) (75)
11	exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ (32095)
12	(meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (60836)
13	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (352050)
14	exp Double-Blind Method/ (51030)
15	exp Control Groups/ (566)
16	exp Placebos/ (8862)
17	RCT.mp. (2313)
18	or/10-17 (422207)
19	9 and 18 (141)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to May Week 2 2008>
Search Strategy:

1	exp Dementia/ (16608)
2	exp Cognition Disorders/ (5630)
3	(dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, subject heading word, abstract, instrumentation] (18112)
4	or/1-3 (22838)
5	exp Exercise/ (26885)
6	exp Therapeutic Exercise/ (15906)
7	exp Physical Activity/ (7225)

8 exp Physical Fitness/ (4333)
9 (exercise$ or physical activit$ or walk$ or run$ or yoga or tai chi).mp. [mp=title, subject heading word, abstract, instrumentation] (68340)
10 or/5-9 (72103)
11 4 and 10 (802)
12 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (71326)
13 RCT.mp. (902)
14 exp Meta Analysis/ (6487)
15 exp "Systematic Review"/ (3681)
16 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (23706)
17 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (14310)
18 exp PLACEBOS/ (4394)
19 exp "Control (Research)"/ (2347)
20 or/12-18 (93423)
21 11 and 20 (127)
22 limit 21 to (english and yr="2003 - 2008") (83)

Database: EMBASE <1980 to 2008 Week 19>
Search Strategy:
---

1 exp Dementia/ (101554)
2 exp Cognitive Defect/ (35519)
3 (dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (94770)
4 or/1-3 (135596)
5 exp exercise/ or exp physical activity/ (159534)
6 exp kinesiotherapy/ (16933)
7 exp Fitness/ (9604)
8 exp Exercise/ or exercise$.mp. or physical activit$.mp. or walk$.mp. or run$.mp. or yoga.mp. or tai chi.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (265529)
9 or/5-8 (304796)
10 4 and 9 (3428)
11 limit 10 to (human and english language and yr="2003 - 2008") (1657)
12 Randomized Controlled Trial/ (157352)
13 exp Randomization/ (25458)
14 exp RANDOM SAMPLE/ (1083)
15 exp Biomedical Technology Assessment/ or exp Evidence Based Medicine/ (283949)
16 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (57934)
17 Double Blind Procedure/ (69149)
18 exp Triple Blind Procedure/ (10)
19 exp Control Group/ (1707)
20 exp PLACEBO/ (112938)
21 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (407342)
22 or/12-21 (620138)

23 11 and 22 (406)

Appendix 4: Literature Search – Cognitive Training

Search date: December 29, 2007
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library

Database: Ovid MEDLINE(R) <1996 to November Week 2 2007>
Search Strategy:

1	exp Dementia/ or exp Memory Disorders/ or exp Cognition Disorders/ (68097)
2	(alzheimer$ or dementia$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (57020)
3	1 or 2 (81807)
4	exp Cognitive Therapy/ (6287)
5	((cognitive or cognition or memory or reality) adj2 (therap$ or rehabilit$ or train$ or retrain$ or re-train$ or support$ or aid$ or stimulation or remediat$ or management or group$ or strateg$)).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (10495)
6	exp Reality Therapy/ (42)
7	(Reality Orientation or Reminiscence Therap$ or Validation Therap$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (92)
8	or/4-7 (10549)
9	3 and 8 (1575)
10	limit 9 to (humans and english language and yr="2006 - 2008") (361)
11	limit 10 to (controlled clinical trial or meta analysis or randomized controlled trial) (72)
12	exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ (29765)
13	(meta analy$ or metaanaly$ or evidence-based medicine or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (80013)
14	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (332772)
15	exp Double-Blind Method/ (48766)
16	exp Control Groups/ (503)
17	exp Placebos/ (8499)
18	RCT.mp. (2098)
19	or/11-18 (398704)
20	10 and 19 (117)

Database: EMBASE <1980 to 2007 Week 52>
Search Strategy:

1	exp DEMENTIA/ (98673)
2	exp Memory Disorder/ (21760)
3	(alzheimer$ or dementia$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (91290)
4	or/1-3 (125391)
5	exp cognitive rehabilitation/ or exp cognitive therapy/ (13757)

6 ((cognitive or cognition or memory or reality) adj2 (therap$ or rehabilit$ or train$ or retrain$ or re-train$ or support$ or aid$ or stimulation or remediat$ or management or group$ or strateg$)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (23115)
7 (Reality Orientation or Reminiscence Therap$ or Validation Therap$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (161)
8 or/5-7 (23200)
9 4 and 8 (2261)
10 limit 9 to (human and english language and yr="2006 - 2008") (417)
11 exp Evidence Based Medicine/ (271508)
12 exp Biomedical Technology Assessment/ (5095)
13 Randomized Controlled Trial/ (152628)
14 exp Randomization/ (24752)
15 exp RANDOM SAMPLE/ (900)
16 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (55006)
17 Double Blind Procedure/ (67654)
18 exp Triple Blind Procedure/ (8)
19 exp Control Group/ (1228)
20 exp PLACEBO/ (108111)
21 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (395206)
22 or/11-21 (600930)
23 10 and 22 (143)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to December Week 1 2007>
Search Strategy:
---

1 exp Dementia/ (14991)
2 exp Memory Disorders/ (1529)
3 exp Cognition Disorders/ (4710)
4 (alzheimer$ or dementia$).mp. [mp=title, subject heading word, abstract, instrumentation] (16201)
5 or/1-4 (21238)
6 exp Cognitive Therapy/ (3071)
7 exp Rehabilitation, Cognitive/ (595)
8 ((cognitive or cognition or memory or reality) adj2 (therap$ or rehabilit$ or train$ or retrain$ or re-train$ or support$ or aid$ or stimulation or remediat$ or management or group$ or strateg$)).mp. [mp=title, subject heading word, abstract, instrumentation] (7659)
9 exp Reality Therapy/ (146)
10 (Reality Orientation or Reminiscence Therap$ or Validation Therap$).mp. [mp=title, subject heading word, abstract, instrumentation] (955)
11 or/6-10 (8448)
12 5 and 11 (1706)
13 limit 12 to (english and yr="2006 - 2007") (387)
14 exp Medical Practice, Evidence-Based/ (3919)
15 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (62969)

16 RCT.mp. (785)
17 exp Meta Analysis/ (5947)
18 exp "Systematic Review"/ (3456)
19 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (20908)
20 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (11977)
21 exp PLACEBOS/ (3902)
22 or/14-21 (84982)
23 13 and 22 (108)

Appendix 5: Literature Search – Exercise for Prevention of Dementia

Search date: April 17, 2008
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, INAHTA/CRD

Database: Ovid MEDLINE(R) <1996 to April Week 2 2008>
Search Strategy:

1	exp Dementia/ (49503)
2	exp Cognition Disorders/ (23964)
3	(dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (60160)
4	or/1-3 (80799)
5	exp Exercise/ or exercise$.mp. or physical activit$.mp. or walk$.mp. or run$.mp. or yoga.mp. or tai chi.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (153868)
6	exp Physical Fitness/ or exp Motor Activity/ (44688)
7	5 or 6 (176830)
8	4 and 7 (1931)
9	(prevent$ or delay$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (474740)
10	exp Primary Prevention/ (35366)
11	exp "Age of Onset"/ (15469)
12	or/9-11 (512070)
13	8 and 12 (364)
14	limit 13 to (english language and humans and yr="2003 - 2008") (149)
15	limit 14 to (controlled clinical trial or meta analysis or randomized controlled trial) (16)
16	exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ (31803)
17	(meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (60173)
18	exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (349434)
19	exp Double-Blind Method/ (50775)
20	exp Control Groups/ (559)
21	exp Placebos/ (8816)
22	RCT.mp. (2278)
23	or/15-22 (418963)
24	14 and 23 (33)

Database: EMBASE <1980 to 2008 Week 15>
Search Strategy:

1	exp Dementia/ (100981)
2	exp Cognitive Defect/ (35158)

3 (dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (94234)
4 or/1-3 (134687)
5 exp exercise/ or exp physical activity/ (158574)
6 exp kinesiotherapy/ (16787)
7 exp Fitness/ (9568)
8 exp Exercise/ or exercise$.mp. or physical activit$.mp. or walk$.mp. or run$.mp. or yoga.mp. or tai chi.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (264114)
9 or/5-8 (303183)
10 4 and 9 (3390)
11 exp PREVENTION/ (453479)
12 exp Onset Age/ (25408)
13 (prevent$ or delay$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (765936)
14 or/11-13 (1039251)
15 10 and 14 (722)
16 limit 15 to (human and english language and yr="1998 - 2008") (496)
17 Randomized Controlled Trial/ (156348)
18 exp Randomization/ (25316)
19 exp RANDOM SAMPLE/ (1047)
20 exp Biomedical Technology Assessment/ or exp Evidence Based Medicine/ (282291)
21 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (57322)
22 Double Blind Procedure/ (68835)
23 exp Triple Blind Procedure/ (8)
24 exp Control Group/ (1607)
25 exp PLACEBO/ (111912)
26 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (404873)
27 or/17-26 (616167)
28 16 and 27 (159)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to April Week 2 2008>
Search Strategy:
---

1 exp Dementia/ (16322)
2 exp Cognition Disorders/ (5514)
3 (dement$ or alzheimer$ or predementia$ or pre-dementia$).mp. [mp=title, subject heading word, abstract, instrumentation] (17805)
4 or/1-3 (22441)
5 exp Exercise/ (26476)
6 exp Therapeutic Exercise/ (15752)
7 exp Physical Activity/ (7131)
8 exp Physical Fitness/ (4244)
9 (exercise$ or physical activit$ or walk$ or run$ or yoga or tai chi).mp. [mp=title, subject heading word, abstract, instrumentation] (67343)

10 or/5-9 (71058)
11 4 and 10 (784)
12 exp "Age of Onset"/ (1928)
13 (prevent$ or delay$).mp. [mp=title, subject heading word, abstract, instrumentation] (89830)
14 12 or 13 (91551)
15 11 and 14 (91)
16 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (70195)
17 RCT.mp. (880)
18 exp Meta Analysis/ (6389)
19 exp "Systematic Review"/ (3631)
20 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (23203)
21 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (14096)
22 exp PLACEBOS/ (4281)
23 exp "Control (Research)"/ (2308)
24 or/16-22 (91868)
25 15 and 24 (21)

References

(1) Mental health and substance abuse: facts and figures [Internet]. World Health Organization; [updated 2008; cited 2008 Jun 7]. Available from: http://www.searo.who.int/en/Section1174/Section1199/Section1567/Section1823_8057.htm

(2) Smith GE, Kokmen E, O'Brien PC. Risk factors for nursing home placement in a population-based dementia cohort. J Am Geriatr Soc 2000; 48(5):519-25.

(3) Caron CD, Ducharme F, Griffith J. Deciding on Institutionalization for a relative with dementia: the most difficult decision for caregivers. Can J Aging 2006; 25(2):193-205.

(4) Banaszak-Holl J, Fendrick MA, Foster NL. Cognitive function and chronic medical conditions as predictors of nursing home admission in a nationally representative sample of older Americans. Alzheimer Dis Assoc Disord 2004; 18(2):83-9.

(5) Hebert R, Dubois M-F, Wolfson C, Chambers L, Cohen C. Factors associated with long-term insitutionalization of older people with dementia: data from the Canadian study of health and aging. J Gerontol A Biol Sci Med Sci 2001; 56(11):M693-M699.

(6) Ferri C, Prince M, Brayne C, Brodaty H, Fratiglioni L, Ganguli M et al. Global prevalence of dementia: a Delphi consensus study. Lancet 2005; 366(9503):2112-7.

(7) Hopkins RW, Hopkins JF. Dementia projections for the counties, regional municipalities and districts of Ontario. PCCC Mental Health Services, Kingston, Ontario: Geriatric Psychiatry Programme Clinical/Research Bulletin No. 15; 2005

(8) People with alzheimer's disease and related dementias. Alzheimer's Disease International; [updated 2007 Nov 23; cited 2008 Jun 1]. Available from: http://www.alzheimer.ca/english/disease/stats-people.htm

(9) Vasular dementia. Alzheimer's Disease International; [updated 2007 Nov 23; cited 2008 Jun 1]. Available from: http://www.alz.co.uk/alzheimers/vascular.html

(10) Clarfield AM. The decreasing prevalence of reversible dementias: an updated meta-analysis. Arch Intern Med 2003; 163:2219-29.

(11) Dementia: hope through research. National Institute of Neurological Disorders and Stroke; [updated 2008 Jun 20; cited 2008 Jun 1]. Available from: http://www.ninds.nih.gov/disorders/dementias/detail_dementia.htm#1032919213

(12) Verghese J. Leisure activities and the risk of dementia in the elderly. N Engl J Med 2003; 348(25):2508-16.

(13) Mukamal K.J. Prospective study of alcohol consumption and risk of dementia in older adults. JAMA 2003; 289(11):1405-13.

(14) Ruitenberg A. Alcohol consumption and risk of dementia: the Rotterdam study. Lancet 2002; 359(9303):281-6.

(15) Ostbye T, Crosse E. Net economic costs of dementia in Canada. Can Med Assoc J 1994; 151(10):1457-64.

(16) Give me a break! Helping family caregivers of seniors overcome barriers to respite. Ottawa: Canadian Association for Community Care; 2002

(17) Hollander MJ, Walker ER. Report of continuing care organizations and terminology [Internet]. [updated 1998; cited 2008 Jun 1]. Available from: http://dsp-psd.pwgsc.gc.ca/Collection/H88-3-23-1999E.pdf

(18) The Canadian Study of Health and Aging Working Group. Patterns of caring for people with dementia in Canada. Can J Aging 1994; 13(4):470-87.

(19) Rudin D.J. Caregiver attitudes regarding utilisation and usefulness of respite services for peoploe with Alzheimer's disease. J Gerontol Soc Work 1994; 23(1/2):85-107.

(20) Dunbrack J. Respite for family caregivers: an environmental scan of publicly-funded programs in Canada [Internet]. [updated 2003; cited 2008 Jun 1]. Available from: http://www.hc-sc.gc.ca/hcs-sss/alt_formats/hpb-dgps/pdf/pubs/2003-respite-releve/2003-respite-releve-eng.pdf

(21) Arskey H, Jackson K, Croucher K, Weatherly H, Golder S, Hare P et al. Review of respite services and short-term breaks for carers for people with dementia. [Internet]. National Co-ordinating Centre for NHS Service Delivery and Organisation R & D (NCCSDO); [updated 2004 Jan 7; cited 2008 May 5]. Available from: http://www.sdo.nihr.ac.uk/files/project/48-final-report.pdf

(22) Lee H, Cameron M. Respite care for people with dementia and their carers. Cochrane Database of Systematic Reviews 2004; Issue 2. Art. No.: CD004396. DOI: 10.1002/14651858.CD004396.pub2:CD004396.

(23) Lawton MP, Brody EM, Saperstein AR. Respite for caregivers of Alzheimer patients: research and practice. New York: Springer Publishing Company; 1991.

(24) Mohide EA, Pringle DM, Streiner DL, Gilbert JR, Muir G, Tew M. A randomized trial of family caregiver support in the home management of dementia. J Am Geriatr Soc 1990; 38(4):446-54.

(25) Chu P, Edwards J, Levin R, Thomson J. The use of clinical case management for early stage Alzheimer's patients and their families. Am J Alzheimers Dis Other Demen 2008; 15(5):284-90.

(26) Grant I, McKibbin CL, Taylor MJ, Mills P, Dimsdale J, Ziegler M et al. In-home respite intervention reduces plasma epinephrine in stressed Alzheimer caregivers. Am J Geriatr Psychiatry 2003; 11(1):62-72.

(27) Wishart L, Macerollo J, Loney P, King A, Beaumont L, Browne G et al. "Special steps": an effective visiting/walking program for persons with cognitive impairment. Can J Nurs Res 2000; 31(4):57-71.

(28) Peacock SC, Forbes DA. Interventions for caregivers of persons with dementia: a systematic review. Can J Nurs Res 2003; 35(4):88-107.

(29) Brodaty H, Green A, Koschera A. Meta-analysis of psychosocial interventions for caregivers of people with dementia. J Am Geriatr Soc 2003; 51(5):657-64.

(30) Thompson CA, Spilsbury K, Hall J, Birks Y, Barnes C, Adamson J. Systematic review of information and support interventions for caregivers of people with dementia. BMC Geriatr 2007; 7(18).

(31) Acton GJ, Kang J. Interventions to reduce the burden of caregiving for an adult with dementia: a meta-analysis. Res Nurs Health 2001; 24(5):349-60.

(32) Pusey H, Richards D. A systematic review of the effectiveness of psychosocial interventions for carers of people with dementia. Aging Ment Health 2001; 5(2):107-19.

(33) Pinquart M, Sorensen S. Helping caregivers of persons with dementia: which interventions work and how large are their effects? Int Psychogeriatr 2006; 18(4):577-95.

(34) Selwood A, Johnston K, Katona C, Lyketsos C, Livingston G. Systematic review of the effect of psychological interventions on family caregivers of people with dementia. J Affect Disord 2007; 101(1-3):75-89.

(35) Graff MJ, Vernooij-Dassen MJ, Thijssen M, Dekker J, Hoefnagels WH, Rikkert MG. Community based occupational therapy for patients with dementia and their care givers: randomised controlled trial. BMJ 2006; 333(7580):1196.

(36) Graff MJ, Vernooij-Dassen MJ, Thijssen M, Dekker J, Hoefnagels WH, Olderikkert MG. Effects of community occupational therapy on quality of life, mood, and health status in dementia patients and their caregivers: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2007; 62(9):1002-9.

(37) Teri L, Huda P, Gibbons L, Young H, van LJ. STAR: a dementia-specific training program for staff in assisted living residences. Gerontologist 2005; 45(5):686-93.

(38) Mahoney DF, Tarlow BJ, Jones RN. Effects of an automated telephone support system on caregiver burden and anxiety: findings from the REACH for TLC intervention study. Gerontologist 2003; 43(4):556-67.

(39) Burgio L, Stevens A, Guy D, Roth DL, Haley WE. Impact of two psychosocial interventions on white and African American family caregivers of individuals with dementia. Gerontologist 2003; 43(4):568-79.

(40) Belle SH, Burgio L, Burns R, Coon D, Czaja SJ, Gallagher-Thompson D et al. Enhancing the quality of life of dementia caregivers from different ethnic or racial groups: a randomized, controlled trial. Ann Intern Med 2006; 145(10):727-38.

(41) Small GN, Rabins PC, Barry PP, Buckholtz NS, DeKosky ST, Ferris SH et al. Diagnosis and treatment of Alzheimer disease and related disorders: consensus statement of the American Association for Geriatric Psychiatry, the Alzheimers Association and the American Geriatrics Society. JAMA 1997; 278(16):1363-71.

(42) Wolf-Klein BP, Silverstone FA. Weight loss in Alzheimer's disease: an international review of the literature. Int Psychogeriatr 1994; 6(2):135-42.

(43) Buchner DM, Larson EB. Falls and fractures in patients with Alzheimer-type dementia. JAMA 1987; 257(11):1492-5.

(44) Morris JC, Rubin EH, Morris EJ, Mandel SA. Senile dementia of the Alzheimer's type: an important risk factor for serious falls. J Gerontol 1987; 42(4):412-7.

(45) Oleske DM, Wilson RS, Bernard BA, Evans DA, Terman EW. Epidemiology of injury in people with Alzheimer's disease. J Am Geriatr Soc 1995; 43(7):741-6.

(46) Tinetti ME, Doucette J, Claus E, Marottoli R. Risk factors for serious injury during falls by older persons in the community. J Am Geriatr Soc 1995; 43(11):1214-21.

(47) Krenz C, Larson EB, Buchner DM, Canfield CG. Characterizing patient dysfunction in Alzheimer's - type dementia. Med Care 1988; 26(5):453-61.

(48) Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. J Gerontol 1990; 45(3):M101-M107.

(49) Dvorak RV, Poehlman ET. Appendicular skeletal muscle mass, physical activity and cogntive status in patients with Alzheimer's disease. Neurology 1998; 51(5):1386-90.

(50) Miller PA, Butin D. The role of occupational therapy in dementia - COPE (Caregiver Options for Practical Experiences). Int J Geriatr Psychiatry 2000; 15(1):86-9.

(51) Teri L, Gibbons LE, McCurry SM, Logsdon RG, Buchner DM, Barlow WE et al. Exercise plus behavioral management in patients with Alzheimer disease: a randomized controlled trial.[see comment]. JAMA 2003; 290(15):2015-22.

(52) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490-4.

(53) Heyn P, Abreu BC, Ottenbacher KJ. The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta-analysis. Arch Phys Med Rehabil 2004; 85(10):1694-704.

(54) Law M, Stewart D, Letts L, Pollock N, Westmorland M, Bosch J et al. Effectiveness of activity programmes for older persons etih dementia. A critical review of the literature by the Occupational Therapy Evidence Based Practice Research Group, McMaster University, Hamilton, Ontario [Internet]. [updated 1999; cited 2008 May 4]. Available from: http://www.srs-mcmaster.ca/Portals/20/pdf/ebp/activity.pdf

(55) Clare L, Woods RT. Cognitive rehabilitation and cognitive training for early-stage Alzheimer's disease and vascular dementia. Cochrane Database of Systematic Reviews 2007; ssue 4. Art. No.: CD003260. DOI: 10.1002/14651858.CD003260.

(56) Spector A, Davies S, Woods B, Orrell M. Reality orientation for dementia: a systematic review of the evidence of effectiveness from randomized controlled trials. Gerontologist 2000; 40(2):206-12.

(57) Spector A, Thorgrimsen L, Woods B, Royan L, Davies S, Butterworth M et al. Efficacy of an evidence based cognitive stimulation therapy programme for people with dementia: randomised controlled trial. Br J Psychiatry 2003; 183:248-54.

(58) Goodman C. Literature searching and evidence interpretation for assessing health care practices. Stockholm, Sweden: The Swedish Council on Technology Assessment in Health Care; 1993

(59) Knapp M, Thorgrimsen L, Patel A, Spector A, Hallam A, Woods B et al. Cognitive stimulation therapy for people with dementia: cost-effectiveness analysis. Br J Psychiatry 2006; 188:574-80.

(60) Kivipelto M, Helkala EL, Laakso MP, et al. Midlife vascular risk factors and Alzheimer's disease in later life: longitudinal population based study. BMJ 2001; 322(7300):1447-51.

(61) Launer LJ. Demonstrating the case that AD is a vascular disease: epidemiologic evidence. Ageing Res Rev 2002; 1(1):61-77.

(62) Paffenbarger RS Jr, Hyde RT, Wing AL, Lee IM, Jung DL, Kampert JB. The association of changes in physical activity level and other lifestyle characteristics with mortality among men. N Engl J Med 1993; 328(8):538-45.

(63) Rogers RL, Meyer JS, Mortel KF. After reaching retirement age physical activity sustains cerebral perfusion and cognition. J Am Geriatr Soc 1990; 38(2):123-8.

(64) Lytle ME, Bilt JV, Pandav RS, Dodge HH, Ganguli M. Exercise level and cognitive decline: the MoVIES project. Alzheimer Dis Assoc Disord 2004; 18(2):57-64.

(65) Larson EB, Wang L, Bowen JD, McCormick WCc, Teri L, Crane P et al. Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. Ann Intern Med 2006; 144(2):73-81.

(66) Abbott RD, White LR, Ross GW, Masaki KH, Curb JD, Petrovitch H. Walking and dementia in physically capable elderly men. JAMA 2004; 292(12):1447-53.

(67) Weuve J, Kang JH, Manson JE, Breteler MMB, Ware JH, Grodstein F. Physical activity including walking and cognitive function in older women. JAMA 2004; 292(12):1454-61.

(68) Rovio S, Kareholt I, Helkala EL, Viitanen M, Winblad B, Tuomilehto J et al. Leisure time physical activity at midlife and the risk of dementia and Alzheimer's disease. Lancet Neurol 2005; 4(11):705-11.

(69) Munro JF, Nicholl JP, Brazier JE, Davey R, Cochrane T. Cost effectiveness of a community based exercise programme in over 65 year olds: cluster randomized trial. J Epidemiol Community Health 2004; 58(12):1004-10.

(70) Cahn-Weiner DA, Boyle PA, Malloy PF. Tests of executive function predict instrumental activities of daily living in community dwelling older individuals. Appl Neuropsychol 2002; 9(3):187-91.

(71) Shumaker SA, Legault C, Coker LH. Behavior based interventions to enhance cognitive functioning and independence in older adults. JAMA 2006; 296(23):2852-4.

(72) Ott A, Breteler MM, van Harskamp F, Claus JJ, van der Cammen TJ, et al. Prevalence of Alzheimer's disease and vascular dementia: association with education. The Rotterdam Study. BMJ 1995; 310(6985):970-3.

(73) Ott A, van Rossum CT, van Harskamp F, van de Mheen H, Hofman A, Breteler MM. Education and the incidence of dementia in a large population based study: The Rotterdam Study. Neurology 1999; 52(3):663-6.

(74) Gatz M. Educating the brain to avoid dementia: Can mental exercise prevent Alzheimer disease? PLoS Med 2005; 2(1):e7.

(75) Ball K, Berch DB, Helmers KF, Jobe JB, Leveck MD, Marsiske M et al. Effects of cognitive training interventions with older adults: a randomized controlled trial. JAMA 2002; 288(18):2271-81.

(76) Willis SL, Tennstedt SL, Marsiske M, Ball K, Elias J, Koepke KM et al. Long-term effects of cognitive training on everyday functional outcomes in older adults. JAMA 2006; 296(23):2805-14.

(77) Teri L, McCurry SM, Logsdon R, Gibbons LE. Training community consultants to help family members improve dementia care: a randomized controlled trial. Gerontologist 2005; 45(6):802-11.

(78) Canadian study of health and aging: study methods and prevalence of dementia. CMAJ 1994; 150(6):899-913.

(79) Information Services Group. Long-term care home system report as of March 31, 2007. Toronto, ON: Ministry of Health and Long-Term Care; Long-Term Care Planning and Renewal Branch; 2007

(80) Alberta Learning Information Service. Alberta occupational profiles [Internet]. Alberta Government; [updated 2008; cited 2008 Oct 6]. Available from: http://www.alis.gov.ab.ca/occinfo/Content/RequestAction.asp?format=html&aspAction=GetTitleSearch&Page=TitleSearch

(81) The prevelance of dementia. Factsheet 3 [Internet]. London, UK: Alzheimer's Disease International; [updated 1999 Apr; cited 2008 Apr 4]. Available from: http://www.alz.co.uk/adi/pdf/3preval.pdf

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 5

Social Isolation in Community-Dwelling Seniors

An Evidence-Based Analysis

October 2008

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. Social isolation in community-dwelling seniors: an evidence-based analysis. *Ontario Health Technology Assessment Series* 2008;8(5).

Permission Requests

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-7288-3 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee.

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

Abbreviations

ADL	Activities of daily living
CADTH	Canadian Agency for Drugs and Technologies in Health
GAINS	Gains through group involvement instrument
HHIE	Hearing Handicap Inventory Elderly
HSSD	Health System Strategy Division
ICD-10	International Classification of Diseases-10
INAHTA	International Agency for Health Technology Assessment
LTC	Long-term care
NICE	National Institute for Clinical Excellence
OARS	Older Americans Resources and Services
RCT	Randomized controlled trial
SD	Standard deviation
SF-36	Rand Medical Outcomes Study short form

Executive Summary

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective of the Evidence-Based Analysis

The objective was to systematically review interventions aimed at preventing or reducing social isolation and loneliness in community-dwelling seniors, that is, persons ≥ 65 years of age who are not living in long-term care institutions. The analyses focused on the following questions:

- Are interventions to reduce social isolation and/or loneliness effective?
- Do these interventions improve health, well-being, and/or quality of life?
- Do these interventions impact on independent community living by delaying or preventing functional decline or disability?
- Do the interventions impact on health care utilization, such as physician visits, emergency visits, hospitalization, or admission to long-term care?

Background: Target Population and Condition

Social and family relationships are a core element of quality of life for seniors, and these relationships have been ranked second, next to health, as the most important area of life. Several related concepts—

reduced social contact, being alone, isolation, and feelings of loneliness—have all been associated with a reduced quality of life in older people. Social isolation and loneliness have also been associated with a number of negative outcomes such as poor health, maladaptive behaviour, and depressed mood. Higher levels of loneliness have also been associated with increased likelihood of institutionalization.

Note: It is recognized that the terms "senior" and "elderly" carry a range of meanings for different audiences; this report generally uses the former, but the terms are treated here as essentially interchangeable.

Methods of the Evidence-Based Analysis

The scientific evidence base was evaluated through a systematic literature review. The literature searches were conducted with several computerized bibliographic databases for literature published between January 1980 and February 2008. The search was restricted to English-language reports on human studies and excluded letters, comments and editorials, and case reports. Journal articles eligible for inclusion in the review included those that reported on single, focused interventions directed towards or evaluating social isolation or loneliness; included, in whole or in part, community-dwelling seniors (≥ 65 years); included some quantitative outcome measure on social isolation or loneliness; and included a comparative group. Assessments of current practices were obtained through consultations with various individuals and agencies including the Ontario Community Care Access Centres and the Ontario Assistive Devices Program. An Ontario-based budget impact was also assessed for the identified effective interventions for social isolation.

Findings

A systematic review of the published literature focusing on interventions for social isolation and loneliness in community-dwelling seniors identified 11 quantitative studies. The studies involved European or American populations with diverse recruitment strategies, intervention objectives, and limited follow-up, with cohorts from 10 to 15 years ago involving mainly elderly women less than 75 years of age. The studies involved 2 classes of interventions: in-person group support activities and technology-assisted interventions. These were delivered to diverse targeted groups of seniors such as those with mental distress, physically inactive seniors, low-income groups, and informal caregivers. The interventions were primarily focused on behaviour-based change. Modifying factors (client attitude or preference) and process issues (targeting methods of at-risk subjects, delivery methods, and settings) influenced intervention participation and outcomes.

Both classes of interventions were found to reduce social isolation and loneliness in seniors. Social support groups were found to effectively decrease social isolation for seniors on wait lists for senior apartments and those living in senior citizen apartments. Community-based exercise programs featuring health and wellness for physically inactive community-dwelling seniors also effectively reduced loneliness. Rehabilitation for mild/moderate hearing loss was effective in improving communication disabilities and reducing loneliness in seniors. Interventions evaluated for informal caregivers of seniors with dementia, however, had limited effectiveness for social isolation or loneliness.

Research into interventions for social isolation in seniors has not been broadly based, relative to the diverse personal, social, health, economic, and environmentally interrelated factors potentially affecting isolation. Although rehabilitation for hearing-related disability was evaluated, the systematic review did not locate research on interventions for other common causes of aging-related disability and loneliness, such as vision loss or mobility declines. Despite recent technological advances in e-health or telehealth, controlled studies evaluating technology-assisted interventions for social isolation have examined only

basic technologies such as phone- or computer-mediated support groups.

Conclusions

Although effective interventions were identified for social isolation and loneliness in community-dwelling seniors, they were directed at specifically targeted groups and involved only a few of the many potential causes of social isolation. Little research has been directed at identifying effective interventions that influence the social isolation and other burdens imposed upon caregivers, in spite of the key role that caregivers assume in caring for seniors. The evidence on technology-assisted interventions and their effects on the social health and well-being of seniors and their caregivers is limited, but increasing demand for home health care and the need for efficiencies warrant further exploration. Interventions for social isolation in community-dwelling seniors need to be researched more broadly in order to develop effective, appropriate, and comprehensive strategies for at-risk populations.

Evidence-Based Analysis of Social Isolation in Community-Dwelling Seniors

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Objective of the Evidence-Based Analysis

The objectives were to systematically review interventions aimed at preventing or reducing social isolation and loneliness in community-dwelling seniors, that is, persons ≥ 65 years of age who are not living in long-term care institutions. The analyses focused on the following questions:

- Are interventions to reduce social isolation and/or loneliness effective?
- Do these interventions improve health, well-being, and/or quality of life?
- Do these interventions impact on independent community living by delaying or preventing functional decline or disability?
- Do the interventions impact on health care utilization, such as physician visits, emergency visits, hospitalization, or admission to long-term care?

Background: Target Population and Condition

Social and family relationships are a core element of quality of life for seniors, and these relationships have been ranked second, next to health, as the most important area of life. (1;2) Several related concepts, reduced social contact, being alone, isolation, and feelings of loneliness have all been associated with a reduced quality of life in older people. (3)

Social isolation refers to the objective characteristics of a situation and has been defined as the lack of meaningful and sustained communication or as having minimal contact with family or the wider community. (4) Loneliness, on the other hand, concerns the way that people perceive, experience, and evaluate lack of communication with other people. (5) The experience of loneliness generally implies an unpleasant experience or negative feelings that occur when an individual's network of social relationships is perceived to be deficient in some important way.

Seniors are vulnerable to a decline in social networks and support due to a range of factors associated with life changes and loss events. These synergistic factors include events such as retirement, loss of loved ones and other relationships, declining health and increasing disability, sensory loss, and mobility restrictions. (6)

Social support provides not only companionship and emotional reassurance but also practical assistance in dealing with difficulties in daily life due to illness or frailty. Social supports and networks can also influence the type and amount of care (formal and informal) that seniors need or receive. Approximately half of community-dwelling seniors (45%) received help exclusively from family and friends (informal caregivers), and over half (55%) received formal assistance, with half of these also receiving care and support from informal caregivers. (7) Living arrangements are a key aspect of one's social network and are often associated with the type of care and support needed by women. Based on the 2002 Canadian General Social Survey, elderly women were much more likely to live alone than men (43% versus 16%), and for women the probability of receiving formal care increased from 9% for those living with children to 15% for those living alone. (8) Lack or loss of caregiver support was also found to be an important risk factor for institutional admission among community-dwelling seniors. (9;10)

Social isolation and loneliness have also been associated with a number of negative outcomes such as poor health and maladaptive behaviour with impacts on dietary deficits and increased utilization of services. (11) They have also been associated with negative psychological effects such as depressed mood, and decreased quality of life and life satisfaction. (12-14) Higher levels of loneliness have also been associated with an increased likelihood of hospitalization and nursing home admissions. (15;16)

Methods of the Evidence-Based Analyses

Search Strategy

The initial literature search for systematic reviews and health technology assessments evaluating interventions for social isolation in community-dwelling seniors was performed using information from several sources: the Cochrane Library, the ECRI Institute, and the International Agency for Health Technology Assessment (INAHTA) database. The Web sites of several other health technology agencies were also reviewed including the Canadian Agency for Drugs and Technologies in Health (CADTH) and the United Kingdom National Institute for Clinical Excellence (NICE).

Databases Searched

The search strategies with appropriate keywords and subject headings for social isolation in community-dwelling seniors are outlined in Appendix 1. The following databases were searched for literature published between January 1980 and February 2008: MEDLINE, MEDLINE In-Process and other Non-Indexed Citations, EMBASE, CINAHL, PsycINFO, The Cochrane Library, and the INAHTA/Centre for Reviews and Dissemination.

Inclusion Criteria

- English-language reports and human studies,
- single-focused interventions directed to or evaluating social isolation or loneliness,
- community-dwelling elderly (≥ 65 years) subjects in whole or in part,
- quantitative outcome measures on social isolation or loneliness, and
- study design that included a control or a comparative group.

Exclusion Criteria

- nonsystematic reviews, letters, comments, and editorials;
- case reports or case series involving fewer than 30 subjects; or
- reports involving comprehensive or integrated models of outreach or care.

The search results were merged into a database using Reference Manager software, and duplicates were subsequently removed. In total, 738 citations were identified. The search results were reviewed, and articles were selected based on information provided in the title and abstract. Copies of original articles of eligible articles were obtained and reference lists were hand searched.

Additional Information Sources

Additional information on estimates of seniors living in the community or in LTC and disease prevalence was obtained from several national Canadian surveys including the Canadian Community Health Survey in 2000, (17) the Statistics Canadian Cycle 16 of the General Social Survey conducted in 2002, (8) and the Participation and Activity Limitation Survey 2006. (18)

Quality of Evidence

An overall assessment of the quality of evidence was based on the grading of recommendations assessment, development, and evaluation (GRADE) system and referred to as the GRADE Working Group criteria. (19)

- Quality of the study refers to a range of criteria associated with the design, conduct, and evaluation of the study.
- Consistency refers to the similarity of estimates of effect across studies. If there is important unexplained inconsistency in the results, confidence in the estimate of effect for that outcome decreases. Differences in the direction of effect, the size of the differences in effect, and the significance of the differences guide the decision about whether important inconsistency exists.
- Directness refers to the extent to which the interventions and outcome measures are similar to those of interest.

As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence.

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Findings of Evidence-Based Analysis

Other Systematic Reviews

The literature search identified 2 systematic reviews on interventions for social isolation and loneliness in community-dwelling seniors. (20;21)

Findlay et al. (20) searched the literature published in English between 1982 and 2002. They included studies that intended to achieve a health gain and recorded any health outcome measures. The authors concluded that there were few high-quality evaluations of effectiveness of interventions for social isolation. Only 6 randomized trials were identified, (22-25;25-27) and 2 of these were ineligible for the Medical Advisory Secretariat analysis as one study involved multiple interventions (26) and the other study involved an intervention in a nursing home. (27)

Several qualitative conclusions were made based on the general evidence and on the characteristics of successful interventions. The degree of training of study facilitators or coordinators was cited as one factor of success. Involving older people in the planning and execution of the interventions was also an important factor in successful interventions. Interventions also had a greater likelihood of success if they involved existing community resources and aimed to build community capacity. An example cited for this was known as a gatekeeper program, in which nontraditional community referral sources were trained to identify "at risk" older people, who often do not come to the attention of support services. (28) The author recommended that networking among communities, governments, the private sector, and researchers be improved, in order to connect financial support with technical expertise, thus enabling more thorough investigations in this area.

Cattan et al. (21) reviewed studies involving health promotion intended to remedy social isolation and loneliness among older people. Their review considered outcome studies published between 1970 and 2002 in any language; pertained to older people, with no specific age cutoff; and included the following inclusion criteria: interventions that were intended to prevent or alleviate social isolation/loneliness and which reported some form of quantitative outcome measure. Thirty quantitative studies were identified, 16 involving randomized controlled trial (RCT) reports. Of the 30 quantitative studies, 10 were eligible for the Medical Advisory Secretariat's analysis. (22-25;29-34) The remainder of the reports discussed by Catton et al. were ineligible for the current review either because the interventions consisted of a broad range of services, or because the studies did not involve mainly seniors, did not involve community-dwelling seniors, were not in English, had no control groups, or were pilot studies with fewer than 30 subjects.

In general the Cattan review concluded that a few interventions for social isolation in community-dwelling seniors were effective. Group activities that included some form of educational or training input, and social activities that targeted specific groups of people were both effective. An observation was also made that intrapersonal resources such as coping, self-esteem, or psychosocial health were significant moderating factors for perceived isolation and loneliness. Interventions that resulted in improved self-esteem and locus of control, leading to perceived competence and personal control were suggested as

pathways to decreased loneliness. The authors concluded that there was limited generalizability of the studies because of the substantial variability in target groups, settings, circumstances, and in measurement tools and outcomes. The authors also suggested that it was as important to focus on reasons for failures as well as reasons for success in the interventions, although limited reporting on the protocols or processes made this difficult in these studies. The authors also acknowledged that the research in this area is further hampered by poorly understood complexities in the conceptual relationship between loneliness, social isolation, and living alone.

Systematic Evidence Review by the Medical Advisory Secretariat

The evidence review by the Medical Advisory Secretariat identified an additional quantitative report in the literature. (35) Therefore, in addition to the 10 quantitative studies identified in the previous systematic reviews, a total of 11 quantitative studies were identified involving single, focused interventions targeting social isolation and loneliness in community-dwelling seniors. Each of the studies involved a different intervention strategy and target group. Table 1 outlines the study designs for these reports. Of the 11 quantitative studies, 6 were RCTs, (23-25;30;32;35) and the balance involved other prospective controlled study designs. Two studies were a form of cluster or community-based intervention where the randomization unit was other than the individual; in one study, comparisons were between different floors of a senior citizen building (29) and in the other, across different municipal regions. (31)

The 3 nonrandomized studies involved the use of various prospective control groups. (22;33;34) One of the studies, involving a phone crisis line, had been referred to as a randomized study, but allocation to the groups was systematic and was therefore reclassified as a prospective controlled study. (22) The other 2 studies, 1 involving mental health services (33) and 1 involving hearing loss rehabilitation, (34) each involved comparisons with 2 different control groups.

Table 1: Evidence Summary for Interventions Targeting Social Isolation and Loneliness in Community-Dwelling Seniors*

Study Design	Level of Evidence†	Number of Eligible Studies
Large RCT, systematic review of RCT	1	3, 2
Large RCT, unpublished but reported to an international scientific meeting	1(g)	0
Small RCT	2	3
Small RCT, unpublished but reported to an international scientific meeting	2(g)	0
Non-RCT with contemporaneous controls	3a	5
Non-RCT with historical controls	3b	0
Non-RCT, presented at international conference	3(g)	0
Surveillance (database or register)	4a	0
Case series (multisite)	4b	0
Case series (single site)	4c	0
Retrospective review, modeling	4d	0
Case series presented at international conference	4(g)	0

*g indicates grey literature; RCT, randomized controlled trial.
†For each included study, levels of evidence were assigned according to a ranking system based on a hierarchy proposed by Goodman. An additional designation "g" was added for preliminary reports of studies that have been presented at international scientific meetings. (36)

Background Study Information

Table 2 presents general information on the 11 quantitative studies involving single, focused interventions

targeting social isolation and loneliness in community-dwelling seniors. The reports involved studies from either American (n = 7) or European (n = 4) settings. Only 1 study (31) also received funding from industry.

Most of the included studies were done on a pilot scale, and only 4 studies involved samples of more than 150 participants. (23;30-32) The mean age of the participants in the studies ranged from 64 to 77 years, and the majority of the trial participants were women. In 3 studies, (23;24;35) only women were included, and one of these involved female informal caregivers of persons with dementia. (35)

Table 2: Overview of Quantitative Studies Involving Interventions Targeting Social Isolation in Community-Dwelling Seniors*

	Author, Year	Region, Country	Target Group	Sample Characteristics	Funding Source
1.	Andersson 1985 (24)	Stockholm, Sweden	On wait lists for senior apartments	108 F Mean age 77 y	Delegation for Social Research & City of Stockholm
2.	Arnetz and Theorell 1983 (29)	Stockholm, Sweden	Residents of senior apartments	60 (40 F + 20 M) Mean age 77.6 y	Delegation for Social Research & City of Stockholm
3.	Hopman-Rock and Westoff 2002 (31)	Leiden, Netherlands	Physically inactive	390 (320 F + 70 M) Mean age 72.3 y	Merck Sharpe & Dohme, Ministry of Public Health, Welfare and Sports, Pfizer, Leerdammer Cheese, & health insurance companies (Zilveren Kruis Achmea & Groene Land Achmea)
4.	McAuley et al. 2000 (32)	Illinois, United States	Physically inactive	174 (125 F + 49 M) Mean age 65.5 y	National Institute on Aging
5.	Caserta and Lund 1993 (30)	Utah, United States	Bereaved	339 (239 F + 100 M) Mean age 67.2 y	National Institute on Aging
6.	Rosen and Rosen 1982 (33)	Georgia, United States	Mental distress	117 (95 F + 22 M) Median age 70 y	Administration on Aging, Office Human Development
7.	Morrow-Howell et al. 1998 (22)	St. Louis, Missouri, United States	Mental health crisis	61 (52 F + 9 M) Mean age 77 y	The Retirement Research Foundation
8.	Heller et al. 1991 (23)	Indiana, United States	Low income & low social support	291 F Mean age 74 y	National Institute Mental Health
9.	Tesch-Romer et al. 1997 (34)	Greifswald, Germany	Hearing impaired	148 (77 F + 71 M) Mean age 71 y	German Research Foundation
10.	Brennan et al. 1995 (25)	Cleveland, Ohio, United States	Informal caregivers	102 (68 F + 34 M) Median age 64 y	National Institute on Aging
11.	Winter and Gitlin 2007 (35)	Philadelphia, Pennsylvania, United States	Informal caregivers	103 F Mean age 66 y	Alzheimer's Association

*F indicates female; M, male; y; years.

Types of Interventions and Target Groups

The reports identified with community-dwelling seniors involved different intervention strategies and target groups. The current analysis group them into studies involving interventions conducted in-person (n = 6) and studies involving interventions assisted by technology (n = 5) such as via the phone or the Internet (Table 3). One of the technology-based studies involved a direct technological intervention, namely, hearing aids. (34) All except 2 studies involved group interventions rather than individual-based interventions. (22;34) The interventions involved diverse senior target groups, such as those who are physically inactive, bereaved, living alone, in need of mental health services, hearing impaired, or on waiting lists for senior apartments. Two of the studies involved interventions targeting social isolation in seniors as informal caregivers to persons with dementia (25) or Alzheimer's disease. (35)

Table 3: Study Participants and Class of Interventions Targeting Social Isolation in Community-Dwelling Seniors

	Study Participants, Country	In-Person Group Activity	Technology-Assisted Activity
1.	Wait list for senior apartments, Sweden	1 RCT (N = 108 F)	
2.	Residents of senior apartments, Sweden	1 CIT (N = 60 F & M)	
3.	Physically inactive, Netherlands	1 CIT (N = 448 F & M)	
4.	Physically inactive, United States	1 RCT (N = 174 F & M)	
5.	Bereaved, United States	1 RCT (N = 339 F & M)	
6.	Mental health services at senior centres, United States	1 Cohort – 2 Control Groups (N = 117 F & M)	
7.	Mental health crisis phone support, United States		1 Cohort (systematic sampling) (N = 61 F & M)
8.	Low income with low, perceived social support, United States		1 RCT (N = 291 F)
9.	Hearing impaired, Germany		1 Cohort – 2 Control Groups (N = 148 F & M)
10.	Informal caregivers of persons with Alzheimer's disease, United States		1 RCT (N = 102 F & M)
11.	Female informal caregivers of persons with dementia, United States		1 RCT (N = 103 F)

*CIT indicates community intervention trial; F, female; M, male; RCT, randomized controlled trial.

Study Objectives, Outcome Assessment, and Follow-Up

The objectives of the interventions, outcomes assessed, and duration of study follow-up are listed in Table 4a for in-person interventions and in Table 4b for technology-assisted interventions. The longest follow-up period for any study was 24 months, (30) with the majority being 1 year or less. The interventions studied had diverse objectives, but all involved some form of behaviour change.

In both the in-person group-based interventions and the technology-assisted interventions, the objectives tended to focus on improving self-efficacy (that is, the subject's belief that he or she can execute a behaviour required to produce a certain outcome successfully) or self-help through an increase in social activation or engagement. Efforts to increase self-efficacy and coping were directed at different target groups: those in bereavement, those in need of mental health services, or those not coping in the community. The methods to increase self-efficacy were varied, using focus groups to provide support and education and a social forum in which to discuss health topics. Two studies involving group-based exercise interventions evaluated the indirect or additional effects of group exercise activity on social isolation. (31;32)

The technology-assisted interventions used the Internet or telephone conferencing systems to support and engage seniors in the community. The lack of in-person contact for these interventions was viewed by the investigators as an advantage for 2 groups of seniors: informal caregivers of persons with dementia, because of their constrained schedules and limited availability, and seniors with a mental health crisis, because of their concern for anonymity.

Two intervention studies for informal caregivers included one led by a nurse (25) and the other by a social worker. (35) Although both studies examined how caregiver burden and social isolation affected caregivers, each involved slightly different objectives. The nurse-led intervention, involving a Web-based computer network support system, was intended to improve decision-making as well as decrease social isolation and burden for the caregiver. The social worker–led telephone-based support group was intended mainly to increase the social support network and decrease burden for caregivers.

Although the study objectives were generally focused on social isolation or loneliness and involved measures of social isolation or loneliness, they also evaluated a number of other outcome assessments (Tables 4a, 4b). The diverse range of psychosocial health and resource outcome measures evaluated in the studies included competency, coping, self-esteem, morale, and life satisfaction. Depression was assessed in 7 studies (22;23;29;30;34) either by the Geriatric Depression Scale (37) or the Center Epidemiologic Studies in Depression Scale. (38) A health-related quality of life outcome measure evaluated by the Rand Medical Outcomes Study short form (SF-36) (39) was reported in one study, (31) and the impact of the intervention on disability as measured by activities of daily living (ADL) (40) was measured in another study. (23) The interventions involving informal caregivers assessed additional outcome measures of caregiver burden and decision making. (25;35) None of the studies evaluated the impact of interventions on health care utilization, such as physician visits, emergency visits, hospitalization, or admission to LTC.

Table 4a: Study Objectives, Outcome Assessments, and Follow-Up for In-Person Group Interventions for Social Isolation

	Intervention	Study Objective	Outcome Assessment Domains*	Follow-Up (months)
1.	Focus groups led by social worker or home helper	Increase social network in seniors on wait list for senior citizen apartments	Social integration, social contacts, alienation, psychological resources, health changes	6
2.	Staff-led senior citizen support groups	Social activation in residents of senior citizen apartments	Mental, physical well-being, social interaction, behaviour	6
3.	Peer- and professional-led exercise and education program	Increase physical activity in inactive community-dwelling seniors	General health, physical performance, health-related knowledge	12
4.	Trained exercise specialist	Evaluate the impact of different modes of exercise on components of subjective well-being	Happiness, satisfaction with life, loneliness	12
5.	Peer and professional-led self-help support groups	Increase self-efficacy in bereaved persons	Self-esteem, life satisfaction, competency	24
6.	Social worker–led self-help support groups	Increase self-efficacy in seniors needing mental health services	Social isolation, activity, morale	12–15

*Details of the domain assessments are outlined in Table 1 of Appendix 3.

Table 4b: Study Objectives, Outcome Assessments, and Follow-Up for Technology-Assisted Interventions for Social Isolation

Intervention	Study Objective	Outcome Assessment Domains*	Follow-Up (months)
7. Social worker crisis phone line	Increase self-efficacy in seniors with mental health crisis	Depressive symptoms, socialization, unmet needs, independence.	4
8. Friendly interviewer phone visits followed by telephone friendship dyads	Increase friendships in community-dwelling low-income women with low perceived social support	Perceived social support, morale, depression, loneliness, physical health, activities daily living, network embeddedness	10
9. Aural rehabilitation	Correct functional deficit in patients referred by physician for hearing assessment	Hearing aid handicap, social activities, social relations, psychosomatic well-being, cognition	6
10. Nurse-moderated computer link	Increase self-efficacy in informal caregivers of persons with Alzheimer's disease	Decision making, social isolation, caregiver burden, depression	12
11. Social worker–led telephone-based support group	Increase social support network in female informal care givers of persons with dementia	Gains, depression, caregiver burden	6

*Details of the domain assessments are outlined in Table 2 of Appendix 3.

Table 5 presents the detailed outcome measurements employed for social isolation, loneliness, and depression. Social isolation was measured by various assessment indices of social contact or social embeddedness ranging from frequency counts of social interactions to formal measurement instruments. The formal instruments designed for social isolation included Perceived Social Support Scale for Friends and for Family (41), Instrumental and Expressive Social Support (42), Network Embeddedness Scale, (43) and the Social Provisions Scale. (44)

Loneliness was evaluated either as a 1-item response to frequency of loneliness or measured by specifically designed instruments such as the UCLA Loneliness Scale. (45) No distinctions were made between emotional loneliness and social loneliness in the studies, and none employed the De Jong Gierveld Loneliness Scale, (46) which was specifically designed for use in elderly populations. Measures of social isolation and loneliness were also extracted from various generic global health or multidimensional functional assessment tools such as the Older Americans Resources and Services (OARS) instrument (47) and the SF-36. (39) The Hearing Handicap Inventory for the Elderly, (48) another multidimensional assessment tool, was applied for a specific population, the hearing-impaired.

For the 2 studies involving informal caregivers of persons with Alzheimer's disease or dementia, social support or isolation were estimated with different measurement instruments, those for caregiver burden and those for gains through group involvement. Two different measures of caregiver burden were employed in the studies, the Zarit Burden Scale (49) and the Impact of Caregiving Scale (50), each of which have subdomains that include the impact of caregiver burden on emotions, social relations, family relations, and social support. Gains were measured using the gains through group involvement instrument (GAINS), a 6-item scale adapted from a full instrument evaluating gains. (51) The gains perceived by caregivers included those in making new friendships, knowing what to do or how to handle loneliness, stress, or resource issues in the past few months.

Table 5: Social Isolation, Loneliness, and Depression Outcome Measurements

		Mental Health & Well Being		
		Social Isolation	**Loneliness**	**Depression**
1.	Self-help programs for seniors on wait list for senior apartments	▪ Social contacts	UCLA Loneliness Scale	NM
2.	Residents of senior apartments	▪ Social activity levels	NM	▪ 1 item (often, sometimes, rarely, never lonely)
3	Exercise programs in physically inactive	▪ Rand Medical Outcomes Study Short Form SF-36	1 item (often, sometimes, rarely, never lonely)	NM
4.	Exercise programs in physically inactive	▪ Social Provisions Scale (SPS)	UCLA Loneliness Scale	NM
5.	Group support program for bereaved	NM	NM	▪ Texas Revised Inventory of Grief (TRIG) ▪ Geriatric Depression Scale (GDS)
6.	Mental health services at senior centres	▪ Older Americans Resources and Services (OARS) ▪ Social activity	1 item (always, frequently, seldom, never lonely)	NM
7.	Mental health crisis phone line	▪ Older Americans Resources and Services (OARS) ▪ Frequency social contacts and satisfaction	1 item (always, frequently, seldom, never lonely)	▪ Geriatric Depression Scale (GDS)
8.	Phone friendships for low income persons with low perceived social support	▪ Perceived social support friends (PSS-FR) and family (PSS-FA) ▪ Network embeddedness	7-item loneliness scale	▪ Center Epidemiologic Studies Depression Scale (CES-D)
9.	Hearing impaired	▪ Hearing handicap Inventory Elderly (HHIE) ▪ German Social Support Scale	UCLA Loneliness Scale	▪ Center Epidemiologic Studies Depression Scale (CES-D)
10.	Support for informal caregivers of persons with Alzheimer's disease	▪ Instrumental and Expressive Social Support (IESS) ▪ Impact of Caregiving Scale	NM	▪ Center Epidemiologic Studies Depression Scale (CES-D)
11.	Support for female informal caregivers of persons with dementia	▪ Caregiver Burden Scale ▪ Gains through Group Involvement Scale (GAINS)	NM	▪ Center Epidemiologic Studies Depression Scale (CES-D)

*NM indicates not measured; UCLA, the University of California, Los Angeles.

Recruitment Strategies and Intervention Protocols

The recruitment strategies and protocols for the in-person group interventions and for the technology-assisted interventions are outlined in Tables 6a and 6b, respectively. Appendix 2 details the intervention protocols.

Eligible subjects were variably defined by age groups in the studies (51–89, 52–91, 60–80, ≥65, and 75+ years). Three studies reported sampling frames involving agency lists: seniors on waiting lists for senior residences, (24) municipal lists, (31) and municipal household listings. (23) The other studies reported diverse recruitment strategies for senior volunteers in various settings and with different living arrangements. Four studies involved subjects referred by a physician, (22;29;33;34) and the others involved various communication and advertising strategies through the media and local community outlets.

Participants were recruited from various settings. Only 1 study reported targeting seniors living alone in the community, and that involved elderly women who were already on a waiting list for senior citizen apartments. (24) One study involved residents of congregate-living senior citizen apartments. (29) Three studies involved interventions with seniors living in the community but in various states of emotional distress: in bereavement, (30) needing mental health services, (33) and in mental health crisis. (22)

Two studies, 1 from the Netherlands (31) and 1 from the United States (32), evaluated exercise interventions with inactive community-dwelling seniors. One study (23) sought to recruit a representative group of the general elderly population at risk for social isolation and included seniors living in the community with low income and low perceived social support, who were randomly selected from residences of low-income housing tracts. That study, however, only involved women.

Table 6a: Recruitment Strategies and Intervention Protocols for In-Person Group Interventions Targeting Social Isolation*

Author, Year, Region	Study Group – Recruitment	Intervention
1. Andersson, 1985 (24) Stockholm, Sweden	▪ 108 F aged 60 to 80 years ▪ living alone ▪ on waiting list for senior citizen apartments	Home-help assistant-led focus group (3–5 participants) meeting in neighbourhood centres for 4 meetings over 2 months
2. Arnetz and Theorell 1983 (29) Stockholm, Sweden	▪ 60 M & F aged 52 to 91 years (30 per floor) ▪ in senior citizen apartment building ▪ randomly selected by staff	Staff-led self-help group (3–4 participants) and social activities in the complex and outings involving picnics, theater visits, activities focusing on social activation in a senior citizen apartment building for 6 months; no special interest activities or programs were created for the control floor
3. Hopman-Rock and Westoff, 2002 (31) Netherlands	▪ 448 (CIT) M & F aged 55 to 75 years ▪ physically inactive ▪ in 12 test and control municipal regions matched on urbanization and involving 21 program centres ▪ recruited by media, brochures, personal contacts	Peer and professional physical activity instructor-led exercise and peer health education for groups of 25 participants for 6 sessions over 6 months, each session consisting of 1 hour health education by peer educator and 1 hour of exercise led by professional exercise instructor.
4. McAuley et al., 2000 (32) Urbana, Illinois, United States	▪ 174 M & F aged 60 to 75 years sedentary lack of regular exercise in past 6 months ▪ recruited through local media and flyers through community outlets (churches, grocery stores, senior centres)	Trained exercise specialists; brisk aerobic program 3 times a week for 6 months starting for 15 minutes and increasing to a maximum 40 minutes per session compared with group undergoing stretching and toning exercises 3 times a week for 6 months
5. Caserta and Lund 1993 (30) Urban counties, Utah, United States	▪ 339 bereaved M& F aged 50 to 89 years ▪ recruited from obituaries, initial letter followed by phone contact	Peer-led (13 groups) and professional-led (13 groups) self-help groups; 14 groups in 8 weeks (weekly) + 12 groups in extra 10 months in community centres/libraries
6. Rosen and Rosen 1982 (33) Rural Georgia, United States	▪ 117 M & F ≥ 65 years ▪ with mental health problems ▪ in senior centres ▪ referred by centre staff ▪ compared with 2 matched control groups	Social worker–led self-help support group meetings; 40 to 49 sessions in senior citizen centres for 12 to 15 months

*CIT indicates community intervention trial; F, female; M, male; RCT, randomized controlled trial.

Table 6b: Recruitment Strategies and Intervention Protocols for Technology-Assisted Interventions Targeting Social Isolation*

Author, Year, Region	Study Group - Recruitment	Intervention
7. Morrow-Howell, 1998 (22) St Louis, Missouri, United States	▪ 61 M & F ≥ 65 years ▪ recruited from crisis line, self referred and referred by friends, family, and professionals	Social work crisis hot line phone provided initial crisis management and subsequent weekly phone follow-up for 4 months
8. Heller, 1991 (23) Indiana, United States	▪ 291 low-income ≥ 65 years ▪ community-dwelling women, with low perceived social support from random residences low-income housing tracts from 3 areas	Friendly interviewer staff contact for 10 weeks followed by peer telephone dyads for 30-week study period
9. Tesch-Romer, 1997 (34) Germany	▪ 148 M & F mean age 71 years ▪ referred by physicians and acousticians and through public media outlets ▪ 3 groups: aided, hearing loss but waiting, no hearing loss	Hearing assessment and aid fitting was performed by registered acousticians after an initial examination by ear, nose, and throat physician. Rehabilitation instructions were provided by the acousticians upon receiving the aid. Six months after the aiding there was a standardized follow-up.
10. Brennan, 1995 (25) Cleveland, Ohio, United States	▪ 102 spousal caregivers of persons with dementia ▪ recruited from a registry, area Association, self referred	Nurse-moderated Web-based computer link providing 24-hour access to information, decision support, and communication support for 1 year
11. Winter and Gitlin 2007 (35) Philadelphia, Pennsylvania, United States	▪ 103 F ≥ 65 years informal caregivers of persons with Alzheimer's disease ▪ Recruited by targeted mailings to adult day centers, clinical programs, media	Social worker–led telephone-based group support intervention weekly 1 hour sessions by social workers for 6 months

*F indicates female; M, male.

Results of In-Person Group-Based Interventions

The effectiveness of the single, focused interventions targeting social isolation and loneliness in community-dwelling seniors are summarized in Table 7. Table 8 outlines the overall assessments of the quality of evidence for these intervention studies.

Support Groups

In-person, group-based support or focused activities led by professional groups to decrease social isolation or loneliness were evaluated in 6 studies. Two studies conducted in Sweden in 1983 and 1985 reported that self-help focus groups decreased social isolation as measured by increased social activity for seniors on waiting lists for senior apartments (increased social contacts, $P < .05$), (24) and for those living in senior apartments (increased social activity level, $P = .02$). (29) Loneliness was not found to be significantly affected by the intervention for seniors on a waiting list and was not measured for those living in senior citizen residences.

Two other studies evaluated self-help/self-support group interventions for targeted groups of seniors including those in mental health distress, those needing mental health services and visiting senior citizen centres in low-income regions in Georgia (33) and bereaved seniors in urban counties in Utah. (30) The support group offered to seniors visiting senior centres with mental health services reported decreased

loneliness ($\chi^2 = 6.76$, $P < .001$), decreased social isolation through increased household activity ($\chi^2 = 5.33$, $P < .05$), and increased social activity ($\chi^2 = 6.55$, $P < .01$) compared with control groups not receiving support.

The study on bereaved seniors did not evaluate measures of social isolation or loneliness but did measure depression and grief. In multivariate analysis, neither grief nor depression was affected by the group-support program over several observation points in a 2-year follow-up. Expanded regression models were evaluated for the independent effects of individual intrapersonal resources, such as life satisfaction, competencies, and self-esteem, on the outcome measures of grief and depression. An unexpected observation was that at the 2-year follow-up, participants' recovery from grief was related more closely to their intrapersonal resources at baseline (life satisfaction [$P = .002$], competencies [$P = .03$], and self-esteem [$P = .03$]) than to the intervention support activities. This pattern, however, was less strong for depression and was significantly detected only for self-esteem ($P = .04$).

Community-Based Exercise Programs

Group exercise interventions were found to reduce social isolation and loneliness in 2 studies. In the Dutch study, Hopman-Rock and Westoff (31) conducted a community intervention incorporating an education and exercise program focusing on well-being and pleasure. They reported increased physical activity ($F = 16.9$, $P < .01$), where physical activity was assessed in household, sport, and leisure settings. The intervention also resulted in greater physical activity in those participants who were less active at baseline ($F = 16.9$, $P < .01$). Loneliness was also reported to be significantly reduced (Friedman statistic; $P < .01$) following the intervention. At follow-up, 82% reported that they had an active lifestyle, compared with 52% at baseline.

The American study (32) was designed as an exploratory RCT to evaluate the effects of aerobic and nonaerobic exercise regimens, and to determine the effects of exercise and the impact of the increased socialization on subjective well-being. Using advanced longitudinal modeling approaches, the study demonstrated that the exercise arms were found to be equally effective in reducing isolation, suggesting that subjective well-being could be improved with less aggressive forms of exercise such as stretching and toning. The relationship between exercise, social isolation, and subjective well-being was also evaluated through multivariate modeling strategies, which took into account the extensive correlations among the variables. Social interactions related to the group exercise activities were reported to have an effect on loneliness ($\beta = -0.10$, $P < .05$) independent of exercise. The authors also noted that in follow-up, adherence to the nonaerobic intervention was higher than adherence to the aerobic intervention (75% versus 51%), and that this posed a potential advantage for exercise programs in the elderly population (where maintaining compliance over long periods is difficult).

Results of Technology-Assisted Interventions

Five studies examined different technology-assisted interventions which targeted community-dwelling seniors and did not require in-person participation.

Telephone Support

Telephone Crisis Support Line

A small demonstration project involving a social worker phone crisis line for seniors at risk of suicide resulted in significantly decreased social isolation through increased person contacts ($t = 2.44$, $P = .01$) and decreased depression ($t = 1.78$, $P = .04$) but not decreased loneliness. (22)

Telephone Friendships

An intervention aimed at increasing social support in low-income women with low perceived social support, by developing phone friendships, was not successful in reducing social isolation, loneliness, or depression. (23) Additional observations, however, were made in subsequent subgroup analyses restricted to those continuing the phone friendship. Participants who continued reported more emotional support ($P < .001$) from the intervention than those not continuing with the phone friendship. Those continuing also differed in baseline characteristics from those that did not continue in that they had higher perceived friend support ($P < .04$), a greater number of friends ($P < 0.04$), and higher ADL scores ($P < .03$). The authors also noted that, overall, the initial participation rates for the study were low, as 52% of those approached for the study refused an initial home assessment.

Technology-Assisted Interventions for Informal Caregivers

The effectiveness of technology-assisted interventions was limited in the 2 studies directed towards relieving the effects of social isolation in informal caregivers of persons with dementia or Alzheimer's disease. (25;35)

Nurse-Led Web-Based Computer Network Support for Informal Caregivers

The nurse-led Web-based computer support system did not demonstrate improvements in depression or social support, and it did not affect caregiver burden according to well-defined measures. (25) The participation or access of the network support system by the study participants, however, was highly variable. Participants accessed the network support system 83 times on average (range 3–590 times, over the 12 months, on average 2 times per week. An analysis of the comments posted on the Web forum suggested that participants perceived the program to be a social support system.

There was a discrepancy between formal quantitative measures and qualitative measures in evaluating how the intervention influenced social isolation. The difference may be attributable to the heavy weighting of the quantitative measure on familiar supports rather than on newly developed supports. Furthermore, it may also be that increased contacts and supports with new friends for the caregivers in this short-term study could not help them to overcome their isolation and loneliness due to the loss of the companionship they had had with the care receiver prior to the onset of their dementia.

Social Worker–Led Telephone Support System for Informal Caregivers

The phone group-support intervention led by social workers, referred to as telesupport, did not demonstrate any main effects in multivariate analysis on self-efficacy gains, depression, or caregiver burden. (35) Subgroup analysis, however, demonstrated a significant interaction effect between depression and age. Younger ($\leq$ 65 years) women compared with older ($>$ 65 years) women were significantly more likely to report decreased depression, with a 4-point lower score ($P = .014$). The participation rate in this intervention was also highly variable: on average, 14.8 sessions (range 0–26, SD = 10.7) out of a possible 26 sessions in 6 months. Participation rates were also influenced by the caregiver's relationship to the care recipient ($P = .022$; 16.7 sessions by wives versus 11.8 sessions by other relatives).

Hearing-Loss Rehabilitation

One prospective cohort study evaluated the effects of hearing-loss rehabilitation in patients referred with mild or moderate hearing loss. (34) The research team considered that randomization of patients for hearing aids would not have been ethical, and outcomes in the intervention group were therefore

compared with 2 prospectively evaluated unaided control groups. Overall, hearing impairment was measured by a multidimensional scale, the Hearing Handicap Inventory for the Elderly (HHIE). The inventory included scales measuring social and emotional problems associated with hearing loss. The scale evaluated the impact of hearing loss on individuals' social activities and interactions, through associated activity limitations, difficulties, or embarrassment. Hearing loss impairment evaluated with this outcome instrument was significantly improved ($F = 24.56$, $P < .01$) in the hearing-aided group compared with the unaided group. Loneliness was also significantly reduced ($F = 6.34$, $P < .01$).

The effects of the intervention were thought to be an underestimate because of the extreme interindividual variability in daytime use of the aids at fitting (daily average range, 36–924 minutes) and at follow-up (daily average range, 26–960 minutes). To increase adherence to hearing aid use, audiologic counseling and psychosocial support in early usage were recommended. It was also noted that most participants were fitted with only a single hearing aid (74%), half of which were in-the-ear aids, and although this was the current practice in Germany, it did not represent ideal aural rehabilitation for symmetrical hearing loss.

Table 7: Effectiveness of Diverse Interventions for Social Isolation, Loneliness, and Depression in Heterogenous Populations of Community-Dwelling Seniors*

	Population	Country, Year	Intervention Type	N	Findings
1.	Wait list for senior apartments	Sweden, 1985	Social worker–led self-help groups	108	↓ Isolation†
2.	Residents of senior apartments	Sweden, 1983	Support groups	60	↓ Isolation†
3.	Physically inactive seniors	Netherlands, 2002	Group exercise programs	382	↓ Isolation‡ ↓ Loneliness‡
4.	Physically inactive seniors	United States, 2000	Group exercise programs	174	↓ Loneliness†
5.	Bereaved seniors	United States, 1993	Peer- and professional- led self-help support groups	339	NS
6.	Users of mental health services at senior centres	United States, 1982	Social worker–led self-help groups	68	↓ Isolation‡ ↓ Loneliness§
7.	Seniors experiencing mental health crisis	United States, 1998	Social worker crisis phone line	61	↓ Isolation‡ ↓ Depression†
8.	Seniors with low income and low perceived social support	United States, 1991	Telephone friendships	291	NS
9.	Hearing-impaired seniors	Germany, 1997	Hearing aids	148	↓ Loneliness†
10.	Informal caregivers of persons with Alzheimer's disease	United States, 1995	Nurse moderated computer link	102	NS
11.	Informal caregivers of persons with dementia	United States, 2007	Social worker–led telephone-based support	103	↓ Depression† (subgroup > 65 y)

↓ indicates decrease; NS, not significant , $P > .05$.
†$P < .05$; ‡$P < .01$; §$P < .001$.

Table 8: GRADE Evidence for Interventions Targeting Social Isolation in Community-Dwelling Seniors*

Intervention	Number of Interventions	Design	Quality	Consis-tency	Directness Generalizability	Overall Quality
In-person group intervention	5	RCT wait list	Low/Moderate	NA	Limited	Moderate
		CIT senior apartment	Moderate		Limited	Moderate
		CIT exercise	Moderate		Limited	Moderate
		RCT exercise	Moderate		Limited	Moderate
		RCT Bereaved	Moderate		Moderate	Moderate
	1	Cohort MH senior centre	Low	NA	Limited	Low
Technology-assisted (phone, Web)	4	RCT crisis phone	Low	NA	Moderate	Low/Moderate
		RCT CG Web link	Moderate		Moderate	Moderate
		RCT CG phone link	Moderate		Moderate	Moderate
		RCT phone pals	Low		Limited	Low/Moderate
Device	1	Cohort hearing aid	Moderate	NA	Moderate	Moderate

*CG indicates caregiver; CIT, community intervention trial; MH, mental health; NA, not applicable; RCT, randomized controlled trial.

Discussion

Evidence Limitations

The systematic evidence search identified only a few studies addressing social isolation, and each study involved a different intervention targeting a different group of elderly subjects. In addition, the available evidence had several major limitations, with generalizability being the most significant. None of the studies were conducted with Canadian populations, and most involved highly selected senior groups from 10 to 15 years ago. Participants in the studies also tended to be in their sixties and seventies on average, and mainly women. Those over 80 years of age and men of any age were not well represented in any of the studies, and it is difficult to determine to what extent the interventions that were mainly evaluated in young, female seniors would be appropriate for the needs and preferences of older and/or male seniors. The durability of any of the intervention outcomes is also largely unknown, as the studies involved short time frames with follow-up periods of generally 1 year or less. In developing programs or interventions for social isolation in the elderly, consideration should also be given to the idea that the seniors of today or tomorrow represent distinct cohorts with a unique life course and aging and likely with particular needs.

Generalizability is also an issue in that the interventions that were identified as targeting social isolation and loneliness mostly involved some element of change, particularly behaviour-based change. The stated behavioural changes depended upon seniors' gaining new skills in coping and resiliency, going out more regularly, seeking information and services, or becoming more physically active. Responses to these interventions are therefore likely to be more variable – influenced by personal factors, gender, race, or cultural differences – than responses to interventions involving devices or medical management.

Matching the interventions targeting social isolation and or loneliness to the needs, attitudes, and preferences of seniors is also an important consideration. The participation rates in several of the intervention studies, including those found to be effective, were low. Less than half of community-dwelling low-income elderly women agreed to participate in introductory interviews for 1 study. (23) Gaining participation in the study was also no guarantee that the potential intervention being offered would be appropriate for each participant, given the varying causes of social isolation or loneliness. An example of this was the intervention involved in establishing phone friendships to create new social support. (23) This intervention could not be expected to be effective if the participants were lonely mainly because of absent or declining family support, as was suggested in post-intervention interviews. Another example was the intervention intended to increase social support for isolated informal caregivers through newly created social networks. (35) However, if the caregiver's loneliness was attributable to the loss of companionship of the care recipient, improving other friendship support would have limited effect on caregiver loneliness. Flexibility of programs and choice would seem to be key aspects of connecting seniors in need with interventions that are effective and appropriate to their needs.

The many complex needs of seniors were found to limit the effectiveness of interventions, particularly the technology-assisted interventions. A straightforward intervention to rehabilitate mild/moderate hearing loss with a hearing aid was effective in reducing communication-related disability and loneliness. The extreme variability in compliance with the hearing aid at baseline and at follow-up, however, suggests that education or counseling regarding appropriate use of their device is needed to ensure that maximum effectiveness is achieved. The authors characterized the provision of a hearing aid as a necessary but not sufficient condition for the subject to achieve effective hearing-loss rehabilitation.

Methodological Issues

Although the studies generally had a single objective that focused on an intervention involving measures of social isolation or loneliness, social isolation in particular was variably defined and measured differently in every study. Social isolation was operationalized from simple frequency counts of friend and family visits to more complex measures of social network support or embeddedness. For informal caregivers, social isolation was evaluated as one component of a global measure of caregiver burden. The varying precision and lack of consensus on measurement across studies limits any comparisons between interventions and across studies.

Many other health states and conditions were also evaluated in the studies, but given the limited focus of the interventions and their short duration, it was unsurprising that the interventions were not found to impact on broader measures of health and quality of life, or on longer-term outcomes such as institutionalization or admission to LTC.

The interventions for social isolation by their very nature were mainly group-based, involving longitudinal follow-up with repeated measures. Analytical approaches in the studies varied from simple bivariate analysis to more advanced techniques taking into account longitudinal follow-up and repeated measurements. The interventions mainly depended on group dynamics, and outcomes could vary considerably as a result. In other cases, the intervention was conducted in settings involving community congregate living, and for practical reasons the assignment to treatment or control group was based on floor of residence or health centre attendance. The research study strategy for these interventions is more complicated and requires consideration of the effects of grouping or clustering either at the design stage or the analytical stage. Although a few studies evaluated in this report did attempt to take clustering into effect, the majority did not.

Relevant Areas Not Addressed or Incompletely Addressed

Social isolation and loneliness occurring in the elderly can be attributed to a variety of interconnected personal, social, economic, health-related, geographic and environmental factors. Research in this area has been narrowly based, focusing on only a few of the diverse potential causes of social isolation and loneliness.

Although the impact of hearing-loss rehabilitation on social isolation was investigated, no studies were found to evaluate the effects of interventions for other age-related functional disability such as vision loss or mobility restrictions. On the other hand, research is not necessarily needed to confirm that correcting mobility restrictions or vision loss would interfere with seniors' quality of life, socialization, and independence. Many programs and services that intuitively seem to be of benefit for seniors' socialization and independence are already offered and funded. In Ontario, mobility aids, hearing aids, and vision aids have variable support from ministry-funded programs. Adult day camps and friendly visitor programs are other popular approaches for socialization that have not been evaluated by formal research but are perceived to be of benefit to seniors. A variety of community organizations in the province provide these services to seniors.

Seniors are in various states of living, health, and aging, with diverse changing needs and preferences. In addition, given the complex, interconnected causal pathways of social isolation, it is unlikely that a single, focused intervention would provide a comprehensive solution for social needs. The identification or targeting of seniors who are at risk for social isolation or loneliness was not addressed in the studies. Given the high prevalence of health conditions and aging-related disabilities, the provision of multiple services and interventions needed by seniors also poses difficulties for assessment, program design, and delivery. The existing trials on social isolation employed a range of professionals to conduct the

interventions, and no comparative information is available to evaluate the abilities of specialists or peer groups to provide supportive interventions. None of the studies evaluated different methods of service delivery and how best to provide services to seniors whose needs and personal situations may vary greatly.

Only 2 studies examined interventions for social isolation in informal caregivers, and the effectiveness of the interventions involving technology-assisted support via phone or computer was limited at best. Given the tremendous role that informal caregivers have in assisting and providing support to seniors in the community, the paucity of evidence on interventions that would support or assist caregivers in this vital activity is particularly regrettable. (7) Seniors' need for support from informal caregivers is not likely to lessen in the future, and more information is required about the needs or burden (including social isolation) of caregivers and about interventions that would support them in that role.

Technology-assisted interventions would potentially seem to offer particular advantages to both isolated caregivers and homebound, isolated, frail seniors, by avoiding the need for out-of-house in-person attendance. However the range of technology-assisted options is limited at present, as is the evidence supporting their effectiveness. One promising area for dealing with social isolation in seniors has been the introduction of video telehome phone monitoring and support systems. Video home phones could also potentially offer efficiencies to health and social support professionals, and social support could be a great advantage for isolated, homebound seniors. Although prospective randomized trials have been implemented, they have evaluated the impact of the technology on home-based medical case management and not the impact on well-being and social factors such as isolation and loneliness. (52;53) The effectiveness of video telehome phone support systems on reducing social isolation in the elderly population has been evaluated in prospective cohort trials (54-56) but so far has not been evaluated in RCTs.

The interventions for social isolation identified in this review were directed only at the individual or group level. No studies evaluated interventions at the higher or environmental level, including factors such as neighbourhood, community, or housing. Housing, or where and how seniors choose to live, has been viewed as a central element of their health and quality of life. (57) Concern for housing or living space relates to broader issues including lifestyle, personality, self-esteem, identity, well-being, and social environment. Adequate housing plays a major role in community care and is often a key to independent living. (58) There are established links between good housing and good health, and the importance of housing has to be factored into health implementation strategies for community-dwelling seniors. (59;60)

Economic Analysis

Disclaimer: The Medical Advisory Secretariat uses a standardized costing methodology for all of its economic analyses of technologies. The main cost categories and the associated methods from the province's perspective are as follows:

Hospital: Ontario Case Costing Initiative cost data are used for all in-hospital stay costs for the designated International Classification of Diseases-10 (ICD-10) diagnosis codes and Canadian Classification of Health Interventions procedure codes. Adjustments may need to be made to ensure the relevant case mix group is reflective of the diagnosis and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, the secretariat normally defaults to considering direct treatment costs only.

Nonhospital: These include physician services costs obtained from the Ontario Schedule of Benefits for physician fees, laboratory fees from the Ontario Laboratory Schedule of Fees, device costs from the perspective of local health care institutions, and drug costs from the Ontario Drug Benefit formulary list price.

Discounting: For all cost-effectiveness analyses, a discount rate of 5% is used as per the Canadian Agency for Drugs and Technologies in Health.

Downstream costs: All costs reported are based on assumptions of utilization, care patterns, funding, and other factors. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature. In cases where a deviation from this standard is used, an explanation has been given as to the reasons, the assumptions, and the revised approach. The economic analysis represents an estimate only, based on assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied for the purpose of developing implementation plans for the technology.

Economic Analysis of Effective Interventions for Social Isolation

Community exercise programs were found to be effective in reducing social isolation outcomes in seniors living in the community. Therefore, an economic analysis to project total cost to implement the program in the first year based on eligible seniors in the community willing to participate in a community exercise program was calculated. Table 9 describes the cost to implement the program in the first year for these interventions.

Table 9: Cost to Implement Community-Based Exercise Programs (2008 $Cdn)*

Type of Professional Delivering Program	Unit Cost, $	First Year Cost, $	Population	Number	First Year Total Cost, $
Recreation Therapist	25.85	74.68	Seniors in the community willing to participate in an exercise program	476,992	35,620,736
Occupational Therapist	29.68	85.74	Seniors in the community willing to participate in an exercise program	476,992	40,898,392
Physiotherapist	18.41	53.18	Seniors in the community willing to participate in an exercise program	476,992	25,368,578

*Assumed hourly exercise group sessions of 9 seniors per group once biweekly with either an occupational therapist, a physiotherapist, or a recreation therapist. Assumed 4.5% of seniors are in long-term care. Assumed 57% of seniors 65+ would participate in a community exercise program and 79% would be compliant. Assumed 65.8% of seniors in the community are mobile.

This economic analysis was calculated for the first year after an introduction of the interventions, from the Ministry of Health and Long-Term Care perspective, using prevalence data only. Incidence and mortality rates were not factored in. Numbers may change based on population trends, rate of intervention uptake, trends in current programs in place in the province, and assumptions on costs. Number refers to patients likely to access these interventions in Ontario based on assumptions stated below from the literature. Resource consumption was confirmed by an expert panel.

Assumptions

Several assumptions were made to calculate the annual budget impact:

- Total population 65 and over in Ontario was calculated from Statistics Canada population data. (61)
- Assumed exercise group sessions (1 hour) of 9 seniors once biweekly (62) with either an occupational therapist (63) or physiotherapist (64) or recreation therapist. (65)
- Assumed 4.5% of seniors are in LTC. (66)
- Assumed 57% of seniors 65+ would participate in a community exercise program and 79% of seniors would be compliant. (67)
- Assumed 65.8% of seniors in the community are mobile. (10)

As a result of these assumptions, and due to the limited data available in the literature, uncertainty could become an issue. If and when new evidence is presented, these results may change and may better predict program resources over time, allowing for a more accurate analysis.

Current Expenditures in the Province of Ontario

Currently there are community programs in Ontario that offer exercise programs to seniors 65 years and older. The funding infrastructure for such programs in the province was not investigated in this review.

Conclusion

A systematic review of the published literature focusing on interventions for social isolation and loneliness in community-dwelling seniors identified 11 quantitative studies. The studies involved European or American populations with diverse recruitment strategies, intervention objectives, and limited follow-up, with cohorts from 10 to 15 years ago involving mainly female seniors in their sixties and seventies. The studies involved 2 classes of interventions: in-person, group-support activities and technology-assisted interventions. These were delivered to diverse targeted groups of seniors such as those in mental or emotional distress, informal caregivers, the physically inactive, and low-income groups. Both classes of interventions were found to reduce social isolation, although the technology-assisted interventions tended to involve only seniors in mental distress and informal caregivers. Effective interventions included social support groups for seniors on wait lists for senior apartments and those living in senior citizen apartments, and community-based exercise programs that featured health and wellness for physically inactive community-dwelling seniors. Rehabilitation for hearing loss was also effective in remedying communication impairment and reducing loneliness in seniors.

Social isolation and loneliness in seniors are attributable to a variety of personal, social, economic, health-related, geographic, and environmental factors. Research into interventions for social isolation in seniors has been very limited, given the diverse potential causes of isolation. Although the impact of hearing loss rehabilitation was investigated, impacts of interventions towards other major age-related disabilities, such as vision loss or mobility declines, were not investigated. The process issues (methods of targeting at-risk subjects, delivery, and settings) and modifying factors (client personality, attitude, or preference) of behaviour-based change interventions for social isolation are particularly important and have not been addressed.

Research into several key areas for sustainability of independent community living for seniors is needed. First, the impact of environmentally directed interventions such as housing or living arrangements has not been investigated in any controlled fashion. Evaluations at this level, however, would be problematic and would require a more complex research design and analytical strategy than has been typically employed in this area. Second, considering the key role that informal caregivers have in supporting seniors in the community, little is known on how to positively influence their social isolation and other burdens imposed on them. Third, the increasing demand for home health care and the need for efficiencies have coincided with the development of many initiatives in the e-health or telehealth field. However, the potential impact of these interventions upon the social health and well-being of seniors has been evaluated only at the pilot or preliminary stage. In conclusion, more evidence is needed to guide the development of effective, appropriate, and comprehensive interventions or strategies for the social needs and health of present-day and future community-dwelling Canadian seniors.

Appendices

Appendix 1. Search Strategy for Social Isolation in Community-Dwelling Seniors

Final Search – Social Isolation

Search date: March 5, 2008
Databases Searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, Cochrane Library, CINAHL, PsycINFO, INAHTA/CRD

Database: Ovid MEDLINE(R) <1996 to February Week 3 2008>
Search Strategy:

1	exp Social Isolation/ (3709)
2	exp Loneliness/ (701)
3	1 or 2 (3709)
4	limit 3 to "all aged (65 and over)" (790)
5	exp Aged/ (788008)
6	(elder$ or senior$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (75147)
7	3 and (5 or 6) (810)
8	4 or 7 (810)
9	exp Telemedicine/ or exp telephone/ or exp videoconferencing/ (12631)
10	exp Community Health Nursing/ or exp Home Care Services/ (18813)
11	exp exercise/ or exp exercise therapy/ (37456)
12	exp Self-Help Groups/ or exp Self Care/ (18674)
13	exp Social Support/ or exp Peer Group/ (25044)
14	exp Social Environment/ (32034)
15	exp Intervention Studies/ (2987)
16	exp Health Promotion/ (21288)
17	exp Health Education/ (48176)
18	exp House Calls/ (801)
19	exp Primary Prevention/ (34879)
20	exp social adjustment/ or exp social facilitation/ (5433)
21	exp health services for the aged/ or exp preventive health services/ (157679)
22	exp counseling/ (10892)
23	exp Pychotherapy/ or exp Social Work/ (3879)
24	((lonely or loneliness or isolation) adj4 (decrease or reduce$ or reduction$ or intervention$ or prevent$)).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (609)
25	or/9-24 (277119)
26	8 and 25 (353)
27	limit 26 to (english language and humans and yr="2003 - 2008") (184)

Database: EMBASE <1980 to 2008 Week 09>
Search Strategy:

---

1 social isolation/ (4986)
2 exp LONELINESS/ (1350)
3 1 or 2 (6201)
4 limit 3 to aged <65+ years> (1144)
5 (elder$ or senior$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (118915)
6 3 and 5 (513)
7 4 or 6 (1260)
8 exp telephone/ (8884)
9 exp TELEMEDICINE/ (1525)
10 exp VIDEOCONFERENCING/ (162)
11 exp Community Care/ (22319)
12 exp Elderly Care/ or exp Home Care/ (38128)
13 exp Kinesiotherapy/ (16609)
14 exp EXERCISE/ (81057)
15 exp Self Help/ (2994)
16 exp Self Care/ (13259)
17 exp Social Support/ (15074)
18 exp Peer Group/ (1100)
19 exp Social Environment/ (71146)
20 exp Intervention Study/ (2710)
21 exp Health Promotion/ (23540)
22 exp Health Education/ (70734)
23 exp Social Adaptation/ (31527)
24 exp Preventive Health Service/ (4231)
25 exp Counseling/ (43484)
26 exp Mental Health Service/ (12728)
27 exp Social Network/ (443)
28 exp social care/ or exp Social Work/ (33091)
29 exp psychotherapy/ (73423)
30 ((lonely or loneliness or isolation) adj4 (decrease or reduce$ or reduction$ or intervention$ or prevent$)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (869)
31 or/8-30 (435544)
32 7 and 31 (1056)
33 limit 32 to (human and english language and yr="2003 - 2008") (417)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to February Week 4 2008>
Search Strategy:

---

1 exp Social Isolation/ (2197)
2 exp LONELINESS/ (641)
3 1 or 2 (2197)
4 limit 3 to (aged <65 to 79 years> or "aged <80 and over>") (710)
5 (elder$ or senior$).mp. [mp=title, subject heading word, abstract, instrumentation] (33441)
6 3 and 5 (249)
7 4 or 6 (725)

8 exp Telephone/ or exp Telemedicine/ or exp Teleconferencing/ (9176)
9 exp Community Health Nursing/ or exp Home Health Care/ or exp Community Health Services/ or exp Community Mental Health Services/ (134368)
10 exp Health Services for the Aged/ or exp Gerontologic Nursing/ or exp Gerontologic Care/ (17447)
11 exp Exercise/ (25112)
12 exp Therapeutic Exercise/ (15205)
13 exp Support Groups/ (4075)
14 exp Self care/ (11961)
15 exp Support, Psychosocial/ (19251)
16 exp Peer Group/ (1704)
17 exp Social Environment/ (11315)
18 exp Health Promotion/ (14613)
19 exp Health Education/ (46582)
20 exp Social Adjustment/ or exp Adaptation, Psychological/ (8095)
21 exp Preventive Health Care/ (77142)
22 exp Home Visits/ (1946)
23 exp Counseling/ (8177)
24 exp PSYCHOTHERAPY/ (44148)
25 exp Social Work/ (4781)
26 ((lonely or loneliness or isolation) adj4 (decrease or reduce$ or reduction$ or intervention$ or prevent$)).mp. [mp=title, subject heading word, abstract, instrumentation] (379)
27 exp Social Networks/ (1982)
28 exp Social Work Service/ (1680)
29 or/8-28 (263356)
30 7 and 29 (421)
31 limit 30 to (english and yr="2003 - 2008") (181)

Appendix 2. Protocols for Intervention Studies for Social Isolation in Community-Dwelling Seniors

Interventions were mainly (8 of 11) led by various professional groups (social workers, nurses, psychologists, exercise specialists, and audiologists). Social workers were reported as conducting the intervention in 3 studies, (22;33;35) and nurses conducted an intervention in 1 study. (25) Peer as well as professional support leaders were identified in 2 studies, 1 involving exercise and education (31) and 1 involving bereavement support groups. (30) The interventions were usually conducted with small groups(< 30 participants) and in community or senior centres. The duration of the interventions was typically 6 months or less, with the longest being 12 months.

The 2 trials involving exercise interventions involved different protocols. In the community intervention study conducted in the Netherlands by Hopman-Rock and Westoff, (31), a program known as the Aging Well and Healthy Program was designed to promote a healthy lifestyle among older adults living independently. The program targeted seniors from 55 to 75 years of age, was conducted in community settings, and consisted of 6 sessions, including a combination of a 45-minute peer-led education component and a 30-minute exercise component led by a professional physical activity instructor. The education topics included successful aging, exercise and mobility, wholesome food, safety in and around the house, resistance (physical and psychological), and infirmities of old age. The exercise program consisted of activities that could be performed sitting or standing, and included warm-up exercises, upper and lower body exercises, whole body movements, and cooling-down exercises. Participants were encouraged to continue the exercises at home for a minimum of 3 times a week.

In the United States, the exercise intervention study was a randomized trial intended to differentiate the effects of different levels of exercise – an aerobic program versus an anaerobic program. (32) Both exercise programs were conducted in community gymnasiums and led by trained exercise specialists. The exercise programs targeted community-dwelling physically inactive seniors aged 60 to 75 years of age. The aerobic program employed brisk walking as the aerobic component and was conducted 3 times per week for 6 months. The exercise intensity was increased over the program from short (10–15 minutes) to longer (45 minutes) intervals and from light to moderate activity levels as measured by physiological testing and heart rate monitoring. The anaerobic program, or less strenuous activity, consisted of a stretching and toning comparative exercise group with the same frequency and duration of the aerobic program and lasted for 40 minutes with 10-minute warm-up and cool-down periods. The program consisted of strengthening exercises of 8 to 12 repetitions per major muscle group and flexibility exercises for all large muscle groups. Both groups were followed up at 6 and 12 months.

Interventions assisted by technology, such as by phone (n = 3) or a Web-based computer support system (n = 1), involved varying protocols over short time periods (4–12 months) for diverse client groups. All of them involved some degree of client-initiated control of the schedules. The intervention to develop a friend support system for community-dwelling, low-income individuals with low perceived social support involved a 2-stage study design. (23) The intervention was initiated by a friendly staff interviewer with phone contacts over 10 weeks and was followed by random assignment of clients to phone "friends" in pairs or dyads, who were encouraged to provide each other with social contact and support by phone and were followed for an additional 30 weeks.

Of the 5 studies employing technology-assisted interventions, 2 involved informal caregivers for persons with Alzheimer's disease and dementia. One of studies included a nurse-led 24-hour access to a Web-based computer link that provided 3 services to caregivers: information, decision support, and communication. (25) Computer terminals were set up in participants' homes, and participants received

90 minutes of instruction and monthly phone calls on service use. A nurse moderator of the Web site served as a group facilitator and clinical expert. The other study involved social worker–led weekly phone conferencing support groups consisting of 5 caregivers. (35)

Appendix 3: Summary of Study Analysis, Outcome Assessments, and Results

Table 1: In-Person Group-Focus Interventions*

Study Group Intervention	Analysis	Outcomes – Scales	Results
Andersson 1985 (24) Study conducted in Stockholm Women on wait lists for seniors apartments Self-help focus groups: 4 meetings led by a social worker or home helper RCT (n = 108) Objective: strengthen social network	T-test ANCOVA	At 6 months: ▪ Social integration (Loneliness – UCLA) ▪ Social contacts ▪ Alienation [Meaninglessness 4-item scale by Gardell and Powerlessness 3-item scale] ▪ Psychological resources (Self-esteem 4-item scale, inability to trust) ▪ Health changes by 5 indicators (psychosomatic complaints, subjective health, drug use, blood pressure, and activities [participation in organized activities, no leisure activities])	T-Test Treatment Group, [No sign change in controls] ▪ ↑ Social contact, *P* = .028 ▪ ↓ Meaninglessness, *P* = .019 ▪ ↑ Self esteem, *P* = .003 ▪ ↓ Diastolic BP, *P* = .007 ▪ ↓ Systolic BP, *P* = .013 (10 mmHg drop in 49% of treatment group, 39% of control group) ANCOVA ▪ ↓ Systolic BP, *P* < .05 ▪ ↑ Social contact, *P* < .05
Arnetz and Theorell 1983 (29) Study conducted in Stockholm Self-help group for seniors in senior apartment building Community Intervention Trial (N = 60) – Control Group other floor (F1 vs. F2) Objective: effects of social activation on mental, physical well-being, social interaction and behaviour	ANOVA	At 3- and 6-month follow-up: ▪ Baseline questionnaire 150 questions (upbringing, education, occupation, marital status, family activities, interests, personality, emotional state, future expectations, social interactions, medical disorders) ▪ Behavioural scale staff-rated 8-item ▪ Social activity level staff-rated ▪ Psychosomatic 4-item index (NS) ▪ Psychological 6-item index ▪ Sleep	ANOVA ▪ ↑ Social activity level – number of activities per week (F = 8.34, *P* = .02) ▪ (NS) Depression (F = 0.01, *P* = .99) ▪ (NS) Suicide ideation (F = 0.95, *P* = .39)
Hopman-Rock and Westoff 2002 (31) Study conducted in the Netherlands Education and exercise program geared to well-being and pleasure rather than health Initial RCT (N = 50) followed by CIT (N = 382) Control municipal areas Objective: program impact on general health, physical performance, health related knowledge	MANOVA, repeated measures Nonparametric (Wilcoxon, Friedman, Kruskall-Wallis) Stratified by men and women and by activity level (< 3 h/wk)	At 3- and 6-month follow-up: ▪ SF-36 (General health, physical functioning, social functioning, role limitation, mental health, energy/fatigue, bodily pain) (NS) ▪ Loneliness (1 item) ▪ Physical performance – (NS) Vooripp physical activity score (PPT) range 0–28 (household, sport and leisure activity – frequent intensity) ▪ Knowledge score (0–20)	↓ Loneliness (3.9 [SD 1.5] to 4.2 [SD 1.3], Friedman *P* < .01) ↑ Physical activity (F = 16.9, *P* < .01) ↑ Physical activity (< median [F = 39.3, *P* < .01]) At follow-up, 82% reported having an active lifestyle (baseline 48% inactive).

Study Group Intervention	Analysis	Outcomes – Scales	Results
McAuley et al. 2000 (32) Study conducted in the United States Exercise program geared to welfare and pleasure rather than health RCT (N = 174) Objective: Impact of aerobic and nonaerobic exercise program on components and the impact of exercise on social support	First stage was exploratory to determine the best fit the repeated measures over time fitting a regression model analysis latent growth curve modelling	At 6- and 12-month follow-up: ▪ Happiness – Memorial University of Newfoundland Scale of Happiness (MUNSH) ▪ Satisfaction with life – the Diner Satisfaction With Life Scale (SWLS) ▪ Social support – the Social Provisions Scale (SPS) ▪ Loneliness – the UCLA Loneliness Scale	Model testing differences between 2 exercise groups was not significant by 3 different tests (aerobic vs. nonaerobic exercise group) χ^2 goodness-of-fit (χ^2 = 74.06, *P* > .05), comparative fit index (CFI = 0.97), root mean square error of approximation (RMSEA) = 0.037 Final Path model (χ^2 = 53.61, *P* < .05) showed significant path coefficients between changes in social support and exercise frequency and changes in well-being Those who exercised more realized ↑happiness (β = .30, *P* < .05) Higher levels of initial social support (β = −.21, *P* < .05) and changes in social support (β = −.10, *P* < .05) were associated with reductions in loneliness
Caserta and Lund 1993 (30) Study conducted in Utah Support groups, recently bereaved Recruited from obituaries. Randomized to control group (N = 98) and to either (N = 241) short (8 weeks) or long-term (> 10 months) treatment in 13 groups Led by peer facilitators and by practitioners (social work, psychology, or nursing) for meetings in community settings Objective: To facilitate self-help	Analysis of variance (ANOVA) Main and interactive effects over time of resources, self esteem, life satisfaction and competencies on depression and grief Stepwise linear regression with 4 models on depression and on grief	Follow-up at 4 time periods up to 24 months <u>Measures:</u> ▪ Depression - Geriatric Depression Scale (GDS) ▪ Grief – Texas Revised Inventory of Grief (TRIG) <u>Intrapersonal Resources:</u> ▪ Self-esteem (Rosenberg self-esteem scale) ▪ Life satisfaction (Life Satisfaction Index (LSI – Neugarten) ▪ Competency scale of 9 scale items – self perceived adaptation & resiliency – life transitions	Intrapersonal resources were more influential than self-help group in reducing negative effects of spousal bereavement. Baseline depression was explained mostly (73.3% variance) by life satisfaction (β = 1.49), competencies (β = −.27), and self esteem (β = −.270) [*P* < .001]

Study Group Intervention	Analysis	Outcomes – Scales	Results
Rosen and Rosen 1982 (33) Conducted in Georgia Group meeting for seniors (N = 68) at senior citizen centres Seniors in need of mental health services versus 2 control groups: Group 1 – those at centre not needing MH services (N = 31) Group 2 – those from centres without MH services (N = 22) Objective: To improve life situation in those displaying a decline in overall functioning – measured by 3 constructs	χ^2, McNemar trend test	At 15-month follow-up: Multidimensional Functional Assessment – Older Americans Resources & Services (OARS) 146 items in16 functional areas, measures of social isolation, activity, and morale	No significant changes over time in either control group Test Group: ↑ Activities ▪ Household 2+ hours/day (18%–37% vs. 6% –7% [χ^2= 5.33, *P* < .05]) ▪ Wants to do more (χ^2= 5.45, *P* < .01) ▪ Attends socials [20%–56% vs. 47%–39% (χ^2 = 6.55, *P* < .01)] ↑ Morale ▪ ↑ Mood (χ^2= 5.10, P < .05) ▪ ↑ Feelings (χ^2= 30.25, P < .001) ▪ ↓ Seldom/never lonely (24%–44% vs. 44%–22% [χ^2= 6.76; *P* < .01]) At baseline, mobility differences between groups, variation in car ownership: NMH (32%), UMH (28%), TMH (6%)

*↓ indicates decrease ↑, increase; χ^2.= chi-squared test; ANCOVA, analysis of covariance; ANOVA, analysis of variance; BP, blood pressure; CIT, community intervention trial; MANOVA, multivariate analysis of variance; MH, mental health; NMH, not needing mental health services; NS, not significant; RCT, randomized controlled trial; SD, standard deviation; SE, standard error; SF-36, Rand Medical Outcomes Study short form; TMH, treated with mental health services; UCLA, University of California, Los Angeles; UMH, unmet mental health services.

Table 2: Technology-Assisted Interventions

Study Group Intervention	Analysis	Outcomes – Scale	Results
Morrow-Howell et al. 1998 (22) Study conducted in St. Louis Link-Plus: a social worker run crisis phone line serving elderly persons at risk of suicide. Consecutive referred cases, after crisis intervention, systematic assignment to treatment and wait list control group. (N = 61) Demonstration project ▪ Objective: To assist clients to access community mental health services. Focus on ↓ depressive symptoms ▪ ↓ unmet ADL needs ▪ ↑ socialization	T-Test ANCOVA ANOVA on each outcome, dependent variable: depressive symptoms, unmet ADLs, social isolation, regressed on pretest covariate, and independent variable (group assignment)	At 4 months: ▪ Geriatric Depression 15-item Scale (GDS) ▪ Multidimensional Functional assessment (OARS) ▪ 4 measures of social isolation – satisfaction with socialization, telephone contact, in-person contact, frequency of loneliness	T-Test ANCOVA ↓ Depression (5.20 vs. 6.59 [t = 1.78, *P* = .04]) Group assign 4% variance ↑ In-person contact (2.09 vs. 1.57 [t = 2.44, *P* = .01]) Group assign 9% variance (NS) Unmet needs (*P* = .17) (NS) Satisfaction with socialization (*P* = .08) (NS) loneliness (*P* = .36)
Heller et al. 1991 (23) Study conducted in Indiana Friendly interviewer staff contact for 10 weeks followed by peer telephone dyads for 30-week study period Objective: to increase social network and social supports through phone friendships	ANOVA Primary outcomes: perceived social support and mental health	At 6 months: ▪ Perceived Social Support Scale friends (PSS-FR) and Family (PSS-FA) ▪ Morale Philadelphia Geriatric Morale Center (17-item) Scale ▪ Depression – (CES-D 20-item scale) ▪ Loneliness – 7-item scale (Paloutzian scale) ▪ Physical health – 20-item scale revised scale (Belloc scale) ▪ ADL – 15 item Fillenbaum scale ▪ Network embeddedness – number of ties and frequency of interactions, weekly, globally, friends & family	No significant differences in social support or mental health changes over groups for either intervention Of the 1314 approached, 685 (52%) refused initial in-home assessment (social life and health) After the study, 71% of dyads were still in contact Those still in dyad contact (compared with those not) received more emotional support (*P* < .001) and had more positive dyad reports (*P* < .001) Those that continued in dyads differed at baseline – perceived friend support (*P* <. 04), greater number of friends (*P* < .04), and higher ADL score (*P* < .03)

Study Group Intervention	Analysis	Outcomes – Scale	Results
Tesch-Romer et al. 1997 (34) Study conducted in Germany Hearing aid Cohort mild–moderate (> 30 dB in at least 1 frequency 0.5, 1, 2, or 3 KHz in better ear) hearing loss aided (n = 70), versus 2 control groups – hearing loss unaided (n = 42) and normal hearing (n = 28) with diary & 6-month follow-up Objective: impact of hearing aid on 5 dependent variables: communication, social integration, well-being, cognitive capacity, functional impairment	MANOVA with replicated matched subsamples group comparisons Hierarchical regression analyses – predict dependent variables at follow-up by baseline scores 2-month hearing diary	At 6-month follow-up: ▪ Hearing Aid Handicap Inventory (HHIE) – scales measuring social and emotional problems with hearing handicap ▪ Social activities – list 14 activities/importance ▪ Social relations – UCLA loneliness scale; satisfaction with social support – German Social Support Scale ▪ Psychosomatic well-being – emotional well-being (PANAS) ▪ CES Depression Scale ▪ Cognition – speed, fluency, and vocabulary	ANOVA ↑ Communication (HHIE) (F = 24.56, *P* < .01, n = 140) ↓ Loneliness and social support (UCLA 30.8 [7.9] to 28.8 [7.4], F = 6.34, *P* < .01, n = 50) (NS) Psychosomatic well-being (affect, depressive & psychosomatic symptoms) (NS) Cognition
Brennan et al. 1995 (25) Study conducted in Cleveland Intervention provides information, communication and decision support Objective: Loss of companionship and support of partner facing social isolation and having to make new and complex decisions Relationship of modifying variables	ANOVA repeated measures	At 1 year: ▪ Decision-making confidence 14-item scale (Saunders et al.) and skill (investigator) ▪ Social isolation (IESS - Instrumental and Expressive Social Support 27-item scale) ▪ Caregiver burden (Impact of Care Giving Scale – 4 domains emotions, social relationships, family relationships, and physical health) ▪ Depression (20 item CES-D scale) Service use exploration	ANOVA Decision confidence (51.9–56.8 vs. 54.7–54.7 [F= 9.73, *P* < .01]) (NS) Decision making (F = 1.69, *P* = .20) (NS) Social Isolation (62.7–62.6 vs. 63.4–65.0 [F = 0.43, *P* = .51])
Winter and Gitlin 2007 (35) Study conducted in Philadelphia Professionally-led telephone support (telesupport) groups 103 family CGs randomized to support groups of 5 for 1 hour/week Objective: To provide a supportive social network that would increase social support and reduce depression and burden among female CGs of persons with dementia	ANCOVA Group effect managed by cluster variable Dependent variables (CG burden, depression, gains) Covariates were baseline values of dependent variables. Treatment group and age were independent	At 6 months: ▪ CG burden 22-item Zarit burden scale (range 0–88) ▪ Depression CES 20-item Scale (range 0–16) ▪ GAINS (Gains Through Group Involvement 6-item scale, range (0–18) [Knowing what to do when lonely, how to handle the blues, how to handle stress, how to find health care or other resources, ability to deal with family relationships]	No significant main effects CES-D [F = 4.58, *P* = .121] CG burden [F = 0.46, *P* = .490] Gains [F = 0.073, *P* = .932] Significant age × depression interaction: greater depression in older (≥ 65 y) women versus younger (< 65 y) women) [F = 6.26, *P* = .014] 4-point depression (16.1 vs. 20.0, *P* = .014)

*↓ indicates decrease; ↑, increase; ADL, activities of daily living; ANCOVA, analysis of covariance; ANOVA, analysis of variance; CES, Center Epidemiologic Studies; CES-D, Center Epidemiologic Studies Depression Scale; CG, caregiver; MANOVA, multivariate analysis of variance; NS, not significant. UCLA, University of California, Los Angeles.

References

(1) Bowling A. The most important things in life. Int J Health Sci 1995; 5:169-75.

(2) O'Boyle CA, McGee H, Hickey A. Reliability and validity of judgement analysis as a method of assessing quality of life. Br J Clin Pharmacol 1989; 27:155.

(3) Victor C, Scambler S, Bond J, Bowling A. Being alone in later life: loneliness, social isolation and living alone. Rev Clin Gerontol 2000; 10:407-17.

(4) Wenger GC, Davies R, Shatahmasebi S, Scott A. Social isolation and loneliness in old age: review and model refinement. Ageing Soc 1996; 16:333-58.

(5) Sarason IG, Sarason BR. Loneliness research: basic concepts and findings. In: Sarason IG, Sarason BR, editors. Social support: theory, research and applications. Boston: Martinus Niijhoff; 1985. 269-286.

(6) Cohen-Mansfield J, Parpura-Gill A. Loneliness in older persons: a theoretical model and empirical findings. Int Psychogeriatr 2007; 19(2):279-94.

(7) Cranswick K, Thomas D. Elder care and the complexities of social networks. Canadian social trends 2005; 77(Summer):10-5.

(8) 2002 General social survey cycle 16: aging and social support - tables. Ottawa (Canada): Statistics Canada; [updated 2003; cited 2008 May 5]. Available from: http://dsp-psd.tpsgc.gc.ca/Collection/Statcan/89-583-X/89-583-XIE2003001.pdf

(9) Landi F, Onder G, Cesari M, Barillaro C, Lattanzio F, Carbonin PU et al. Comorbidity and social factors predicted hospitalization in frail elderly patients. J Clin Epidemiol 2004; 57(8):832-6.

(10) Trottier H, Martel L, Houle C, Berthelot J, Legare J. Living at home or in an institution: what makes the difference for seniors? Health Reports 2000; 11(4):49-61.

(11) Locher JL, Ritchie CS, Roth DL, Baker PS, Bodner EV, Allman RM. Social isolation, support, and capital and nutritional risk in an older sample: ethnic and gender differences. Soc Sci Med 2005; 60(4):747-61.

(12) Bowling A. Social networks and social support among older people and implications for emotional well-being and psychiatric morbidity. Int Rev Psychiatry 1994; 6(1):41-58.

(13) Prince MJ, Harwood RH, Blizard RA, Thomas A, Mann AH. Social support deficits, loneliness and life events as risk factors for depression in old age. The Gospel Oak Project V1. Psychol Med 1997; 27(2):323-32.

(14) Wenger GC. Social networks and the prediction of elderly people at risk. Aging Ment Health

1997; 1(4):311-20.

(15) Russell DW, Cutrona CE, de la Mora A, Wallace RB. Loneliness and nursing home admission among rural older adults. Psychol Aging 1997; 12(4):574-89.

(16) Steinbach U. Social networks, institutionalization, and mortality among elderly people in the United States. J Gerontol 1992; 47(4):S183-S190.

(17) Rockwood K, Howlett SE, MacKnight C, Beattie BL, Bergman H, Hebert R et al. Prevalence, attributes, and outcomes of fitness and frailty in community-dwelling older adults: Report from the Canadian Study of Health and Aging. J Gerontol A Biol Sci Med Sci 2004; 59(12):1310-7.

(18) Participation and activity limitation survey 2006: analytical report. Statistics Canada; [updated 2007 Dec; cited 2008 Jun 4]. Available from: http://www.statcan.ca/english/freepub/89-628-XIE/89-628-XIE2007002.pdf

(19) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490-8.

(20) Findlay RA. Interventions to reduce social isolation amongst older people: where is the evidence? Ageing Soc 2003; 23:647-58.

(21) Cattan M, White M, Bond J, Learmouth A. Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. Ageing Soc 2005; 25:41-67.

(22) Morrow-Howell N, Becker-Kemppainen S, Judy L. Evaluating an intervention for the elderly at increased risk of suicide. Res Soc Work Pract 1998; 8(1):28-46.

(23) Heller K, Thompson MG, Trueba PE, Hogg JR, Vlachos-Weber I. Peer support telephone dyads for elderly women: was this the wrong intervention? Am J American Psychol 1991; 19(1):53-74.

(24) Andersson L. Intervention against loneliness in a group of elderly women: an impact evaluation. Soc Sci Med 1985; 20(4):355-64.

(25) Brennan PF, Moore SM, Smyth KA. The effects of a special computer network on caregivers of persons with Alzheimer's disease. Nurs Res 1995; 44(3):166-72.

(26) LaVeist TA, Sellers RM, Elliot Brown KA, Nickerson KJ. Extreme social isolation, use of community-based senior support services and mortality among African American elderly women. Am J American Psychol 1997; 25(5):721-32.

(27) White H, McConnell E, Clipp E, Branch LG, Sloane R, Pieper C et al. A randomized controlled trial of the psychosocial impact of providing internet training and access to older adults. Aging Ment Health 2002; 6(3):213-21.

(28) Florio ER, Rockwood TT, Hendryx TH, Jensen MS, Raschko R, Dyck DG. A model gatekeeper program to find the at-risk elderly. J Case Manag 1996; 5(3):106-14.

(29) Arnetz BB, Theorell T. Psychological, sociological and health behavior aspects of a long term activation programme for institutionalized elderly people. Soc Sci Med 1983; 17(8):449-56.

(30) Caserta MS, Lund D. Intrapersonal resources and the effectiveness of self-help groups for bereaved older adults. Gerontologist 1993; 33(5):619-29.

(31) Hopman-Rock M, Westoff MH. Development and evaluation of "aging well and healthy": a health-education and exercise program for community-living older adults. J Aging Phys Act 2002; 10:364-81.

(32) McAuley E, Blissmer B, Marquez DX, Jerome GJ, Kramer AF, Katula J. Social relations, physical activity and well being in older adults. Prev Med 2000; 31(5):608-17.

(33) Rosen CE, Rosen S. Evaluating an intervention program for the elderly. Community Ment Health J 1982; 18(1):21-33.

(34) Tesch-Romer C. Psychological effects of hearing aid use in older adults. J Gerontol B Psychol Sci Soc Sci 1997; 52(3):127-38.

(35) Winter L, Gitlin LN. Evaluation of a telephone-based support group intervention for female caregivers of community-dwelling individuals with dementia. Am J Alzheimers Dis Other Demen 2007; 21(6):391-7.

(36) Goodman C. Literature searching and evidence interpretation for assessing health care practices. Sweden: The Swedish Council on Technology Assessment in Health Care; 1993

(37) Yesavage JA, Brink TL, Rose RL, Lum O, Huang V, Adey M et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 1983; 17(1):37-49.

(38) Radloff LS. The CES-D Scale; A self-report depression scale for research in the general population. Appl Psych Meas 1977; 1(3):385-401.

(39) Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). Conceptual framework and item selection. Med Care 1992; 30(6):473-83.

(40) Fillenbaum GG. Screening the elderly. A brief instrumental activities of daily living measure. J Am Geriatr Soc 1985; 33(10):698-706.

(41) Procidano ME, Heller K. Measures of perceived social support from friends and from family: three validation studies. Am J Community Psychol 1983; 11(1):1-24.

(42) Ensel W, Woelfel M. Measuring the instrumental and expressive functions of social support. In: Lin N, Dean A, Ensel W, editors. Social support, life events and depression. Orlando, Fl: Academic Press; 1986. 129-152.

(43) Thompson MG, Heller K. Facets of support related to well-being: quantitative social isolation and perceived family support in a sample of elderly women. Psychol Aging 1990; 5(4):535-44.

(44) Cutrona C, Russell D. The provisions of social relationships and adaptation to stress. In: Jones WH, Perlman D, editors. Advances in personal relationships. Greenwich Ct: JIA Press; 1987. 37-67.

(45) Russell D, Peplau LA, Cutrona CE. The revised UCLA Loneliness Scale: concurrent and discriminant validity evidence. J Pers Soc Psychol 1980; 39(3):472-80.

(46) De Jong GJ, Van TT. A shortened scale for overall, emotional and social loneliness. [Dutch]. Tijdschrift voor Gerontologie en Geriatrie 2008; 39(1):4-15.

(47) Fillenbaum G. Multidimensional functinal assessment of older adults; the Duke Older Americans Resources and Services procedures. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.

(48) Ventry I, Weinstein B. The hearing handicap inventory for the elderly: a new tool. Ear Hear 1982; 3(3):128-34.

(49) Bedard M, Molloy DW, Squire L, Dubois S, Lever JA, O'Donnell M. The Zarit burden interview: a new short version and screening version. Gerontologist 2001; 41(5):652-7.

(50) Poulshock S, Deimling G. Families caring for elders in residence: issues in the measurement of burden. J Gerontol 1984; 39(2):230-9.

(51) Kaye LW. Assessing the efficacy of a self-help support group program for older women. J Women Aging 1995; 7(4):11-30.

(52) Shea S, Weinstock RS, Starren J, Teresi J, Palmas W, Field L et al. A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus. J Am Med Inform Assoc 2006; 13(1):40-51.

(53) Johnson DE, Ashton C. Effects of computer-mediated communication on social support and loneliness for isolated persons with disabilities. American Journal of Recreation Therapy 2003; 2(3):23-32.

(54) Arnaert A, Delesie L. Effectiveness of video-telephone nursing care for the homebound elderly. Can J Nurs Res 2007; 39(1):20-36.

(55) Smith GE, Lunde AM, Hathaway JC, Vickers KS. Telehealth home monitoring of solitary persons with mild dementia. Am J Alzheimers Dis Other Demen 2007; 22(1):20-6.

(56) Nakamura K, Takano T, Akao C. The effectiveness of videophones in home healthcare for the elderly. Med Care 1999; 37(2):117-25.

(57) Bochel C, Bochel H, Page D. Housing: the foundation of community care. Health Soc Care Community 1999; 7(6):492-501.

(58) Balfour JL, Kaplan GA. Neighborhood environment and loss of physical function in older adults; evidence from the Alameda County study. Am J Epidemiol 2002; 155(6):507-15.

(59) Iwarsson S, Wahl H, Nygren C, Oswald F, Sixsmith A, Sixsmith J et al. Importance of the home environment for healthy aging: conceptual and methodological background of the European ENABLE - AGE Project. Gerontologist 2007; 47(1):78-84.

(60) Oswald F, Wahl H, Schilling O, Nygren C, Fange A, Sixsmith A et al. Relationship between housing and healthy aging in very old age. Gerontologist 2007; 47(1):96-107.

(61) Population by sex and age group, by province and territory. Statistics Canada; [updated 2007 Nov 29; cited 2008 May 5]. Available from: http://www40.statcan.ca/l01/cst01/demo31a.htm

(62) Barnett A, Smith B, Lord SR, Williams M, Baumand A. Community-based group exercise improves balance and reduces falls in at-risk older people: A randomized controlled trial. Age Ageing 2003; 32(4):407-14.

(63) Occupational therapy: fee schedule. Workplace Safety and Insurance Board; [updated 2008 Feb 25; cited 2008 Aug 8]. Available from: http://www.wsib.on.ca/wsib/wsibobj.nsf/LookupFiles/DownloadableFileOccupationalTherapy/$File/2752A.pdf

(64) Physiotherapy: fee schedule. Workplace Safety and Insurance Board; [updated 2008 Feb 25; cited 2008 Aug 8]. Available from: http://www.wsib.on.ca/wsib/wsibobj.nsf/LookupFiles/DownloadableFilePhysiotherapy/$File/2714A.pdf

(65) Alberta Learning Information Service. Alberta occupational profiles [Internet]. Alberta Government; [updated 2008; cited 2008 Oct 6]. Available from: http://www.alis.gov.ab.ca/occinfo/Content/RequestAction.asp?format=html&aspAction=GetTitleSearch&Page=TitleSearch

(66) Information Services Group. Long-term care home system report as of March 31, 2007. Toronto, ON: Ministry of Health and Long-Term Care; Long-Term Care Planning and Renewal Branch; 2007

(67) Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E et al. Tai chi and fall reductions in older adults: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60(2):187-94.

Ontario Health Technology Assessment Series 2008; Vol. 8, No. 6

The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)

October 2008

Ontario

Medical Advisory Secretariat
Ministry of Health and Long-Term Care

Suggested Citation

This report should be cited as follows:

Medical Advisory Secretariat. The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR). *Ontario Heath Technology Assessment Series* 2008;8(6).

Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to MASinfo.moh@ontario.ca.

How to Obtain Issues in the Ontario Health Technology Assessment Series

All reports in the *Ontario Health Technology Assessment Series* are freely available in PDF format at the following URL: www.health.gov.on.ca/ohtas.

Print copies can be obtained by contacting MASinfo.moh@ontario.ca.

Conflict of Interest Statement

All analyses in the Ontario Health Technology Assessment Series are impartial and subject to a systematic evidence-based assessment process. There are no competing interests or conflicts of interest to declare.

Peer Review

All Medical Advisory Secretariat analyses are subject to external expert peer review. Additionally, the public consultation process is also available to individuals wishing to comment on an analysis prior to finalization. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Contact Information

The Medical Advisory Secretariat
Ministry of Health and Long-Term Care
20 Dundas Street West, 10th floor
Toronto, Ontario
CANADA
M5G 2N6
Email: MASinfo.moh@ontario.ca
Telephone: 416-314-1092

ISSN 1915-7398 (Online)
ISBN 978-1-4249-8016-1 (PDF)

About the Medical Advisory Secretariat

The Medical Advisory Secretariat is part of the Ontario Ministry of Health and Long-Term Care. The mandate of the Medical Advisory Secretariat is to provide evidence-based policy advice on the coordinated uptake of health services and new health technologies in Ontario to the Ministry of Health and Long-Term Care and to the healthcare system. The aim is to ensure that residents of Ontario have access to the best available new health technologies that will improve patient outcomes.

The Medical Advisory Secretariat also provides a secretariat function and evidence-based health technology policy analysis for review by the Ontario Health Technology Advisory Committee (OHTAC).

The Medical Advisory Secretariat conducts systematic reviews of scientific evidence and consultations with experts in the health care services community to produce the *Ontario Health Technology Assessment Series.*

About the Ontario Health Technology Assessment Series

To conduct its comprehensive analyses, the Medical Advisory Secretariat systematically reviews available scientific literature, collaborates with partners across relevant government branches, and consults with clinical and other external experts and manufacturers, and solicits any necessary advice to gather information. The Medical Advisory Secretariat makes every effort to ensure that all relevant research, nationally and internationally, is included in the systematic literature reviews conducted.

The information gathered is the foundation of the evidence to determine if a technology is effective and safe for use in a particular clinical population or setting. Information is collected to understand how a new technology fits within current practice and treatment alternatives. Details of the technology's diffusion into current practice and input from practicing medical experts and industry add important information to the review of the provision and delivery of the health technology in Ontario. Information concerning the health benefits; economic and human resources; and ethical, regulatory, social and legal issues relating to the technology assist policy makers to make timely and relevant decisions to optimize patient outcomes.

If you are aware of any current additional evidence to inform an existing evidence-based analysis, please contact the Medical Advisory Secretariat: MASinfo.moh@ontario.ca. The public consultation process is also available to individuals wishing to comment on an analysis prior to publication. For more information, please visit http://www.health.gov.on.ca/english/providers/program/ohtac/public_engage_overview.html.

Table of Contents

List of Tables

List of Figures

Abbreviations

CI	Confidence interval
ED	Emergency Department
FEMOR	Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over
GRADE	Grading of Recommendation Assessment, Development, and Evaluation
ICD	International Classification of Disease
ICER	Incremental cost-effectiveness ratio
INAHTA	International Agency for Health Technology Assessment
LTC	Long-term care
PATH	Program for Assessment of Technology in Health
RCT	Randomized controlled trial
RR	Relative risk

Economic Analysis

In early August 2007, the Medical Advisory Secretariat began work on the Aging in the Community project, an evidence-based review of the literature surrounding healthy aging in the community. The Health System Strategy Division at the Ministry of Health and Long-Term Care subsequently asked the secretariat to provide an evidentiary platform for the ministry's newly released Aging at Home Strategy.

After a broad literature review and consultation with experts, the secretariat identified 4 key areas that strongly predict an elderly person's transition from independent community living to a long-term care home. Evidence-based analyses have been prepared for each of these 4 areas: falls and fall-related injuries, urinary incontinence, dementia, and social isolation. For the first area, falls and fall-related injuries, an economic model is described in a separate report.

Please visit the Medical Advisory Secretariat Web site, http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html, to review these titles within the Aging in the Community series.

1. *Aging in the Community: Summary of Evidence-Based Analyses*
2. *Prevention of Falls and Fall-Related Injuries in Community-Dwelling Seniors: An Evidence-Based Analysis*
3. *Behavioural Interventions for Urinary Incontinence in Community-Dwelling Seniors: An Evidence-Based Analysis*
4. *Caregiver- and Patient-Directed Interventions for Dementia: An Evidence-Based Analysis*
5. *Social Isolation in Community-Dwelling Seniors: An Evidence-Based Analysis*
6. *The Falls/Fractures Economic Model in Ontario Residents Aged 65 Years and Over (FEMOR)*

Disclaimer: The Medical Advisory Secretariat uses a standardized costing methodology for all of its economic analyses of technologies. The main cost categories and the associated methods from the province's perspective are as follows:

Hospital: Ontario Case Costing Initiative cost data are used for all in-hospital stay costs for the designated International Classification of Diseases-10 (ICD-10) diagnosis codes and Canadian Classification of Health Interventions procedure codes. Adjustments may need to be made to ensure the relevant case mix group is reflective of the diagnosis and procedures under consideration. Due to the difficulties of estimating indirect costs in hospitals associated with a particular diagnosis or procedure, the secretariat normally defaults to considering direct treatment costs only.

Nonhospital: These include physician services costs obtained from the Ontario Schedule of Benefits for physician fees, laboratory fees from the Ontario Laboratory Schedule of Fees, device costs from the perspective of local health care institutions, and drug costs from the Ontario Drug Benefit formulary list price.

Discounting: For all cost-effectiveness analyses, a discount rate of 5% is used as per the Canadian Agency for Drugs and Technologies in Health.

Downstream costs: All costs reported are based on assumptions of utilization, care patterns, funding, and other factors. These may or may not be realized by the system or individual institutions and are often based on evidence from the medical literature. In cases where a deviation from this standard is used, an explanation has been given as to the reasons, the assumptions, and the revised approach. The economic analysis represents an estimate only, based on assumptions and costing methods that have been explicitly stated above. These estimates will change if different assumptions and costing methods are applied for the purpose of developing implementation plans for the technology.

Purpose

The Program for Assessment of Technology in Health (PATH) was commissioned to develop an economic model to predict long-term costs and effects and assess the cost-effectiveness of interventions that prevent falls and fall-related injuries and that thereby keep seniors in the community. The following report summarizes the Falls/Fractures Economic Model in Ontario Residents Aged 65 and Over (FEMOR). This economic analysis was conducted by PATH for the secretariat of the ministry.

The secretariat conducts full evidence-based analyses of health technologies being considered for use in Ontario. These analyses are then presented to the Ontario Health Technology Advisory Committee, whose mandate is to provide evidence-based examination of proposed health technologies in the context of existing clinical practice and provide advice and recommendations to Ontario practitioners and the broader health care system and the ministry.

Background

Several definitions for falls exist in the literature; however, a recently published consensus statement suggested that a fall be defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level." (1)

Although estimates of fall rates vary widely based on the location, age, and living arrangements of the elderly population, it is estimated that each year approximately 30% of community-dwelling individuals aged 65 and older, and 50% of those aged 85 and older will fall. (2-4) Of those individuals who fall, 12% to 42% will have a fall-related injury. (5;6)

In 2005, 12.8% of Ontario's population was aged 65 or older, a figure that is expected to increase by almost 65% by 2031. (7) With more than 1 in 5 Ontarians being 65 or older in 2031, the number of community-dwelling seniors at risk for encountering a fall will dramatically increase, thus increasing the demand for community-based services and the burden on Ontario's health system.

Several cohort studies and meta-analyses have identified falls and fall-related injuries as a strong predictor of admission to an LTC home. (8;9) It has been shown that the risk of LTC home admission is over 5 times higher in seniors who experienced 2 or more falls without injury, and over 10 times higher in seniors who experienced a fall causing serious injury. (10)

Minor injuries such as bruises, abrasions, lacerations, and sprains occur after 44% of falls, (11) while major injuries such as hip and wrist fractures occur after approximately 4% to 5% of falls. (12;13) As individuals age, their ability to use their hands to break a fall and protect their hip is reduced, and

therefore wrist fractures are more common than hip fractures between the ages of 65 and 75, while hip fractures become more prevalent after the age of 75. (14)

Injuries due to falls place a significant burden on the Ontario health system and are the leading cause of injury-related hospital visits (1,201/100,000 population) and emergency department visits (4,821/100,000 population) in Ontarians aged 65 and older. (15) Furthermore, once an individual is admitted into an acute hospital following a fall, their average length of stay is approximately 40% longer than that for all-cause hospitalizations. (16) This highlights not only the severity of injuries due to falls, but also the need for community-based services that will allow a more expedient discharge of elderly individuals back to their homes following a fall-related hospitalization.

Study Question

The objective of this study was to estimate the cost-effectiveness of interventions identified in the systematic review conducted by the Medical Advisory Secretariat (17) for falls in community-dwelling seniors that may be effective in reducing the probability of an elderly person's falling and/or sustaining a fall-related injury and thereby reducing the transition into health care settings (i.e., emergency departments [ED], hospitals, and LTC and rehabilitation facilities), a reduction that will offset costs to the public system.

Types of Evaluation

A cost-effectiveness analysis was conducted in order to report cost per fall avoided between the effective interventions identified through the systematic review versus the base case. Because utilities were not identified in this patient population and differences in health-related quality of life between the interventions have not been demonstrated, a cost-effectiveness analysis was deemed to be appropriate and a cost-utility analysis was ruled out. Because costs varied amongst the interventions, a cost-minimization analysis was also ruled out. Falls avoided was deemed an appropriate denominator of the incremental cost-effectiveness ratio (ICER) since trials used in the analysis assessed the outcome of falls in community-dwelling seniors.

Target Population

The target population of this cost-effectiveness analysis was seniors in the community at risk for falling**.**

Comparators

All effective interventions identified through the systematic review were analyzed. Table 1 shows the interventions, their target population, and respective relative risks (RRs) and confidence intervals (CIs).

Table 1: Effective Interventions Analyzed in the FEMOR Model

Intervention	Target Population	Quality of Trial Evidence	Relative Risk (95% CI)
Exercise (≥6 months)	Males and females at risk of falling	Some heterogeneity in the type of programs/services provided and duration of intervention	0.76 (0.64–0.91)
Environmental modifications	Males and females at high risk of falling (history of at least 1 fall)	Some heterogeneity in the type of programs/services provided and duration of intervention	0.66 (0.54–0.81)
Vitamin D + calcium	Females at risk of falling	Trials assessing mostly women	0.83 (0.73–0.95)
Medication withdrawal	Males and females on psychotropic medications and at risk of falling	One trial of moderate quality and several limitations to implementation	0.34 (0.16–0.74)
Gait-stabilizing device	Mobile males and females at risk of falling	Only 1 trial assessing outdoor falls in mobile seniors	0.42 (0.26–0.92)

CI indicates confidence interval.

For a description of the interventions, patient populations, and quality of trials please refer to the Medical Advisory Secretariat systematic review. (18)

Perspective

The primary analytic perspective was that of the Ministry of Health and Long-Term Care. That is, only direct medical costs were considered.

Literature Search

Studies used in this analysis were randomized controlled clinical trials (RCTs) conducted to assess the effectiveness of interventions to reduce falls in community-dwelling seniors. Please refer to the Medical Advisory Secretariat systematic review for a full description of effectiveness. (19)

A search was performed in OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), The Cochrane Library, and the International Agency for Health Technology Assessment (INAHTA) for studies published between January 2000 and September 2007. The search strategy is detailed in Appendix 1. Furthermore, all studies included in a 2003 Cochrane review published by Gillespie et al. (20) were considered for inclusion in this review.

Abstracts were reviewed, and studies meeting the inclusion criteria outlined below were obtained. Studies were grouped based on intervention type, and data on population characteristics, falls outcomes, and study design were extracted. Reference lists were also checked for relevant studies. Results for each outcome from individual studies were meta-analyzed using fixed-effects models.

Inclusion Criteria

- English language (January 2000–September 2007)
- population of community-dwelling seniors (majority aged 65+)
- study design: RCT, quasi-experimental trial, systematic review, or meta-analysis

Exclusion Criteria

- special populations (e.g., stroke or osteoporosis; however, studies restricted only to women were included);
- studies including a mix of older and younger individuals;
- studies reporting only surrogate outcomes (such as balance or strength improvements); and
- studies whose outcome cannot be extracted for meta-analysis.

Outcomes of Interest

- number of fallers, and
- number of falls resulting in injury/fracture.

Assessment of Quality of Studies

The quality assigned to individual studies was determined using the Medical Advisory Secretariat's adaptation of the Levels of Evidence used by the Centre for Evidence-Based Medicine at the Oxford Centre for Evidence Based Medicine in the United Kingdom. (21) The overall quality of the evidence was examined according to the Grading of Recommendation Assessment, Development, and Evaluation (GRADE) Working Group criteria. (22) As stated by the GRADE Working Group, the following definitions were used in grading the quality of the evidence.

High	Further research is very unlikely to change confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
Low	Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
Very low	Any estimate of effect is very uncertain.

Interventions Identified in Literature

- physical exercise
- vision assessment and referral
- cataract surgery
- environmental modifications
- vitamin D supplements
- vitamin D and calcium supplements
- hormone replacement therapy
- medication withdrawal
- gait-stabilizing devices
- hip protectors
- multifactorial interventions

Summary of Findings

Exercise programs were stratified into targeted programs where the exercise routine was tailored to the individuals' needs and untargeted programs that were identical among subjects. Furthermore, analyses were stratified by exercise program duration (< 6 months and ≥ 6 months) and fall risk of study participants. Similarly, the analyses on the environmental modification studies were stratified by risk.

Low-risk study participants had had no fall in the year prior to study entry, while high-risk participants had had at least 1 fall in the previous year.

A total of 17 studies investigating multifactorial interventions were identified in the literature search. Of these studies, 10 reported results for a high-risk population with previous falls, while 6 reported results for study participants representative of the general population. One study provided stratified results by fall risk, and therefore results from this study were included in each stratified analysis.

Table 2: Summary of Meta-Analyses of Studies Investigating the Effectiveness of Interventions on the Risk of Falls in Community-Dwelling Seniors*

Intervention	RR [95% CI]	GRADE
Exercise programs		
1. Targeted programs		
General population	0.81 [0.67–0.98]	Low
High-risk population	0.93 [0.82–1.06]	High
Short duration	0.91 [0.73–1.13]	High
Long duration	0.89 [0.79–1.01]	Moderate
2. Untargeted programs		
General population	0.78 [0.66–0.91]	Moderate
High-risk population	0.89 [0.72–1.10]	Very low
Short duration	0.85 [0.71–1.01]	Low
Long duration	0.76 [0.64–0.91]	Moderate
3. Combined targeted vs. untargeted programs		
General population	N/A	N/A
High-risk population	0.87 [0.57–1.34]	Moderate
Short duration	1.11 [0.73–1.70]	High
Long duration	0.73 [0.57–0.95]	High
Vision intervention		
Assessment/referral	1.12 [0.82–1.53]	Moderate
Cataract surgery	1.11 [0.92–1.35]	Moderate
Environmental modifications		
Low-risk population	1.03 [0.75–1.41]	High
High-risk population	0.66 [0.54–0.81]	High
General population	0.85 [0.75–0.97]	High
Drugs/Nutritional supplements		
Vitamin D (men and women)	0.94 [0.77–1.14]	High
Vitamin D (women only)	0.55 [0.29–1.08]	Moderate
Vitamin D and calcium (men and women)	0.89 [0.74–1.07]	Moderate
Vitamin D and calcium (women only)	0.83 [0.73–0.95]	Moderate
Hormone replacement therapy	0.98 [0.80–1.20]	Low
Medication withdrawal	0.34 [0.16–0.74]†	Low
Gait-stabilizing device	0.43 [0.29–0.64]‡	Moderate
Multifactorial intervention		
Geriatric screening (general population)	0.87 [0.69–1.10]	Very low
High-risk population	0.86 [0.75–0.98]	Low

*CI indicates confidence interval; N/A, not applicable; RR, relative risk.
†Hazard ratio is reported because RR was not available.
‡The RR for the gait-stabilizing device was adjusted to reflect the general population because the trial reported a RR for outdoor falls only. Risk was adjusted as per rate of outdoor falls for males and females reported in the literature. (23)

Modelling

A Markov model was built and the ICER of effective interventions that reduced the frequency of falls in community-dwelling seniors was determined using TreeAge Pro 2007. Effectiveness was expressed as falls avoided. A fall was defined as an unexpected event in which the participant comes to rest on the

ground, floor, or lower level. (24) Please see the Medical Advisory Secretariat systematic review (25) for details on trials. A clinically important fall was defined as a medical contact for a fall that resulted in either an ED or a hospital visit.

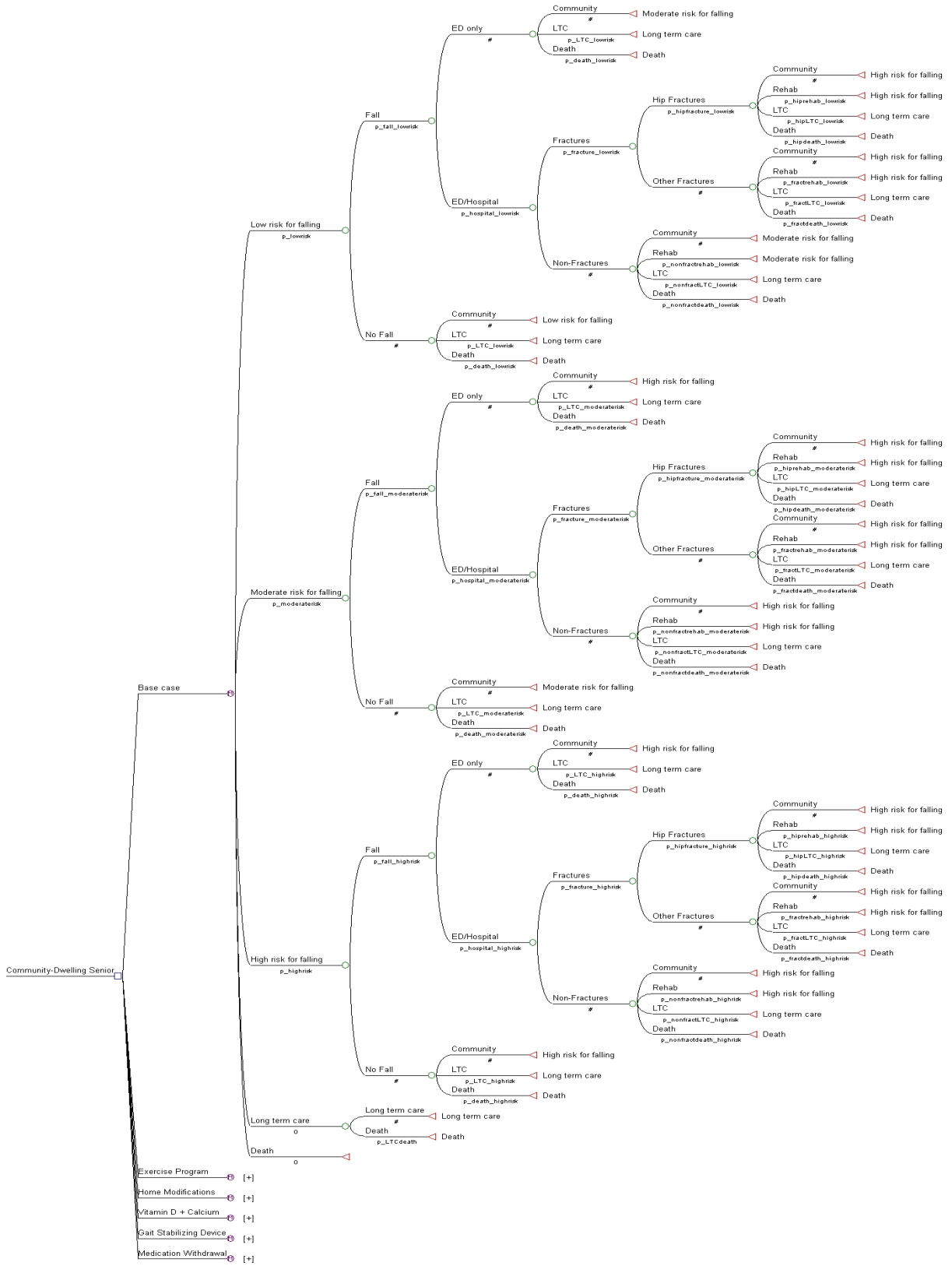
Health states of the model were based on how seniors in the community would transition between health care settings once they experience a clinically important fall that would result in either an ED or hospital visit. They would then transition between the various medical settings according to the risk they were assigned or they would die or move into LTC. They could also transition back into the community.

Figure 1 depicts how cohorts of seniors travel through the FEMOR model. As a senior enters the model, there is a choice of falling or not falling. Once a clinically important fall is experienced, there is a choice of being admitted to hospital or visiting the ED. Hospital admissions occur due to hip fractures, other fractures, and nonfracture injuries. Seniors are then discharged either back to the community, to an LTC facility, or to a rehabilitation centre, or they die in hospital, depending on the severity of their fracture or injury. Seniors may also progress to an LTC facility or die after an ED visit if they did not experience a fall. Please refer to Figure 1 for the progression of clinically important falls in the community into the various medical settings.

The model probabilities are driven by Ontario ministry-specific data. Numbers of clinically important falls and fractures were identified by searching the National Ambulatory Care Reporting System (NACRS) and Discharge Abstract Database (DAD) using International Classification of Disease (ICD) codes for the inclusive period of 2001–2006. The included ICD-9 and ICD-10 codes for falls and fractures are reported in Appendix 2.

To estimate initial proportions of low-, moderate-, and high-risk fallers on April 1, 2007, the frequency of medical contacts (i.e., either an ED or a hospital visit) for previous falls were counted for each senior in the time period of fiscal year 2001/2002 to fiscal year 2006/2007. Note that an ED visit that resulted in a subsequent hospitalization was counted as 1 medical contact for fall. The risk categories were defined as follows: low risk – no previous medical contact for falls; moderate risk – 1 medical contact for a fall with no fracture; high risk – 2 or more medical contacts for falls and/or any medical contact for fractures. Once the numbers of moderate- and high-risk fallers were identified, the low-risk fallers were assumed to be the rest of the community-dwelling seniors obtained by subtracting the number of moderate- and high-risk fallers from the general population (excluding the proportion of seniors in LTC facilities) in Ontario. All numbers were stratified by age and sex. Once numbers were identified, proportions were calculated, and tables by risk, age, and sex were entered in the FEMOR model for estimates of initial proportions of low-, moderate-, and high-risk fallers.

Figure 1: FEMOR Model Structure



To classify falls by risk, previous falls from the time of the fall in question were counted for the remainder of the time period (2001–2006), and cohorts by risk were identified based on the risk definition stated above. If a faller did not have a previous medical contact for a fall, then it was assumed that the fall was a low-risk fall. If a faller had 1 previous medical contact for a fall that did not result in a fracture, then it was assumed that the fall was a moderate-risk fall. If a faller had 2 or more medical contacts for falls and/or any medical contact for fractures, then it was assumed that the fall was a high-risk fall. Note again that an ED visit that resulted in a subsequent hospitalization was counted as 1 medical contact for fall. Approximately 4% of the data had a record for an ED visit that indicated a subsequent hospitalization but for which no hospital discharge abstract could be found. These visits were excluded from the analysis. Once numbers of falls were identified, annual falls rates were calculated by risk and probabilities were assigned to ED and hospital visits. Fractures and injuries were then identified based on the data on falls, and probabilities were assigned to hip fractures, other fractures, and nonfracture injuries and discharges to rehabilitation centres, LTC facilities, and in-hospital deaths. All numbers were stratified by age and sex, and tables by risk, age, and sex were entered in the FEMOR model.

General population rates for admission into LTC (26) (Appendix 3) and mortality (Personal communication, Program for Assessment of Technology in Health, July 2008) (Appendix 4) by age and sex in Ontario were obtained from Statistics Canada (27), and tables were entered in the FEMOR model.

Compliance rates were incorporated into the model to address adherence to the interventions. It was assumed that after a year a certain proportion of the cohort would fail to adhere to the intervention annually. Table 3 describes the compliance rates for each intervention.

Time Horizon

The time horizon of the model was lifetime with an annual time cycle.

Table 3: Compliance Rates Used in the FEMOR Model

Intervention	Annual Compliance Rate, %	Mean Age, y	Reference
Exercise (≥ 6 months)	79.0	77.5	Literature (28)
Environmental modifications	75.7	81.2	Literature (29)
Vitamin D + calcium	81.8	71.0	Literature (30)
Medication withdrawal	53.0	74.6	Literature (31)
Gait-stabilizing device	80.0	74.2	Literature (32)

Note: In order to calculate budgetary impacts for each intervention, several assumptions were made in order to calculate the impacted populations in Ontario:
N was calculated from total population 65+ in Ontario (Appendix 5) (33)
Assumed 4.5% of seniors are in LTC (34)
Exercise program – assumed compliant (79%) (35) mobile seniors in the community with no disability (65.8%) (36) willing to participate in an exercise program (57%) (37)
Environmental modification – assumed compliant (75.7%) (38) frail seniors (49.4%) (39) in the community with a disability (34.2%) (36)
Vitamin D + calcium – assumed compliant (81.8%) (40) senior females in the community with 1 of more risks for fractures (52.9%) (41)
Medication withdrawal – assumed compliant (53%) (42) seniors in the community on psychotropic medications (11.8%) (43) willing to stop their medications (27%) (44)
Gait-stabilizing device – assumed compliant (80%) (45) seniors in the community that are mobile with no disability (65.8%) (36)

Table 4 describes the affected population numbers by sex for each intervention.

Table 4: Affected Population Numbers Used in the Budgetary Impact Analysis

Intervention	Female (N)	Male (N)
Exercise (≥ 6 months)	263,629	203,037
Environmental modifications	113,793	87,639
Vitamin D + calcium	385,012	N/A
Medication withdrawal	15,024	11,571
Gait-stabilizing device	468,362	360,713

N/A indicates not applicable.

Valuing Outcomes

As well as determining the ICER for each intervention compared to the base case, total costs and outcomes for each alternative intervention were determined. Total costs are reported in 2008 Canadian dollars. Outcomes measured were the number of falls avoided, life years, LTC cost, and hospital costs. Utilities were not identified in the literature; therefore, the analysis is based upon reported events, i.e., falls avoided.

Resource Use and Costs

All physician visit costs were obtained from the Ontario Schedule of Physician Benefits (OSB). (46) Hospital costs were obtained from personal contacts within the ministry derived from the Ontario Case Costing Initiative (Personal communication, OCCI; July 2008). Rehabilitation and LTC costs were obtained from ministry reports (Personal communication, Ministry of Health and Long-Term Care, July 2008). All other costs were obtained from published literature or published websites. Please refer to Table 5 for a description of all resources, assumptions, and references used in the FEMOR model.

Table 5: Resource Use in the FEMOR Model*

Resource	Unit	Cost, $ (Cdn)	Assumptions	Reference (Cost; Assumption)
Medical visits				
Internal medicine	1 consult	132.50	Assumed 1 internal medicine consult for hospitalizations	OSB (47); literature (48)
Special orthopedic surgery	1 consult	132.50	Assumed 1 special orthopedic surgery consult for hospitalizations	OSB (49); literature (48)
Physical medicine and rehab	1 consult	149.55	Assumed 1 physical medicine and rehab consult for hospitalizations	OSB (50); literature (48)
Family medicine	1 consult	56.10	Assumed 1 family physician consult when senior goes back into the community	OSB (51); literature (48)
Emergency (ED) doctor visit	ED consult	72.80		OSB (52)
ED visit	Per fall case	110.59	Assumed weighted cost for ED falls	OCCI†
Inpatient hospitalizations				
Injuries	Per fall case	10,865.99	Assumed weighted cost for all injury codes due to a fall excluding fractures	OCCI †
All fractures	Per fall case	10,847.18	Assumed weighted cost for all fracture codes due to a fall excluding hip fractures	OCCI †
Hip fractures	Per fall case	14,146.50	Assumed weighted cost for all hip fractures codes due to a fall	OCCI †
In-hospital most responsible physician (MRP)	Per day	55.45	Assumed a weighted length of stay for each in-hospital stay. Cost of subsequent visit by MRP following admission to hospital	OSB (53)
Follow-up drugs	Per fall case	111.66	Assumed drug follow-up cost for any fall once a senior goes back into the community and sees their family physician	Literature (54)
Rehabilitation program	Per day	571.00	Assumed 21 days for injuries and 48 days for hip and other fractures	MOHLTC (Personal communication, January 2008); literature (48)
Long-term care (LTC)	Per day	133.75	Assumed once a senior enters an LTC facility - remain there for 365 days	MOHLTC (personal communication, January 2008); literature (48)

(continues)

Resource	Unit	Cost, $ (Cdn)	Assumptions	Reference (Cost; Assumption)
Interventions				
Exercise program	Annual	53.18	Assumed 9 people per group - 26 classes with a PT per year	Literature (55)
Physiotherapist (PT)	Per visit	18.41	–	PT fee schedule (56) – code P900
Home modification	Annual	290.74	Assumed 1 OT home visit (2 hours) a year plus the cost of the modifications.	Literature (57)
Occupational therapist (OT)	Per home visit	120.20	–	MOHLTC homecare costs – (Personal communication, May 2008)
Home modifications	Per home visit	50.30	–	Literature (58)
Calcium/Vitamin D	Annual	24.10	Assumed daily intake of vitamin D (1000 IU) plus calcium (1000 mg).	Literature (59)
Calcium	500 mg tablets	0.03	100 tablets of 500 mg each	Website (60)
Vitamin D	1000 IU capsules	0.02	250 capsules of 1000 IU each	Website (61)
Gait-stabilizing device	Per device	29.95	Assumed it is replaced every year	Website; (62) Literature (63)
Medication withdrawal	Annual	50.00	Assumed a pharmacy consult per year.	Website (64)

*ED indicates emergency department; MOH, Ministry of Health and Long-Term Care; OCCI, Ontario Case Costing Initiative; OSB, Ontario Schedule of Benefits.
† indicates personal communication from Ontario Case Costing Initiative.

The ministry perspective included direct medical costs only. Resources used and costs incurred were all derived from Canadian data and assumptions. All costs are presented in 2008 Canadian dollars.

Discounting

Costs and outcomes were discounted at a 5% rate annually as recommended by the Canadian Agency for Drugs and Technologies in Health (CADTH) guidelines. (65) The model is based on an annual cycle.

Reporting

Assuming that all affected individuals, both females and males, adhere to each strategy in the first year and drop out in subsequent years according to the compliance rates reported in the literature, the FEMOR model predicts the lifetime outputs reported in Tables 6 and 7 for females and males, respectively.

Table 6: Female Lifetime Outcomes From the FEMOR Model*

Females	Lifetime Cost per Patient, $	Lifetime Cost Avoided Versus Base Case per Patient, $	Lifetime Falls per Patient	Lifetime Falls Avoided per Patient	Incremental Cost-Effectiveness Ratio	Life Years per Patient
Base case	42,140		0.885			8.798
Exercise program	41,964	176.19	0.874	0.011	Dominant	8.296
Home modification	42,099	41.39	0.873	0.012	Dominant	8.797
Vitamin D + calcium	41,956	183.93	0.875	0.010	Dominant	8.296
Gait-stabilizing device	41,856	284.19	0.869	0.016	Dominant	8.798
Medication withdrawal	42,076	63.91	0.879	0.006	Dominant	8.798

*Costs are in 2008 Canadian dollars.

All strategies in females are dominant, with the gait-stabilizing device strategy providing the highest savings and preventing the most falls.

Table 7: Male Lifetime Outcomes From the FEMOR Model

Males	Lifetime Cost per Patient, $	Lifetime Cost Avoided Versus Base Case per Patient, $	Lifetime Falls per Patient	Lifetime Falls Avoided per Patient	Incremental Cost-Effectiveness Ratio	Life Years per Patient
Base case	19,201		0.554			7.901
Exercise program	19,074	126.56	0.544	0.010	Dominant	7.901
Home modification	19,159	42.07	0.543	0.010	Dominant	7.901
Gait-stabilizing device	19,003	198.16	0.540	0.014	Dominant	7.901
Medication withdrawal	19,141	60.07	0.548	0.005	Dominant	7.901

*Costs are in 2008 Canadian dollars.

All strategies in males are dominant, with the gait-stabilizing device strategy providing the highest savings and preventing the most falls.

Tables 8 and 9 show the potential cost avoided to the public system in terms of hospital and LTC costs with each strategy for females and males, respectively.

Table 8: Female Lifetime Long-Term Care and Hospital Costs From the FEMOR Model

Females	Lifetime Long-Term Cost per Patient, $	Lifetime Long-Term Care Cost Avoided per Patient, $	Lifetime Hospital Cost per Patient, $	Lifetime Hospital Cost Avoided per Patient, $
Base case	37,628		2,010	
Exercise program	37,458	170.64	1,986	23.63
Home modification	37,464	164.74	1,985	24.34
Vitamin D + calcium	37,454	174.55	1,987	22.80
Gait-stabilizing device	37,380	248.26	1,975	34.40
Medication withdrawal	37,552	76.89	1,999	10.91

Costs are in 2008 Canadian dollars.

Table 9: Male Lifetime Long-Term Care and Hospital Costs From the FEMOR Model

Males	Lifetime Long-Term Cost per Patient, $	Lifetime Long-Term Care Cost Avoided per Patient, $	Lifetime Hospital Cost per Patient, $	Lifetime Hospital Cost Avoided per Patient, $
Base case	16,234		1,146	
Exercise program	16,119	114.77	1,126	19.95
Home modification	16,121	112.78	1,125	21.30
Gait-stabilizing device	16,074	160.04	1,118	28.67
Medication withdrawal	16,173	60.94	1,135	10.79

Costs are in 2008 Canadian dollars.

The budgetary impacts in female and male Ontario residents aged ≥65 are provided in Tables 10 and 11, respectively. Based on the affected populations calculated from literature assumptions, the gait-stabilizing device has the highest impact to the Ontario public system in both women and men.

Table 10: Ontario Lifetime Savings in Women Aged ≥65 From the FEMOR Model

Females	Lifetime Cost per Patient, $	Lifetime Cost Avoided per Patient, $	N	Ontario Lifetime Savings, $
Base case	42,140			
Exercise program	41,964	176.19	263,629	46,447,835
Home modification	42,099	41.39	113,793	4,709,528
Vitamin D + calcium	41,956	183.93	385,012	70,815,345
Gait-stabilizing device	41,856	284.19	468,362	133,105,070
Medication withdrawal	42,076	63.91	15,024	960,113

Costs are in 2008 Canadian dollars.

Table 11: Ontario Lifetime Savings in Men Aged ≥65 From the FEMOR Model

Males	Lifetime Cost per Patient, $	Lifetime Cost Avoided per Patient, $	N	Ontario Lifetime Savings, $
Base case	19,201			
Exercise program	19,074	126.56	203,037	25,695,678
Home modification	19,159	42.07	87,639	3,687,375
Gait-stabilizing device	19,003	198.16	360,713	71,479,689
Medication withdrawal	19,141	60.07	11,571	695,026

Costs are in 2008 Canadian dollars.

Detailed reports of model outcomes for each intervention by age are presented in Appendix 6.

Conclusions

High-quality evidence indicates that long-term exercise programs in mobile seniors and environmental modifications in the homes of frail elderly persons are cost-effective in reducing falls in Ontario's elderly population.

A combination of vitamin D and calcium supplementation in elderly women is cost-effective in reducing falls.

The use of outdoor gait-stabilizing devices for mobile seniors during the winter in Ontario is cost-effective in reducing falls; however, evidence is based on 1 trial of moderate quality.

While withdrawal of psychotropic medication may be a cost-effective method for reducing falls, evidence is limited and long-term compliance has been demonstrated to be difficult to achieve.

Acknowledgments

The following individuals contributed to the production of this report:
Kiran Chandra, PATH
Tara Gomes, Medical Advisory Secretariat
Gord Blackhouse, PATH
Kellee Kaulback, PATH
Tanya Khan, Medical Advisory Secretariat
Ilia Ferrusi, PATH
Alan Yoshioka, AY's Edit
Les Levin, Medical Advisory Secretariat
Ron Goeree, PATH

Appendices

Appendix 1: Search Strategies

Search date: October 2, 2007
Databases searched: OVID MEDLINE, MEDLINE In-Process and Other Non-Indexed Citations, EMBASE, CINAHL, Cochrane Library, INAHTA/NHS EED

Database: Ovid MEDLINE(R) <1996 to September Week 3 2007>
Search Strategy:
---

1 exp Accidental Falls/pc [Prevention & Control] (2140)
2 exp Accidental Falls/ (6124)
3 exp Accident Prevention/ or exp Primary Prevention/ or exp risk reduction behavior/ or exp Preventive Health Services/ or exp Preventive Medicine/ (172856)
4 2 and 3 (718)
5 (fall$ adj4 prevent$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (1416)
6 1 or 4 or 5 (2961)
7 limit 6 to (humans and english language and yr="2000 - 2007") (1906)
8 limit 7 to "all aged (65 and over)" (1259)
9 (elder$ or senior$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (71440)
10 7 and (8 or 9) (1292)
11 limit 10 to (controlled clinical trial or meta analysis or randomized controlled trial) (200)
12 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (54569)
13 exp Random Allocation/ or random$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (326025)
14 exp Double-Blind Method/ (48004)
15 exp Control Groups/ (493)
16 exp Placebos/ (8371)
17 RCT.mp. (1998)
18 or/11-17 (366985)
19 10 and 18 (296)

Database: EMBASE <1980 to 2007 Week 39>
Search Strategy:
---

1 exp Falling/pc [Prevention] (2)
2 exp Falling/ (9062)
3 exp prevention/ or exp Preventive Health Service/ or exp Preventive Medicine/ or exp Risk Reduction/ (456395)
4 2 and 3 (1568)
5 (fall$ adj4 prevent$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (2198)

6 1 or 4 or 5 (2963)
7 limit 6 to (human and english language and yr="2000 - 2008") (1351)
8 limit 7 to aged <65+ years> (661)
9 (senior$ or elder$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (115074)
10 8 or 9 (115397)
11 7 and 10 (797)
12 Randomized Controlled Trial/ (149282)
13 exp Randomization/ (24000)
14 exp RANDOM SAMPLE/ (792)
15 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$)).ti,mp. or (published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ab. (76601)
16 Double Blind Procedure/ (66657)
17 exp Triple Blind Procedure/ (8)
18 exp Control Group/ (1007)
19 exp PLACEBO/ (104532)
20 (random$ or RCT).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (386635)
21 or/12-20 (511379)
22 11 and 21 (238)

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to September Week 4 2007>
Search Strategy:
---
1 exp Accidental Falls/pc [Prevention and Control] (2193)
2 exp Accidental Falls/ (4650)
3 exp "FALL PREVENTION (IOWA NIC)"/ (1)
4 exp Preventive Health Care/ (73373)
5 exp SAFETY/ (37546)
6 or/3-5 (109313)
7 2 and 6 (972)
8 1 or 7 (2510)
9 (fall$ adj4 prevent$).mp. [mp=title, subject heading word, abstract, instrumentation] (1057)
10 8 or 9 (2776)
11 limit 10 to (english and yr="2000 - 2007") (1916)
12 random$.mp. or exp RANDOM ASSIGNMENT/ or exp RANDOM SAMPLE/ (60536)
13 RCT.mp. (736)
14 exp Meta Analysis/ (5696)
15 exp "Systematic Review"/ (3320)
16 (meta analy$ or metaanaly$ or pooled analysis or (systematic$ adj2 review$) or published studies or medline or embase or data synthesis or data extraction or cochrane).mp. (19960)
17 exp double-blind studies/ or exp single-blind studies/ or exp triple-blind studies/ (11524)
18 exp PLACEBOS/ (3799)
19 or/12-18 (78869)
20 11 and 19 (222)

Appendix 2: ICD-9 and ICD-10 Codes Included in the FEMOR Model Analysis

ICD-9 Codes for Falls	
ICD-9 Code	**Description**
8800	FALL ON/F STAIRS/STEPS, ESCALATOR
8809	FALL ON/F STAIRS/STEPS, OTH STAIRS/STEPS
8810	FALL ON/F LADDERS/SCAFFOLDING, FALL F LADDER
8811	FALL ON/F LADDERS/SCAFFOLDING, FALL F SCAFFOLDING
8820	FALL F/OUT OF BUILDING/OTHER STRUCTURE
8831	ACCDNTL FALL INTO WELL
8832	ACCDNTL FALL INTO STORM DRAIN/MANHOLE
8839	FALL INTO OTH HOLE/OTHER OPENING IN SURFACE
8840	OTH FALL F ONE LEVEL TO ANOTHER, FALL F PLAYGROUND EQUIPMENT
8841	OTH FALL F ONE LEVEL TO ANOTHER, FALL F CLIFF
8842	OTH FALL F ONE LEVEL TO ANOTHER, FALL F CHAIR/BED
8849	OTH FALL F ONE LEVEL TO ANOTHER, OTH FALL F ONE LEVEL TO ANOTHER
8850	FALL ON SAME LEVEL F SLIPPING, TRIPPING/STUMBLING
8869	FALL ON SAME LEVEL F COLLISION, PUSHING/SHOVING, BY/W OTH PERSON, OTH & UNSPCFD
8880	OTH & UNSPCFD FALL

ICD-10 Codes for Falls	
ICD-10 Code	**Description**
W00	FALL ON SAME LEVEL INVOLVING ICE AND SNOW
W01	FALL ON SAME LEVEL FROM SLIPPING, TRIPPING AND STUMBLING
W03	OTHER FALL ON SAME LEVEL DUE TO COLLISION WITH, OR PUSHING BY, ANOTHER PERSON
W04	FALL WHILE BEING CARRIED OR SUPPORTED BY OTHER PERSONS
W0500	FALL INVOLVING WHEELCHAIR
W0501	FALL INVOLVING ADULT WALKER
W0502	FALL INVOLVING BABY WALKER
W0503	FALL INVOLVING STROLLER/CARRIAGE
W0508	FALL INVOLVING OTHER SPECIFIED WALKING DEVICES
W0509	FALL INVOLVING UNSPECIFIED WALKING DEVICES
W06	FALL INVOLVING BED
W07	FALL INVOLVING CHAIR
W08	FALL INVOLVING OTHER FURNITURE
W09	FALL INVOLVING PLAYGROUND EQUIPMENT
W10	FALL ON AND FROM STAIRS AND STEPS
W11	FALL ON AND FROM LADDER
W12	FALL ON AND FROM SCAFFOLDING
W13	FALL FROM, OUT OF OR THROUGH BUILDING OR STRUCTURE
W14	FALL FROM TREE

W15	FALL FROM CLIFF
W17	OTHER FALL FROM ONE LEVEL TO ANOTHER
W18	OTHER FALL ON SAME LEVEL
W19	UNSPECIFIED FALL

ICD-9 Codes for Fractures (Note that hip fractures are italicized)

ICD-9 Code	Description
8000	FRACTURE OF VAULT OF SKULL, CLOSED WMEN INTRACRANIAL INJURY
8001	FRACTURE OF VAULT OF SKULL, CLOSED W INTRACRANIAL INJURY
8002	FRACTURE OF VAULT OF SKULL, OPEN WMEN INTRACRANIAL INJURY
8003	FRACTURE OF VAULT OF SKULL, OPEN W INTRACRANIAL INJURY
8010	FRACTURE OF BASE OF SKULL, CLOSED WMEN INTRACRANIAL INJURY
8011	FRACTURE OF BASE OF SKULL, CLOSED W INTRACRANIAL INJURY
8012	FRACTURE OF BASE OF SKULL, OPEN WMEN INTRACRANIAL INJURY
8013	FRACTURE OF BASE OF SKULL, OPEN W INTRACRANIAL INJURY
8020	FRACTURE OF FACE BONES, NASAL BONES, CLOSED
8021	FRACTURE OF FACE BONES, NASAL BONES, OPEN
8022	FRACTURE OF FACE BONES, MANDIBLE, CLOSED
8023	FRACTURE OF FACE BONES, MANDIBLE, OPEN
8024	FRACTURE OF FACE BONES, MALAR & MAXILLARY BONES, CLOSED
8025	FRACTURE OF FACE BONES, MALAR & MAXILLARY BONES, OPEN
8026	FRACTURE OF FACE BONES, ORBITAL FLOOR (BLOW-OUT), CLOSED
8027	FRACTURE OF FACE BONES, ORBITAL FLOOR (BLOW-OUT), OPEN
8028	FRACTURE OF FACE BONES, OTH FACIAL BONES, CLOSED
8029	FRACTURE OF FACE BONES, OTH FACIAL BONES, OPEN
8030	OTH & UNQUALIFIED SKULL FRACTURES, CLOSED WMEN INTRACRANIAL INJURY
8031	OTH & UNQUALIFIED SKULL FRACTURES, CLOSED W INTRACRANIAL INJURY
8032	OTH & UNQUALIFIED SKULL FRACTURES, OPEN WMEN INTRACRANIAL INJURY
8033	OTH & UNQUALIFIED SKULL FRACTURES, OPEN W INTRACRANIAL INJURY
8040	MULT FRACTURES INVL SKULL W OTH BONES, CLSD WMEN INTRACRANIAL INJURY
8041	MULT FRACTURES INVL SKULL W OTH BONES, CLSD W INTRACRANIAL INJURY
8042	MULT FRACTURES INVL SKULL W OTH BONES, OPEN WMEN INTRACRANIAL INJURY
8043	MULT FRACTURES INVL SKULL W OTH BONES, OPEN W INTRACRANIAL INJURY
8050	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, CERVICAL, CLOSED
8051	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, CERVICAL, OPEN
8052	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, DORSAL (THORACIC), CLOSED
8053	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, DORSAL (THORACIC), OPEN
8054	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, LUMBAR, CLOSED
8055	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, LUMBAR, OPEN
8056	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, SACRUM & COCCYX, CLOSED
8057	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, SACRUM & COCCYX, OPEN
8058	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, UNSPCFD, CLOSED
8059	FRACTURE OF VERTEBRAL COLUMN WMEN SPINAL CORD LESION, UNSPCFD, OPEN

8060	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, CERVICAL, CLOSED
8061	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, CERVICAL, OPEN
8062	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, DORSAL (THORACIC), CLOSED
8063	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, DORSAL (THORACIC), OPEN
8064	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, LUMBAR, CLOSED
8065	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, LUMBAR, OPEN
8066	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, SACRUM & COCCYX, CLOSED
8067	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, SACRUM & COCCYX, OPEN
8068	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, UNSPCFD, CLOSED
8069	FRACTURE OF VERTEBRAL COLUMN W SPINAL CORD LESION, UNSPCFD, OPEN
8070	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, RIB(S), CLOSED
8071	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, RIB(S), OPEN
8072	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, STERNUM, CLOSED
8073	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, STERNUM, OPEN
8074	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, FLAIL CHEST
8075	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, CHEA, CLOSE
8076	FRACTURE OF RIB(S), STERNUM, LARYNX & TRACHEA, CHEA, OPE
8080	FRACTURE OF PELVIS, ACETABULUM, CLOSED
8081	FRACTURE OF PELVIS, ACETABULUM, OPEN
8082	FRACTURE OF PELVIS, PUBIS, CLOSED
8083	FRACTURE OF PELVIS, PUBIS, OPEN
8084	FRACTURE OF PELVIS, OTH SPCFD PART, CLOSED
8085	FRACTURE OF PELVIS, OTH SPCFD PART, OPEN
8088	FRACTURE OF PELVIS, UNSPCFD, CLOSED
8089	FRACTURE OF PELVIS, UNSPCFD, OPEN
8090	ILL-DEFINED FRACTURES OF TRUNK, FRACTURE OF TRUNK, CLOSED
8091	ILL-DEFINED FRACTURES OF TRUNK, FRACTURE OF TRUNK, OPEN
8100	FRACTURE OF CLAVICLE, CLOSED
8101	FRACTURE OF CLAVICLE, OPEN
8110	FRACTURE OF SCAPULA, CLOSED
8111	FRACTURE OF SCAPULA, OPEN
8120	FRACTURE OF HUMERUS, UPPER END, CLOSED
8121	FRACTURE OF HUMERUS, UPPER END, OPEN
8122	FRACTURE OF HUMERUS, SHAFT/UNSPCFD PART, CLOSED
8123	FRACTURE OF HUMERUS, SHAFT/UNSPCFD PART, OPEN
8124	FRACTURE OF HUMERUS, LOWER END, CLOSED
8125	FRACTURE OF HUMERUS, LOWER END, OPEN
8130	FRACTURE OF RADIUS & ULNA, UPPER END/UNSPCFD PART, CLOSED
8131	FRACTURE OF RADIUS & ULNA, UPPER END/UNSPCFD PART, OPEN
8132	FRACTURE OF RADIUS & ULNA, SHAFT, CLOSED
8133	FRACTURE OF RADIUS & ULNA, SHAFT, OPEN
8134	FRACTURE OF RADIUS & ULNA, LOWER END, CLOSED
8135	FRACTURE OF RADIUS & ULNA, LOWER END, OPEN
8140	FRACTURE OF CARPAL BONE(S), CLOSED

8141	FRACTURE OF CARPAL BONE(S), OPEN
8150	FRACTURE OF METACARPAL BONE(S), CLOSED
8151	FRACTURE OF METACARPAL BONE(S), OPEN
8160	FRACTURE OF ONE/MORE PHALANGES OF HAND, CLOSED
8161	FRACTURE OF ONE/MORE PHALANGES OF HAND, OPEN
8170	MULTIPLE FRACTURES OF HAND BONES, CLOSED
8171	MULTIPLE FRACTURES OF HAND BONES, OPEN
8180	ILL-DEFINED FRACTURES OF UPPER LIMB, CLOSED
8181	ILL-DEFINED FRACTURES OF UPPER LIMB, OPEN
8190	MULT FRACTURES INVL BOTH UPPER LIMBS & UPPER LIMB W RIBS & STERNUM, CLSD
8191	MULT FRACTURES INVL BOTH UPPER LIMBS & UPPER LIMB W RIBS & STERNUM, OPEN
8200	FRACTURE OF NECK OF FEMUR, TRANSCERVICAL FRACTURE, CLOSED
8201	FRACTURE OF NECK OF FEMUR, TRANSCERVICAL FRACTURE, OPEN
8202	FRACTURE OF NECK OF FEMUR, PERTROCHANTERIC FRACTURE, CLOSED
8203	FRACTURE OF NECK OF FEMUR, PERTROCHANTERIC FRACTURE, OPEN
8208	FRACTURE OF NECK OF FEMUR, UNSPCFD PART, CLOSED
8209	FRACTURE OF NECK OF FEMUR, UNSPCFD PART, OPEN
8210	FRACTURE OF OTH & UNSPCFD PARTS OF FEMUR, SHAFT/UNSPCFD PART, CLOSED
8211	FRACTURE OF OTH & UNSPCFD PARTS OF FEMUR, SHAFT/UNSPCFD PART, OPEN
8212	FRACTURE OF OTH & UNSPCFD PARTS OF FEMUR, LOWER END, CLOSED
8213	FRACTURE OF OTH & UNSPCFD PARTS OF FEMUR, LOWER END, OPEN
8220	FRACTURE OF PATELLA, CLOSED
8221	FRACTURE OF PATELLA, OPEN
8230	FRACTURE OF TIBIA & FIBULA, UPPER END/UNSPCFD PART, CLOSED
8231	FRACTURE OF TIBIA & FIBULA, UPPER END/UNSPCFD PART, OPEN
8232	FRACTURE OF TIBIA & FIBULA, SHAFT, CLOSED
8233	FRACTURE OF TIBIA & FIBULA, SHAFT, OPEN
8240	FRACTURE OF ANKLE, MEDIAL MALLEOLUS, CLOSED
8241	FRACTURE OF ANKLE, MEDIAL MALLEOLUS, OPEN
8242	FRACTURE OF ANKLE, LATERAL MALLEOLUS, CLOSED
8243	FRACTURE OF ANKLE, LATERAL MALLEOLUS, OPEN
8244	FRACTURE OF ANKLE, BIMALLEOLAR, CLOSED
8245	FRACTURE OF ANKLE, BIMALLEOLAR, OPEN
8246	FRACTURE OF ANKLE, TRIMALLEOLAR, CLOSED
8247	FRACTURE OF ANKLE, TRIMALLEOLAR, OPEN
8248	FRACTURE OF ANKLE, UNSPCFD, CLOSED
8249	FRACTURE OF ANKLE, UNSPCFD, OPEN
8250	FRACTURE OF CALCANEUS, CLSD
8251	FRACTURE OF CALCANEUS, OPEN
8252	FRACTURE OF OTH TARSAL & METATARSAL BONES, CLSD
8253	FRACTURE OF OTH TARSAL & METATARSAL BONES, OPEN
8260	FRACTURE OF ONE/MORE PHALANGES OF FOOT, CLOSED
8261	FRACTURE OF ONE/MORE PHALANGES OF FOOT, OPEN
8270	OTHER, MULTIPLE & ILL-DEFINED FRACTURES OF LOWER LIMB, CLOSED
8271	OTHER, MULTIPLE & ILL-DEFINED FRACTURES OF LOWER LIMB, OPEN
8280	FRACTURES, BOTH LOWER LIMBS/LOWER W UPPER LIMB/LOWER LIMB W RIB & STERNUM, CLSD

8281	FRACTURES, BOTH LOWER LIMBS/LOWER W UPPER LIMB/LOWER LIMB W RIB & STERNUM, OPEN
8290	FRACTURE OF UNSPCFD BONES, CLOSED
8291	FRACTURE OF UNSPCFD BONES, OPEN

ICD-10 Codes for Fractures (Note that hip fractures are italicized)	
ICD-10 Code	**Description**
S02000	FRACTURE OF VAULT OF SKULL, CLOSED
S02001	FRACTURE OF VAULT OF SKULL, OPEN
S02100	FRACTURE OF BASE OF SKULL, CLOSED
S02101	FRACTURE OF BASE OF SKULL, OPEN
S02200	FRACTURE OF NASAL BONES, CLOSED
S02201	FRACTURE OF NASAL BONES, OPEN
S02300	FRACTURE OF ORBITAL FLOOR, CLOSED
S02301	FRACTURE OF ORBITAL FLOOR, OPEN
S02400	FX MALAR & MAX BONES LEFORT 1 CLSD
S02401	FX MALAR & MAXILLARY BONES LEFORT 1 OPEN
S02410	FX MALAR & MAX BONES LEFORT 2 CLSD
S02411	FX MALAR & MAX BONE LEFORT 2 OPEN
S02420	FX MALAR & MAX BONES CMB MIDFACE CLSD
S02421	FX MALAR & MAX BONES CMB MIDFACE OPEN
S02430	FX MALAR & MAX BONES LEFORT 3 UNIL CLSD
S02431	FX MALAR & MAX BONES LEFORT 3 UNIL OPEN
S02440	FX MALAR & MAX BONES BIL LEFORT 3 CLSD
S02441	FX MALAR & MAX BONES BIL LEFORT 3 OPEN
S02480	OTH FX OF MALAR & MAXILLARY BONES CLOSED
S02481	OTH FX OF MALAR & MAXILLARY BONES OPEN
S02490	UNSPEC FX MALAR & MAXILLARY BONES CLOSED
S02491	UNSPEC FX MALAR & MAXILLARY BONES OPEN
S025	FRACTURE OF TOOTH
S02600	FRACTURE OF MANDIBLE, CLOSED
S02601	FRACTURE OF MANDIBLE, OPEN
S02610	FRACTURE OF RAMUS, CLOSED
S02611	FRACTURE OF RAMUS, OPEN
S02620	FX OF TEMPOROMANDIBULAR JOINT, CLOSED
S02621	FX OF TEMPOROMANDIBULAR JOINT, OPEN
S02670	MULTIPLE MANDIBULAR FRACTURE SITES CLOSD
S02671	MULTIPLE MANDIBULAR FRACTURE SITES OPEN
S02700	MULT FX INV SKULL & FACIAL BONES, CLOSED
S02701	MULT FX INV SKULL & FACIAL BONES OPEN
S02800	FRACTURE OF ALVEOLUS, CLOSED
S02801	FRACTURE OF ALVEOLUS, OPEN
S02810	FRACTURE OF HARD PALATE, CLOSED
S02811	FRACTURE OF HARD PALATE, OPEN
S02890	FX OTH & UNSPEC SKL & FACIAL BONE CLSD
S02891	FX OTH & UNSPEC SKL & FACIAL BONES OPEN
S02900	FX SKL & FACIAL BONES, PART UNSPEC CLSD
S02901	FX SKL & FACIAL BONES PART UNSPEC OPN

S12000	FX OF FIRST CERVICAL VERTEBRA, CLOSED
S12001	FRACTURE OF FIRST CERVICAL VERTEBRA OPEN
S12100	FX OF SECOND CERVICAL VERTEBRA, CLOSED
S12101	FX OF SECOND CERVICAL VERTEBRA OPEN
S12200	FRACTURE OF C3 - C4 VERTEBRA, CLOSED
S12201	FRACTURE OF C3 - C4 VERTEBRA, OPEN
S12210	FRACTURE OF C5 - C7 VERTEBRA, CLOSED
S12211	FRACTURE OF C5 - C7 VERTEBRA, OPEN
S12700	MULTIPLE FX OF CERVICAL SPINE, CLOSED
S12701	MULTIPLE FX OF CERVICAL SPINE, OPEN
S12800	FRACTURE OF OTHER PARTS OF NECK, CLOSED
S12801	FRACTURE OF OTHER PARTS OF NECK, OPEN
S12900	FRACTURE OF NECK, PART UNSPEC CLOSED
S12901	FRACTURE OF NECK, PART UNSPEC OPEN
S22000	FX OF THORACIC VERTEBRA T1 - T6, CLOSED
S22001	FX OF THORACIC VERTEBRA T1 - T6, OPEN
S22010	FX OF THORACIC VERTEBRA T7- T12, CLOSED
S22011	FX OF THORACIC VERTEBRA T7- T12 OPEN
S22090	FX OF UNSPEC THORACIC VERTEBRA, CLOSED
S22091	FX OF UNSPEC THORACIC VERTEBRA, OPEN
S22100	MULT FRACTURES OF THORACIC SPINE, CLOSED
S22101	MULT FRACTURES OF THORACIC SPINE, OPEN
S22200	FRACTURE OF STERNUM, CLOSED
S22201	FRACTURE OF STERNUM, OPEN
S22300	FRACTURE OF RIB, CLOSED
S22301	FRACTURE OF RIB, OPEN
S22400	MULTIPLE FRACTURES OF 2 - 4 RIBS, CLOSED
S22401	MULTIPLE FRACTURES OF 2 - 4 RIBS, OPEN
S22410	MULT FRACTURES OF 5 OR MORE RIBS, CLOSED
S22411	MULT FRACTURES OF 5 OR MORE RIBS, OPEN
S22490	MULT FX OF UNSPEC NUMBER OF RIBS, CLOSED
S22491	MULT FX OF UNSPEC NUMBER OF RIBS OPEN
S22500	FLAIL CHEST, CLOSED
S22501	FLAIL CHEST, OPEN
S22800	FX OF OTHER PARTS OF BONY THORAX, CLOSED
S22801	FX OF OTHER PARTS OF BONY THORAX, OPEN
S22900	FX OF BONY THORAX, PART UNSPEC, CLOSED
S22901	FX OF BONY THORAX, PART UNSPEC, OPEN
S32000	FX OF LUMBAR VERTEBRA, L1 LEVEL, CLOSED
S32001	FX OF LUMBAR VERTEBRA, L1 LEVEL, OPEN
S32010	FX OF LUMBAR VERTEBRA, L2 LEVEL, CLOSED
S32011	FX OF LUMBAR VERTEBRA, L2 LEVEL, OPEN
S32020	FX OF LUMBAR VERTEBRA, L3 LEVEL, CLOSED
S32021	FX OF LUMBAR VERTEBRA, L3 LEVEL, OPEN
S32030	FX OF LUMBAR VERTEBRA, L4 LEVEL, CLOSED
S32031	FX OF LUMBAR VERTEBRA, L4 LEVEL, OPEN
S32040	FX OF LUMBAR VERTEBRA, L5 LEVEL, CLOSED
S32041	FX OF LUMBAR VERTEBRA, L5 LEVEL, OPEN

S32090	FX OF LUMBAR VERTEBRA, UNSPEC LVL CLOSED
S32091	FX OF LUMBAR VERTEBRA, UNSPEC LVL OPEN
S32100	FRACTURE OF SACRUM, CLOSED
S32101	FRACTURE OF SACRUM, OPEN
S32200	FRACTURE OF COCCYX, CLOSED
S32201	FRACTURE OF COCCYX, OPEN
S32300	FRACTURE OF ILIUM, CLOSED
S32301	FRACTURE OF ILIUM, OPEN
S32400	FRACTURE OF ACETABULUM, CLOSED
S32401	FRACTURE OF ACETABULUM, OPEN
S32500	FRACTURE OF PUBIS, CLOSED
S32501	FRACTURE OF PUBIS, OPEN
S32700	MULT FX OF LUMBAR SPINE & PELVIS, CLOSED
S32701	MULT FX OF LUMBAR SPINE & PELVIS, OPEN
S32800	FX OTH/UNSPEC PART LMBR SPN/PELVIS, CLSD
S32801	FX OTH/UNSPEC PART LMBR SPN/PELVIS, OPN
S42000	FX OF STERNAL END OF CLAVICLE, CLOSED
S42001	FX OF STERNAL END OF CLAVICLE, OPEN
S42010	FRACTURE OF SHAFT OF CLAVICLE, CLOSED
S42011	FRACTURE OF SHAFT OF CLAVICLE, OPEN
S42020	FX OF ACROMIAL END OF CLAVICLE, CLOSED
S42021	FX OF ACROMIAL END OF CLAVICLE, OPEN
S42090	FX OF UNSPEC PART OF CLAVICLE, CLOSED
S42091	FX OF UNSPEC PART OF CLAVICLE, OPEN
S42100	FX OF ACROMIAL PROCESS OF SCAPULA CLOSED
S42101	FX OF ACROMIAL PROCESS OF SCAPULA OPEN
S42110	FX OF CORACOID PROCESS OF SCAPULA CLOSED
S42111	FX OF CORACOID PROCESS OF SCAPULA OPEN
S42120	FX GLENOID CAV & NECK OF SCAPULA CLOSED
S42121	FX OF GLENOID CAV & NECK OF SCAPULA OPEN
S42180	FX OF OTHER PART OF SCAPULA, CLOSED
S42181	FRACTURE OF OTHER PART OF SCAPULA, OPEN
S42190	FX OF UNSPEC PART OF SCAPULA, CLOSED
S42191	FX OF UNSPEC PART OF SCAPULA, OPEN
S42200	FX OF SURGICAL NECK OF HUMERUS, CLOSED
S42201	FX OF SURGICAL NECK OF HUMERUS, OPEN
S42210	FX OF ANATOMICAL NECK OF HUMERUS, CLOSED
S42211	FX OF ANATOMICAL NECK OF HUMERUS, OPEN
S42220	FX GREATER TUBEROSITY OF HUMERUS, CLOSED
S42221	FX OF GREATER TUBEROSITY OF HUMERUS OPEN
S42280	FX OTH PART OF UPP END OF HUMERUS CLOSED
S42281	FX OTH PART OF UPP END OF HUMERUS OPEN
S42290	FX UNSPEC PART OF UPP END HUMERUS CLOSED
S42291	FX UNSPEC PART OF UPP END HUMERUS OPEN
S42300	FRACTURE OF SHAFT OF HUMERUS, CLOSED
S42301	FRACTURE OF SHAFT OF HUMERUS, OPEN
S42390	FX OF UNSPECIFIED PART OF HUMERUS CLOSED
S42391	FX OF UNSPECIFIED PART OF HUMERUS, OPEN

S42400	SUPRACONDYLAR FRACTURE OF HUMERUS CLOSED
S42401	SUPRACONDYLAR FRACTURE OF HUMERUS, OPEN
S42410	FX OF LATERAL CONDYLE OF HUMERUS, CLOSED
S42411	FX OF LATERAL CONDYLE OF HUMERUS, OPEN
S42420	FX OF MEDIAL CONDYLE OF HUMERUS, CLOSED
S42421	FX OF MEDIAL CONDYLE OF HUMERUS, OPEN
S42430	FX OF UNSPEC CONDYLE OF HUMERUS, CLOSED
S42431	FX OF UNSPEC CONDYLE OF HUMERUS, OPEN
S42480	FX OTH PART OF LOW END OF HUMERUS CLOSED
S42481	FX OTH PART OF LOW END OF HUMERUS OPEN
S42490	FX UNSPEC PART LOW PART OF HUMERUS CLOSE
S42491	FX UNSPEC PART OF LOW PART HUMERUS OPEN
S42700	MULT FX CLAVICLE SCAPULA & HUMERUS CLOSE
S42701	MULT FX CLAVICLE SCAPULA & HUMERUS OPEN
S42800	FX OTH PART OF SHOULDER & UPP ARM CLOSED
S42801	FX OTH PARTS OF SHOULDER & UPP ARM OPEN
S42900	FX SHOULDER GIRDLE PART UNSPEC CLOSED
S42901	FX SHOULDER GIRDLE PART UNSPEC OPEN
S52000	FX OF OLECRANON PROCESS OF ULNA, CLOSED
S52001	FX OF OLECRANON PROCESS OF ULNA, OPEN
S52010	FX OF CORONOID PROCESS OF ULNA, CLOSED
S52011	FX OF CORONOID PROCESS OF ULNA, OPEN
S52020	MONTEGGIA'S FRACTURE, CLOSED
S52021	MONTEGGIA'S FRACTURE, OPEN
S52080	OTH/MULT FX OF UPPER END OF ULNA, CLOSED
S52081	OTH/MULT FX OF UPPER END OF ULNA, OPEN
S52090	UNSPEC FX OF UPPER END OF ULNA, CLOSED
S52091	UNSPEC FX OF UPPER END OF ULNA, OPEN
S52100	FRACTURE OF HEAD OF RADIUS, CLOSED
S52101	FRACTURE OF HEAD OF RADIUS, OPEN
S52110	FRACTURE OF NECK OF RADIUS, CLOSED
S52111	FRACTURE OF NECK OF RADIUS, OPEN
S52120	FX OF RADIUS W ULNA, UPPER END, CLOSED
S52121	FX OF RADIUS W ULNA, UPPER END, OPEN
S52180	OTH/MULT FX OF UPP END OF RADIUS, CLOSED
S52181	OTH/MULT FX OF UPP END OF RADIUS, OPEN
S52190	UNSPEC FX OF UPP END OF RADIUS, CLOSED
S52191	UNSPEC FX OF UPP END OF RADIUS, OPEN
S52200	FRACTURE OF SHAFT OF ULNA, CLOSED
S52201	FRACTURE OF SHAFT OF ULNA, OPEN
S52300	FRACTURE OF SHAFT OF RADIUS, CLOSED
S52301	FRACTURE OF SHAFT OF RADIUS, OPEN
S52400	FX OF SHAFT OF BOTH ULNA & RADIUS CLOSED
S52401	FX OF SHAFT OF BOTH ULNA & RADIUS OPEN
S52500	COLLES' FRACTURE, CLOSED
S52501	COLLES' FRACTURE, OPEN
S52580	OTHER FX OF LOWER END OF RADIUS, CLOSED
S52581	OTHER FX OF LOWER END OF RADIUS, OPEN

S52590	UNSPEC FX OF LOWER END OF RADIUS, CLOSED
S52591	UNSPECFX OF LOWER END OF RADIUS OPEN
S52600	FX LOW END OF BOTH ULNA & RADIUS CLOSED
S52601	FX LOW END OF BOTH ULNA & RADIUS, OPEN
S52700	MULTIPLE FRACTURES OF FOREARM, CLOSED
S52701	MULTIPLE FRACTURES OF FOREARM, OPEN
S52800	FRACTURE OF OTH PARTS OF FOREARM, CLOSED
S52801	FRACTURE OF OTH PARTS OF FOREARM, OPEN
S52900	FRACTURE OF FOREARM, PART UNSPEC CLOSED
S52901	FRACTURE OF FOREARM, PART UNSPEC OPEN
S62000	FX NAVICULAR (SCAPHOID) BONE HAND CLOSED
S62001	FX NAVICULAR [SCAPHOID] BONE HAND OPEN
S62100	FRACTURE OF LUNATE BONE, CLOSED
S62101	FRACTURE OF LUNATE BONE, OPEN
S62110	FRACTURE OF TRIQUETRAL BONE, CLOSED
S62111	FRACTURE OF TRIQUETRAL BONE, OPEN
S62120	FRACTURE OF PISIFORM BONE, CLOSED
S62121	FRACTURE OF PISIFORM BONE, OPEN
S62130	FRACTURE OF TRAPEZIUM BONE, CLOSED
S62131	FRACTURE OF TRAPEZIUM BONE, OPEN
S62140	FRACTURE OF TRAPEZOID BONE, CLOSED
S62141	FRACTURE OF TRAPEZOID BONE, OPEN
S62150	FRACTURE OF CAPITATE BONE, CLOSED
S62151	FRACTURE OF CAPITATE BONE, OPEN
S62160	FRACTURE OF HAMATE BONE, CLOSED
S62161	FRACTURE OF HAMATE BONE, OPEN
S62180	FRACTURE OF OTHER CARPAL BONES, CLOSED
S62181	FRACTURE OF OTHER CARPAL BONES, OPEN
S62190	FRACTURE OF UNSPEC CARPAL BONES, CLOSED
S62191	FRACTURE OF UNSPEC CARPAL BONES, OPEN
S62200	FX BASE FIRST METACARPAL BONE, CLOSED
S62201	FX BASE FIRST METACARPAL BONE, OPEN
S62210	FX SHAFT FIRST METACARPAL BONE, CLOSED
S62211	FX SHAFT FIRST METACARPAL BONE, OPEN
S62220	FX NECK FIRST METACARPAL BONE, CLOSED
S62221	FX NECK OF FIRST METACARPAL BONE, OPEN
S62270	FX MULT SITE FIRST METACARPAL BONE, CLSD
S62271	FX MULT SITE FIRST METACARPAL BONE, OPEN
S62290	FX UNSP SITE FIRST METACARPAL BONE, CLSD
S62291	FX UNSP SITE FIRST METACARPAL BONE, OPEN
S62300	FX OF BASE OF OTH METACARPAL BONE CLOSED
S62301	FX OF BASE OF OTH METACARPAL BONE OPEN
S62310	FX OF SHAFT OF OTH METACARPAL BONE CLOSE
S62311	FX OF SHAFT OF OTH METACARPAL BONE OPEN
S62320	FX OF HEAD OF OTH METACARPAL BONE CLOSED
S62321	FX OF HEAD OF OTH METACARPAL BONE OPEN
S62370	FX MULT SITE OTH METACARPAL BONE, CLSD
S62371	FX MULT SITE OTH METACARPAL BONE, OPEN

S62390	FX UNSP SITE OTHER METACARPAL BONE, CLSD
S62391	FX UNSP SITE OTHER METACARPAL BONE, OPEN
S62400	MULT FX OF METACARPAL BONES, CLOSED
S62401	MULT FX OF METACARPAL BONES, OPEN
S62500	FRACTURE OF PROXIMAL PHALANX, CLOSED
S62501	FRACTURE OF PROXIMAL PHALANX, OPEN
S62510	FRACTURE OF DISTAL PHALANX, CLOSED
S62511	FRACTURE OF DISTAL PHALANX, OPEN
S62570	FRACTURE OF MULT SITES OF THUMB, CLOSED
S62571	FRACTURE OF MULT SITES OF THUMB, OPEN
S62590	FX OF UNSPEC PART OF PHALANX, CLOSED
S62591	FX OF UNSPEC PART OF PHALANX, OPEN
S62600	FX MID/PROXIMAL PHALANX FINGER, CLSD
S62601	FX MID/PROXIMAL PHALANX FINGER, OPEN
S62610	FX OF DISTAL PHALANX OF FINGER, CLOSED
S62611	FX OF DISTAL PHALANX OF FINGER, OPEN
S62670	FRACTURE OF MULT SITES OF FINGER, CLOSED
S62671	FRACTURE OF MULT SITES OF FINGER, OPEN
S62690	FX UNSPEC PART PHALANX FINGER, CLSD
S62691	FX UNSPEC PART PHALANX FINGER, OPEN
S62700	MULTIPLE FRACTURES OF FINGERS, CLOSED
S62701	MULTIPLE FRACTURES OF FINGERS, OPEN
S62800	FX OTH/ UNSPEC PART WRIST/HAND, CLOSED
S62801	FX OTH/ UNSPEC PART WRIST/HAND, OPEN
S72000	*FX UPP FEMORAL EPIPHYSIS/SEPARATION CLSD*
S72001	*FX UPP FEMORAL EPIPHYSIS/SEPARATION OPN*
S72010	*FX BAS FEM NECK/CERVICOTROCHANTERIC CLSD*
S72011	*FX BAS FEM NECK/CERVICOTROCHANTERIC OPEN*
S72080	*OTHER FRACTURE OF FEMORAL NECK, CLOSED*
S72081	*OTHER FRACTURE OF FEMORAL NECK, OPEN*
S72090	*UNSPEC FRACTURE OF NECK OF FEMUR, CLOSED*
S72091	*UNSPEC FRACTURE OF NECK OF FEMUR, OPEN*
S72100	*INTERTROCHANTERIC FRACTURE, CLOSED*
S72101	*INTERTROCHANTERIC FRACTURE, OPEN*
S72190	*UNSPECIFIED TROCHANTERIC FRACTURE CLOSED*
S72191	*UNSPECIFIED TROCHANTERIC FRACTURE, OPEN*
S72200	*SUBTROCHANTERIC FRACTURE, CLOSED*
S72201	*SUBTROCHANTERIC FRACTURE, OPEN*
S72300	FRACTURE OF SHAFT OF FEMUR, CLOSED
S72301	FRACTURE OF SHAFT OF FEMUR, OPEN
S72400	FX LOW FEM EPIPHYSIS/SEPARATION CLSD
S72401	FX LOW FEM EPIPHYSIS/SEPARATION OPEN
S72410	CONDYLAR FRACTURE OF FEMUR, CLOSED
S72411	CONDYLAR FRACTURE OF FEMUR, OPEN
S72420	SUPRACONDYLAR FRACTURE OF FEMUR, CLOSED
S72421	SUPRACONDYLAR FRACTURE OF FEMUR, OPEN
S72490	UNSPEC FX LOW (DISTAL) END OF FEMUR CLSD
S72491	UNSPEC FX LOW (DISTAL) END OF FEMUR OPEN

S72700	MULTIPLE FRACTURES OF FEMUR, CLOSED
S72701	MULTIPLE FRACTURES OF FEMUR, OPEN
S72800	FRACTURES OF OTHER PARTS OF FEMUR CLOSED
S72801	FRACTURES OF OTHER PARTS OF FEMUR OPEN
S72900	FRACTURE OF FEMUR PART UNSPEC CLOSED
S72901	FRACTURE OF FEMUR PART UNSPECIFIED OPEN
S82000	FRACTURE OF PATELLA, CLOSED
S82001	FRACTURE OF PATELLA, OPEN
S82100	FX UPP END TIBIA W OR W/O FIBULA, CLSD
S82101	FX UPP END TIBIA W OR W/O FIBULA, OPEN
S82200	FX SHAFT TIBIA W OR W/O FIBULA, CLSD
S82201	FX SHAFT TIBIA W OR W/O FIBULA, OPEN
S82300	FX LOW END TIBIA W OR W/O FIBULA, CLSD
S82301	FX LOW END TIBIA W OR W/O FIBULA, OPEN
S82400	FRACTURE OF FIBULA ALONE, CLOSED
S82401	FRACTURE OF FIBULA ALONE, OPEN
S82500	FRACTURE OF MEDIAL MALLEOLUS, CLOSED
S82501	FRACTURE OF MEDIAL MALLEOLUS, OPEN
S82600	FRACTURE OF LATERAL MALLEOLUS, CLOSED
S82601	FRACTURE OF LATERAL MALLEOLUS, OPEN
S82700	MULTIPLE FRACTURES OF LOWER LEG, CLOSED
S82701	MULTIPLE FRACTURES OF LOWER LEG, OPEN
S82800	BIMALLEOLAR FRACTURE OF ANKLE, CLOSED
S82801	BIMALLEOLAR FRACTURE OF ANKLE, OPEN
S82810	TRIMALLEOLAR FRACTURE OF ANKLE, CLOSED
S82811	TRIMALLEOLAR FRACTURE OF ANKLE, OPEN
S82820	TIBIAL PLAFOND FRACTURE CLOSED
S82821	TIBIAL PLAFOND FRACTURE OPEN
S82890	FRACTURE OF ANKLE NOS, CLOSED
S82891	FRACTURE OF ANKLE NOS, OPEN
S82900	FX OF LOWER LEG, PART UNSPEC, CLOSED
S82901	FX OF LOWER LEG, PART UNSPECIFIED, OPEN
S92000	FRACTURE OF CALCANEUS, CLOSED
S92001	FRACTURE OF CALCANEUS, OPEN
S92100	FRACTURE OF TALUS, CLOSED
S92101	FRACTURE OF TALUS, OPEN
S92200	FRACTURE OF NAVICULAR BONE, CLOSED
S92201	FRACTURE OF NAVICULAR BONE, OPEN
S92210	FRACTURE OF CUBOID BONE, CLOSED
S92211	FRACTURE OF CUBOID BONE, OPEN
S92220	FRACTURE OF CUNEIFORM BONE, CLOSED
S92221	FRACTURE OF CUNEIFORM BONE, OPEN
S92290	FRACTURE OF UNSPEC TARSAL BONE, CLOSED
S92291	FRACTURE OF UNSPEC TARSAL BONE, OPEN
S92300	FRACTURE OF METATARSAL BONE, CLOSED
S92301	FRACTURE OF METATARSAL BONE, OPEN
S92400	FRACTURE OF GREAT TOE, CLOSED
S92401	FRACTURE OF GREAT TOE, OPEN

S92500	FRACTURE OF OTHER TOE, CLOSED
S92501	FRACTURE OF OTHER TOE, OPEN
S92700	MULTIPLE FRACTURES OF FOOT, CLOSED
S92701	MULTIPLE FRACTURES OF FOOT, OPEN
S92900	FRACTURE OF FOOT, UNSPECIFIED, CLOSED
S92901	FRACTURE OF FOOT, UNSPECIFIED, OPEN
T0200	FRACTURES INVOLVING HEAD W NECK CLOSED
T0201	FRACTURES INVOLVING HEAD WITH NECK, OPEN
T0210	FX INV THORAX W LOWER BACK PELVIS CLOSED
T0211	FX INV THORAX W LOWER BACK PELVIS OPEN
T0220	FX INV MULT RGN ONE UPPER LIMB CLOSED
T0221	FX INV MULT RGN ONE UPPER LIMB OPEN
T0230	FX INV MULT RGN ONE LOWER LIMB CLOSED
T0231	FX INV MULT RGN ONE LOWER LIMB OPEN
T0240	FX INV MULT REGIONS BOTH UPP LIMBS CLSD
T0241	FX INV MULT REGIONS BOTH UPP LIMBS OPEN
T0250	FX INV MULT REGIONS BOTH LOW LIMBS CLSD
T0251	FX INV MULT REGIONS BOTH LOW LIMBS OPEN
T0260	FX INV MULT REGIONS UPP/LOW LIMB CLOSED
T0261	FX INV MULT REGIONS UPP/LOW LIMB OPEN
T0270	FX THORAX W LOW BACK PELV W LIMB(S) CLSD
T0271	FX THORAX W LOW BACK PELV W LIMBS OPEN
T0280	FRACTURES INV OTH CMB BODY REGIONS CLSD
T0281	FRACTURES INV OTH CMB BODY REGIONS OPEN
T0290	MULTIPLE FRACTURES, UNSPECIFIED, CLOSED
T0291	MULTIPLE FRACTURES, UNSPECIFIED, OPEN
T080	FRACTURE OF SPINE, LEVEL UNSPEC, CLOSED
T081	FRACTURE OF SPINE, LEVEL UNSPEC, OPEN
T100	FX OF UPPER LIMB, LEVEL UNSPEC, CLOSED
T101	FX OF UPPER LIMB, LEVEL UNSPEC, OPEN
T1420	FRACTURE OF UNSPECIFIED BODY REGION CLSD
T1421	FRACTURE OF UNSPECIFIED BODY REGION OPEN

Appendix 3: Residents in Long-Term Care Facilities by Age and Sex in Ontario

Age	Females	Males
All ages	61,845	33,280
Less than 10 years	75	174
10 to 17 years	1,013	1,783
18 to 44 years	2,892	5,597
45 to 64 years	3,702	5,230
65 to 69 years	1,771	1,790
70 to 74 years	3,258	2,447
75 to 79 years	7,004	3,693
80 to 84 years	12,969	4,976
85 years and over	29,161	7,590

*Residents on books on March 31 or at the end of the reporting year.
**More recent data are available in a more current Statistics Canada report; however, trends are similar by age group, and the effect upon the model of slight variations in the numbers would be negligible.
Source: Statistics Canada, 2006, Residential Care Facilities 2003/2004, Catalogue no. 83-237-XIE, Table 4-7, p. 57. (66)

Appendix 4: Life Tables by Age and Sex in Ontario

Females				Males			
Age	p(alive)	p(dead)	Life Expectancy	Age	p(alive)	p(dead)	Life Expectancy
60	0.99413	0.00587	24.72	60	0.99018	0.00982	20.84
61	0.99359	0.00641	23.86	61	0.98915	0.01085	20.04
62	0.99296	0.00704	23.01	62	0.98802	0.01198	19.26
63	0.99226	0.00774	22.17	63	0.98679	0.01321	18.49
64	0.99150	0.00850	21.34	64	0.98549	0.01451	17.73
65	0.99067	0.00933	20.52	65	0.98407	0.01593	16.98
66	0.98975	0.01026	19.70	66	0.98248	0.01752	16.25
67	0.98869	0.01131	18.90	67	0.98070	0.01930	15.53
68	0.98757	0.01243	18.11	68	0.97876	0.02124	14.82
69	0.98638	0.01362	17.34	69	0.97671	0.02329	14.14
70	0.98507	0.01493	16.57	70	0.97445	0.02555	13.46
71	0.98355	0.01645	15.81	71	0.97190	0.02810	12.80
72	0.98177	0.01823	15.07	72	0.96896	0.03104	12.16
73	0.97981	0.02019	14.34	73	0.96571	0.03429	11.53
74	0.97770	0.02230	13.62	74	0.96221	0.03779	10.92
75	0.97533	0.02467	12.92	75	0.95835	0.04165	10.33
76	0.97258	0.02742	12.24	76	0.95401	0.04599	9.76
77	0.96934	0.03066	11.57	77	0.94909	0.05091	9.20
78	0.96576	0.03424	10.92	78	0.94369	0.05631	8.67
79	0.96193	0.03807	10.29	79	0.9379	0.06210	8.16
80	0.95760	0.04240	9.67	80	0.93154	0.06846	7.67
81	0.95252	0.04748	9.08	81	0.92445	0.07555	7.19
82	0.94646	0.05354	8.51	82	0.91647	0.08353	6.74
83	0.93932	0.06068	7.96	83	0.90786	0.09214	6.31
84	0.93128	0.06872	7.44	84	0.89871	0.10129	5.90
85	0.92245	0.07755	6.96	85	0.88865	0.11135	5.50
86	0.91297	0.08703	6.50	86	0.87732	0.12268	5.13
87	0.90296	0.09704	6.07	87	0.86434	0.13566	4.78
88	0.89233	0.10767	5.67	88	0.84996	0.15005	4.45
89	0.88101	0.11899	5.29	89	0.83442	0.16558	4.15
90	0.86912	0.13088	4.94	90	0.81736	0.18264	3.87
91	0.85678	0.14322	4.61	91	0.79840	0.20160	3.63
92	0.84412	0.15588	4.30	92	0.77717	0.22283	3.42
93	0.82913	0.17087	4.00	93	0.77914	0.22086	3.25
94	0.81320	0.18680	3.72	94	0.76133	0.23867	3.03
95	0.79624	0.20376	3.46	95	0.74246	0.25754	2.83
96	0.77823	0.22177	3.22	96	0.72249	0.27751	2.63
97	0.75917	0.24083	2.99	97	0.70142	0.29858	2.45
98	0.73906	0.26094	2.78	98	0.67923	0.32077	2.28
99	0.71791	0.28209	2.58	99	0.65594	0.34406	2.13
100	0.69575	0.30425	2.40	100	0.63154	0.36846	1.98

Statistics Canada: Complete life table, 2000 to 2002.

Appendix 5: Population Census by Age and Sex in Ontario

Age Group	Total	Male	Female
60	124,950	60,990	63,960
61	119,185	58,175	61,005
62	117,940	57,580	60,350
63	113,995	55,515	58,485
64	105,920	51,275	54,645
65	101,270	48,710	52,565
66	95,630	45,780	49,855
67	93,605	44,560	49,040
68	89,490	42,680	46,815
69	86,240	40,915	45,325
70	85,315	40,205	45,110
71	82,505	38,610	43,895
72	78,860	37,085	41,780
73	78,795	36,465	42,335
74	76,470	35,150	41,330
75	75,615	34,495	41,120
76	71,610	32,115	39,495
77	66,475	29,325	37,155
78	64,610	27,960	36,645
79	60,605	25,690	34,915
80	58,275	23,810	34,460
81	54,715	21,680	33,040
82	50,415	19,395	31,020
83	45,550	17,175	28,375
84	41,315	15,180	26,135
85	37,160	13,375	23,785
86	30,880	10,670	20,205
87	22,730	7,405	15,325
88	19,370	6,280	13,085
89	17,050	5,355	11,695
90	14,460	4,305	10,155
91	12,675	3,715	8,960
92	10,015	2,780	7,240
93	7,665	1,995	5,670
94	5,750	1,385	4,365
95	4,280	1,000	3,275
96	3,155	795	2,355
97	2,250	525	1,725
98	1,600	410	1,190
99	1,055	240	815
100 years and over	1,730	315	1,415

Statistics Canada, 2006 Census of Population, Statistics Canada catalogue no. 97-551-XCB2006009.

Appendix 6: Additional Tables by Age

Females – Discounted Lifetime Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Vitamin D + Calcium, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	36,228	35,612	35,615	35,706	35,354	35,511
66	37,885	37,361	37,413	37,424	37,128	37,477
67	39,402	38,979	39,074	39,012	38,776	39,206
68	41,276	40,911	41,031	40,927	40,725	41,172
69	43,126	42,817	42,965	42,819	42,650	43,079
70	45,105	44,844	44,997	44,834	44,693	45,090
71	45,809	45,585	45,748	45,567	45,447	45,812
72	46,600	46,413	46,583	46,387	46,288	46,616
73	47,268	47,115	47,289	47,084	47,005	47,290
74	47,494	47,368	47,544	47,334	47,268	47,521
75	47,700	47,598	47,774	47,561	47,508	47,728
76	48,022	47,941	48,117	47,903	47,861	48,052
77	48,546	48,481	48,655	48,443	48,409	48,577
78	48,954	48,906	49,076	48,869	48,843	48,985
79	47,645	47,609	47,776	47,572	47,552	47,676
80	46,160	46,136	46,298	46,100	46,086	46,190
81	44,914	44,898	45,055	44,865	44,854	44,943
82	43,742	43,734	43,885	43,702	43,694	43,771
83	42,472	42,470	42,614	42,440	42,435	42,499
84	40,014	40,017	40,155	39,990	39,987	40,041
85	37,492	37,500	37,630	37,474	37,474	37,518
86	35,060	35,070	35,194	35,047	35,048	35,084
87	33,107	33,120	33,237	33,099	33,100	33,131
88	30,968	30,982	31,094	30,963	30,964	30,990
89	28,847	28,863	28,968	28,845	28,847	28,869
90	26,779	26,795	26,895	26,779	26,781	26,799
91	24,754	24,771	24,866	24,756	24,758	24,774
92	22,933	22,949	23,040	22,936	22,938	22,951
93	21,124	21,140	21,225	21,128	21,130	21,142
94	19,602	19,617	19,697	19,606	19,608	19,618
95	18,093	18,108	18,184	18,098	18,100	18,109
96	17,061	17,076	17,149	17,066	17,068	17,076
97	15,951	15,965	16,034	16,956	15,958	15,965
98	14,692	14,706	14,771	14,697	14,699	14,709
99	14,032	14,046	14,107	14,037	14,039	14,045
100	13,630	13,643	13,704	13,635	13,637	13,643

Costs are in 2008 Canadian dollars.

Females – Lifetime Falls per Patient per Arm in the FEMOR Model

Age	Base Case	Exercise Program	Home Modification	Vitamin D + Calcium	Gait-Stabilizing Device	Medication Withdrawal
65	1.138	1.096	1.088	1.104	1.081	1.090
66	1.119	1.085	1.079	1.090	1.071	1.092
67	1.096	1.068	1.065	1.072	1.057	1.082
68	1.076	1.053	1.052	1.055	1.044	1.068
69	1.054	1.035	1.035	1.036	1.027	1.049
70	1.031	1.016	1.016	1.017	1.009	1.029
71	1.012	0.999	1.000	0.999	0.993	1.010
72	0.992	0.982	0.983	0.982	0.977	0.992
73	0.968	0.960	0.961	0.959	0.955	0.967
74	0.947	0.940	0.941	0.939	0.936	0.947
75	0.924	0.918	0.919	0.917	0.915	0.923
76	0.900	0.896	0.897	0.895	0.893	0.900
77	0.874	0.871	0.872	0.870	0.868	0.874
78	0.846	0.843	0.843	0.842	0.841	0.846
79	0.820	0.817	0.818	0.817	0.816	0.820
80	0.791	0.789	0.789	0.788	0.787	0.791
81	0.759	0.758	0.758	0.757	0.757	0.759
82	0.727	0.726	0.726	0.725	0.725	0.727
83	0.691	0.690	0.691	0.690	0.690	0.691
84	0.657	0.656	0.656	0.656	0.656	0.657
85	0.622	0.622	0.622	0.621	0.621	0.622
86	0.589	0.589	0.589	0.589	0.589	0.589
87	0.558	0.558	0.558	0.558	0.557	0.558
88	0.529	0.529	0.529	0.529	0.529	0.529
89	0.501	0.501	0.501	0.501	0.501	0.501
90	0.475	0.474	0.475	0.474	0.474	0.475
91	0.449	0.449	0.449	0.449	0.449	0.449
92	0.423	0.423	0.423	0.423	0.423	0.423
93	0.398	0.398	0.398	0.398	0.398	0.398
94	0.373	0.373	0.373	0.373	0.373	0.373
95	0.353	0.352	0.353	0.352	0.352	0.353
96	0.336	0.336	0.336	0.336	0.336	0.336
97	0.318	0.318	0.318	0.318	0.318	0.318
98	0.299	0.299	0.299	0.299	0.299	0.299
99	0.286	0.286	0.286	0.286	0.286	0.286
100	0.281	0.281	0.281	0.281	0.281	0.281

Females – Discounted Life Years per Patient per Arm in the FEMOR Model

Age	Base Case	Exercise Program	Home Modification	Vitamin D + Calcium	Gait-Stabilizing Device	Medication Withdrawal
65	12.230	12.234	12.235	12.234	12.235	12.235
66	11.940	11.941	11.924	11.941	11.942	11.942
67	11.640	11.641	11.641	11.641	11.642	11.641
68	11.333	11.334	11.334	11.334	11.334	11.334
69	11.020	11.021	11.021	11.021	11.021	11.020
70	10.700	10.701	10.701	10.701	10.701	10.700
71	10.374	10.374	10.374	10.374	10.374	10.374
72	10.042	10.042	10.042	10.042	10.042	10.042
73	9.706	9.706	9.706	9.706	9.706	9.706
74	9.366	9.366	9.366	9.366	9.366	9.366
75	9.022	9.022	9.022	9.022	9.022	9.022
76	8.674	8.674	8.674	8.674	8.674	8.674
77	8.325	8.325	8.325	8.325	8.325	8.325
78	7.975	7.975	7.975	7.975	7.975	7.975
79	7.627	7.627	7.627	7.627	7.627	7.627
80	7.279	7.279	7.279	7.279	7.279	7.279
81	6.930	6.930	6.930	6.930	6.930	6.930
82	6.587	6.587	6.587	6.586	6.586	6.587
83	6.249	6.249	6.249	6.249	6.249	6.249
84	5.923	5.923	5.923	5.923	5.923	5.923
85	5.610	5.610	5.610	5.610	5.610	5.610
86	5.310	5.310	5.310	5.310	5.310	5.310
87	5.023	5.023	5.023	5.023	5.023	5.023
88	4.749	4.749	4.749	4.749	4.749	4.749
89	4.486	4.486	4.486	4.486	4.486	4.486
90	4.236	4.236	4.236	4.236	4.236	4.236
91	3.999	3.999	3.999	3.999	3.999	3.999
92	3.774	3.774	3.774	3.774	3.774	3.774
93	3.554	3.554	3.554	3.554	3.554	3.554
94	3.349	3.349	3.349	3.349	3.349	3.349
95	3.157	3.157	3.157	3.157	3.157	3.157
96	2.983	2.983	2.983	2.983	2.983	2.983
97	2.829	2.829	2.829	2.829	2.829	2.829
98	2.693	2.693	2.693	2.693	2.693	2.693
99	2.586	2.586	2.586	2.586	2.586	2.586
100	2.527	2.527	2.527	2.527	2.527	2.527

Females – Discounted Lifetime Long-Term Care Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Vitamin D + Calcium, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	31,571	31,037	30,927	31,129	30,836	30,954
66	33,199	32,742	32,669	32,808	32,562	32,838
67	34,717	34,345	34,306	34,386	34,190	34,533
68	36,563	36,237	36,216	36,264	36,096	36,452
69	38,409	38,127	38,121	38,143	38,002	38,344
70	40,380	40,138	40,142	40,144	40,026	40,343
71	41,063	40,851	40,862	40,851	40,749	41,040
72	41,821	41,638	41,654	41,632	41,547	41,807
73	42,509	42,355	42,373	42,344	42,275	42,501
74	42,714	42,581	42,602	42,568	42,511	42,709
75	42,926	42,814	42,835	42,799	42,753	42,924
76	43,249	43,154	43,174	43,138	43,100	43,247
77	43,781	43,700	43,720	43,684	43,653	43,780
78	44,237	44,170	44,189	44,154	44,130	44,237
79	42,951	42,894	42,911	42,878	42,859	42,950
80	41,535	41,488	41,503	41,474	41,459	41,535
81	40,345	40,307	40,320	40,293	40,282	40,345
82	39,262	39,230	39,242	39,217	39,209	39,262
83	38,109	38,084	38,094	38,072	38,066	38,109
84	35,782	35,762	35,770	35,752	35,747	35,782
85	33,407	33,391	33,398	33,382	33,379	33,407
86	31,107	31,095	31,100	31,087	31,085	31,107
87	29,282	29,272	29,277	29,266	29,265	29,282
88	27,292	27,284	27,288	27,279	27,278	27,292
89	25,357	25,352	25,355	25,347	25,347	25,357
90	23,464	23,460	23,462	23,456	23,456	23,464
91	21,620	21,617	21,618	21,614	21,614	21,620
92	19,961	19,959	19,960	19,956	19,956	19,961
93	18,354	18,352	18,353	18,350	18,351	18,354
94	17,002	17,001	17,002	16,999	16,999	17,002
95	15,682	15,681	15,682	15,680	15,680	15,682
96	14,755	14,754	14,755	14,753	14,753	14,755
97	13,756	13,755	13,756	13,755	13,755	13,756
98	12,646	12,645	12,646	12,645	12,645	12,646
99	12,190	12,190	12,190	12,189	12,189	12,190
100	11,855	11,855	11,855	11,854	11,855	11,855

Costs are in 2008 Canadian dollars.

Females – Discounted Lifetime Hospital Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Vitamin D + Calcium, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	1,709	1,634	1,618	1,647	1,606	1,622
66	1,760	1,696	1,685	1,705	1,670	1,709
67	1,792	1,739	1,733	1,745	1,717	1,765
68	1,846	1,800	1,797	1,804	1,781	1,830
69	1,887	1,848	1,847	1,850	1,830	1,877
70	1,931	1,898	1,898	1,899	1,882	1,926
71	1,981	1,952	1,954	1,952	1,939	1,978
72	2,039	2,014	2,016	2,013	2,002	2,037
73	2,063	2,043	2,045	2,041	2,032	2,062
74	2,113	2,095	2,098	2,093	2,085	2,112
75	2,148	2,133	2,136	2,131	2,125	2,148
76	2,186	2,173	2,176	2,171	2,166	2,186
77	2,220	2,209	2,212	2,207	2,203	2,220
78	2,233	2,224	2,227	2,222	2,219	2,233
79	2,258	2,250	2,252	2,248	2,245	2,258
80	2,253	2,247	2,249	2,245	2,243	2,253
81	2,256	2,250	2,252	2,249	2,247	2,256
82	2,239	2,235	2,237	2,233	2,232	2,239
83	2,203	2,200	2,201	2,198	2,197	2,203
84	2,159	2,156	2,157	2,155	2,154	2,159
85	2,101	2,099	2,100	2,097	2,097	2,101
86	2,044	2,043	2,043	2,041	2,041	2,044
87	2,005	2,004	2,004	2,003	2,002	2,005
88	1,946	1,945	1,945	1,944	1,944	1,946
89	1,867	1,866	1,867	1,866	1,866	1,867
90	1,788	1,867	1,866	1,866	1,787	1,788
91	1,699	1,699	1,699	1,698	1,698	1,699
92	1,611	1,611	1,611	1,610	1,610	1,611
93	1,521	1,521	1,521	1,521	1,521	1,521
94	1,444	1,443	1,444	1,443	1,443	1,444
95	1,352	1,352	1,352	1,351	1,351	1,352
96	1,304	1,303	1,303	1,303	1,303	1,304
97	1,237	1,237	1,237	1,237	1,237	1,237
98	1,152	1,152	1,152	1,151	1,152	1,152
99	1,078	1,078	1,078	1,078	1,078	1,078
100	1,044	1,044	1,044	1,044	1,044	1,044

Costs are in 2008 Canadian dollars.

Males – Discounted Lifetime Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	17,072	16,665	16,655	16,565	17,072
66	17,684	17,350	17,462	17,409	17,684
67	18,332	18,058	18,109	18,187	18,332
68	19,039	18,816	18,886	18,968	19,039
69	19,814	19,631	19,714	19,783	19,814
70	20,729	20,576	20,667	20,719	20,729
71	20,737	20,610	20,707	20,740	20,737
72	20,752	20,649	20,750	20,762	20,752
73	20,815	20,732	20,835	20,829	20,815
74	20,757	20,691	20,795	20,773	20,757
75	20,839	20,786	20,890	20,857	20,839
76	20,970	20,929	21,033	20,989	20,970
77	21,100	21,069	21,172	21,119	21,100
78	21,348	21,325	21,427	21,366	21,348
79	20,702	20,686	20,787	20,720	20,702
80	20,035	20,026	20,124	20,053	20,035
81	19,496	19,491	19,587	19,514	19,496
82	18,872	18,872	18,965	18,890	18,872
83	18,367	18,370	18,459	18,384	18,367
84	17,266	17,272	17,357	17,283	17,266
85	16,214	16,222	16,303	16,231	16,214
86	15,247	15,257	15,334	15,263	15,247
87	14,457	14,467	14,542	14,472	14,457
88	13,584	13,595	13,667	13,599	13,584
89	12,848	12,859	12,929	12,862	12,848
90	12,087	12,098	12,165	12,100	12,087
91	11,202	11,213	11,276	11,215	11,202
92	10,444	10,455	10,515	10,456	10,444
93	9,818	9,830	9,888	9,830	9,818
94	9,180	9,191	9,247	9,192	9,180
95	8,698	8,709	8,762	8,709	8,698
96	7,916	7,926	7,975	7,926	7,916
97	7,104	4,117	4,160	4,117	7,104
98	6,335	6,344	6,388	6,344	6,335
99	6,329	6,338	6,381	6,338	6,329
100	6,452	6,452	6,506	6,461	6,452

Costs are in 2008 Canadian dollars.

Males – Lifetime Falls per Patient per Arm in the FEMOR Model

Age	Base Case	Exercise Program	Home Modification	Gait-Stabilizing Device	Medication Withdrawal
65	0.684	0.652	0.645	0.646	0.684
66	0.669	0.643	0.639	0.648	0.669
67	0.654	0.633	0.630	0.642	0.654
68	0.639	0.622	0.621	0.633	0.639
69	0.624	0.611	0.610	0.621	0.624
70	0.610	0.599	0.599	0.608	0.610
71	0.597	0.588	0.588	0.596	0.597
72	0.583	0.576	0.576	0.583	0.583
73	0.570	0.564	0.565	0.570	0.570
74	0.556	0.551	0.552	0.556	0.556
75	0.544	0.540	0.541	0.544	0.544
76	0.532	0.529	0.530	0.532	0.532
77	0.518	0.516	0.516	0.518	0.518
78	0.504	0.502	0.502	0.504	0.504
79	0.492	0.490	0.491	0.492	0.492
80	0.477	0.476	0.477	0.477	0.477
81	0.463	0.462	0.462	0.463	0.463
82	0.445	0.445	0.445	0.445	0.445
83	0.427	0.427	0.427	0.427	0.427
84	0.408	0.407	0.408	0.408	0.408
85	0.387	0.386	0.387	0.387	0.387
86	0.369	0.369	0.369	0.369	0.369
87	0.356	0.356	0.356	0.356	0.356
88	0.338	0.338	0.338	0.338	0.338
89	0.325	0.325	0.325	0.325	0.325
90	0.311	0.311	0.311	0.311	0.311
91	0.293	0.293	0.293	0.293	0.293
92	0.276	0.276	0.276	0.276	0.276
93	0.269	0.269	0.269	0.269	0.269
94	0.256	0.256	0.256	0.256	0.256
95	0.242	0.242	0.242	0.242	0.242
96	0.224	0.224	0.224	0.224	0.224
97	0.212	0.212	0.212	0.212	0.212
98	0.200	0.200	0.200	0.200	0.200
99	0.194	0.194	0.194	0.194	0.194
100	0.202	0.202	0.202	0.202	0.202

Males – Discounted Life Years per Patient per Arm in the FEMOR Model

Age	Base Case	Exercise Program	Home Modification	Gait-Stabilizing Device	Medication Withdrawal
65	10.764	10.765	10.766	10.766	10.764
66	10.454	10.455	10.455	10.455	10.454
67	10.140	10.141	10.141	10.140	10.140
68	9.823	9.823	9.823	9.823	9.823
69	9.503	9.504	9.504	9.503	9.503
70	9.180	9.181	9.181	9.180	9.180
71	8.855	8.856	8.856	8.855	8.855
72	8.529	8.529	8.529	8.529	8.529
73	8.202	8.203	8.203	8.202	8.202
74	7.877	7.877	7.877	7.877	7.877
75	7.552	7.552	7.552	7.552	7.552
76	7.229	7.229	7.229	7.229	7.229
77	6.909	6.909	6.909	6.909	6.909
78	6.594	6.594	6.594	6.594	6.594
79	6.283	6.283	6.283	6.283	6.283
80	5.977	5.977	5.977	5.977	5.977
81	5.676	5.676	5.676	5.676	5.676
82	5.382	5.382	5.382	5.382	5.382
83	5.097	5.097	5.097	5.097	5.097
84	4.819	4.819	4.819	4.819	4.819
85	4.549	4.549	4.549	4.549	4.549
86	4.288	4.288	4.288	4.288	4.288
87	4.036	4.036	4.036	4.036	4.036
88	3.796	3.796	3.796	3.796	3.796
89	3.573	3.573	3.573	3.573	3.573
90	3.366	3.366	3.366	3.366	3.366
91	3.178	3.178	3.178	3.178	3.178
92	3.019	3.019	3.019	3.019	3.019
93	2.899	2.899	2.899	2.899	2.899
94	2.730	2.730	2.730	2.730	2.730
95	2.576	2.576	2.576	2.576	2.576
96	2.428	2.428	2.428	2.428	2.428
97	2.295	2.295	2.295	2.295	2.295
98	2.176	2.176	2.176	2.176	2.176
99	2.090	2.090	2.090	2.090	2.090
100	2.037	2.037	2.037	2.037	2.037

Males – Discounted Lifetime Long-Term Care Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	13,773	13,433	13,357	13,309	13,354
66	14,416	14,135	14,085	14,026	14,182
67	15,095	14,861	14,831	14,767	14,965
68	15,838	15,645	15,629	15,563	15,767
69	16,648	16,486	16,480	16,415	16,608
70	17,589	17,451	17,452	17,388	17,566
71	17,629	17,510	17,515	17,454	17,615
72	17,671	17,572	17,579	17,523	17,663
73	17,766	17,683	17,693	17,641	17,762
74	17,742	17,673	17,683	17,637	17,740
75	17,847	17,788	17,798	17,756	17,845
76	18,006	17,956	17,966	17,928	18,005
77	18,175	18,134	18,143	18,110	18,174
78	18,458	18,424	18,433	18,404	18,458
79	17,843	17,815	17,823	17,798	17,843
80	17,228	17,205	17,213	17,191	17,228
81	16,744	16,725	16,731	16,712	16,743
82	16,187	16,172	16,177	16,162	16,187
83	15,767	15,754	15,759	15,746	15,766
84	14,755	14,746	14,750	14,739	14,755
85	13,797	13,790	13,793	13,784	13,797
86	12,896	12,890	12,893	12,886	12,896
87	12,160	12,156	12,158	12,152	12,160
88	11,378	11,374	11,376	11,371	11,378
89	10,743	10,740	10,742	10,738	10,743
90	10,083	10,081	10,082	10,079	10,083
91	9,278	9,277	9,278	9,275	9,278
92	8,623	8,622	8,623	8,621	8,623
93	8,074	8,073	8,074	8,072	8,074
94	7,495	7,494	7,494	7,493	7,495
95	7,164	7,164	7,164	7,163	7,164
96	6,567	6,567	6,567	6,566	6,567
97	5,888	5,888	5,888	5,888	5,888
98	5,200	5,200	5,200	5,200	5,200
99	5,259	5,259	5,259	5,259	5,259
100	5,188	5,188	5,188	5,188	5,188

Costs are in 2008 Canadian dollars.

Males – Discounted Lifetime Hospital Cost per Patient per Arm in the FEMOR Model

Age	Base Case, $	Exercise Program, $	Home Modification, $	Gait-Stabilizing Device, $	Medication Withdrawal, $
65	1,028	968	955	954	1,028
66	1,044	994	985	1,002	1,044
67	1,060	1,019	1,013	1,036	1,060
68	1,074	1,040	1,037	1,062	1,074
69	1,089	1,061	1,060	1,082	1,089
70	1,110	1,087	1,086	1,106	1,110
71	1,128	1,108	1,109	1,126	1,128
72	1,146	1,130	1,131	1,145	1,146
73	1,164	1,150	1,151	1,163	1,164
74	1,180	1,168	1,170	1,179	1,180
75	1,201	1,191	1,193	1,201	1,201
76	1,222	1,214	1,216	1,222	1,222
77	1,231	1,224	1,226	1,231	1,231
78	1,244	1,238	1,239	1,244	1,244
79	1,261	1,256	1,257	1,261	1,261
80	1,261	1,257	1,258	1,261	1,261
81	1,262	1,259	1,260	1,262	1,262
82	1,251	1,248	1,249	1,251	1,251
83	1,237	1,234	1,235	1,237	1,237
84	1,213	1,211	1,212	1,213	1,213
85	1,188	1,187	1,187	1,188	1,188
86	1,170	1,169	1,170	1,170	1,170
87	1,168	1,167	1,168	1,168	1,168
88	1,141	1,140	1,140	1,141	1,141
89	1,108	1,107	1,108	1,108	1,108
90	1,077	1,076	1,077	1,077	1,077
91	1,042	1,041	1,042	1,042	1,042
92	995	994	994	995	995
93	966	966	966	966	966
94	926	926	926	926	926
95	870	870	870	870	870
96	766	766	766	766	766
97	693	693	693	693	693
98	642	642	642	642	642
99	643	643	643	643	643
100	789	789	789	789	789

Costs are in 2008 Canadian dollars.

References

(1) Lamb SE, Jorstad-Stein EC, Hauer K, Becker C. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. J Am Geriatr Soc 2005; 53(9):1618-22.

(2) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(3) Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988; 319(26):1701-7.

(4) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(5) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(6) Stalenhoef PA, Crebolder H, Knottnerus JA, van der Horst F. Incidence, risk factors and consequences of falls among elderly subjects living in the community. Eur J Public Health 1997; 7(3):328-34.

(7) Bélanger A, Martel L, Malenfant C. Population projections for Canada, provinces, and territories 2005 - 2031 [Internet]. Ottawa: Statistics Canada; [updated 2005; cited 2008 Jun 6]. Available from: http://www.statcan.ca/english/freepub/91-520-XIE/0010591-520-XIE.pdf

(8) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(9) Gaugler JE, Duval S, Anderson KA, Kane RL. Predicting nursing home admission in the U.S: a meta-analysis. BMC Geriatr 2007; 7:13.

(10) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(11) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(12) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(13) O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol 1993; 137(3):342-54.

(14) Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006; 35 Suppl 2:ii37-ii41.

(15) Macpherson AK, Schull M, Cernat G, Redelmeier DA, Laupacis A. Injuries in Ontario. ICES atlas [Internet]. Toronto: Institute for Clinical Evaluative Sciences; [updated 2005; cited 2008 Jul 25]. Available from: http://www.ices.on.ca/webpage.cfm?site_id=1&org_id=67&morg_id=0&gsec_id=0&item_id=3053&type=atlas

(16) Report on Seniors' falls in Canada [Internet]. Ottawa: Public Health Agency of Canada; [updated 2005; cited 2008 Nov 1]. Available from: http://www.phac-aspc.gc.ca/seniors-aines/pubs/seniors_falls/pdf/seniors-falls_e.pdf

(17) Prevention of falls and fall-related injuries in community-dwelling elderly persons: an evidence-based analysis. Ontario Health Technology Assessment Series 2008; 8(2).

(18) Prevention of falls and fall-related injuries in community-dwelling elderly persons: an evidence-based analysis. Ontario Health Technology Assessment Series 2008; 8(2).

(19) Prevention of falls and fall-related injuries in community-dwelling elderly persons: an evidence-based analysis. Ontario Health Technology Assessment Series 2008; 8(2).

(20) Gillespie LD, Gillespie WJ, Robertson MC, Lamb SE, Cumming RG, Rowe BH. Interventions for preventing falls in elderly people. Cochrane Database of Systematic Reviews 2003; Issue 4. Art. No.: CD000340. DOI: 10.1002/14651858.CD000340.

(21) Levels of evidence [Internet]. Oxford Centre for Evidence-Based Medicine; [updated 2001; cited 2008 Jun 6]. Available from: http://www.cebm.net/index.aspx?o=1025

(22) Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S et al. Grading quality of evidence and strength of recommendations. BMJ 2004; 328(7454):1490.

(23) Close JC, Lord SL, Menz HB, Sherrington C. What is the role of falls? Best Pract Res Clin Rheumatol 2005; 19(6):913-35.

(24) Lamb SE, Jorstad-Stein EC, Hauer K, Becker C. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. J Am Geriatr Soc 2005; 53(9):1618-22.

(25) Prevention of falls and fall-related injuries in community-dwelling elderly persons: an evidence-based analysis. Ontario Health Technology Assessment Series 2008; 8(2).

(26) Residential care facilities - 2003/2004 [Internet]. Ottawa, Ontario: Statistics Canada; [updated 2007; cited 2008 May 15]. Available from: http://www.statcan.ca/english/freepub/83-237-XIE/83-237-XIE2006001.pdf

(27) Age and sex for the population of Canada, provinces, territories, Census Metropolitan Areas and Census Agglomerations, 2001 and 2006 censuses - 100% data [Internet]. Statistics Canada; [updated 2008; cited 2008 Jun 6]. Available from: http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?Temporal=2006&PID=88984&GID=837983&METH=1&APATH=3&PTYPE=88971&THEME=66&AID=&FREE=0&FOCUS=&VID=0&GC=99&GK=NA&RL=0&d1=0

(28) Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60(2):187-94.

(29) Nikolaus T, Bach M. Preventing falls in community-dwelling frail older people using a home intervention team (HIT): results from the randomized Falls-HIT trial. J Am Geriatr Soc 2003; 51(3):300-5.

(30) Bischoff-Ferrari HA, Orav EJ, wson-Hughes B. Effect of cholecalciferol plus calcium on falling in ambulatory older men and women: a 3-year randomized controlled trial. Arch Intern Med 2006; 166(4):424-30.

(31) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(32) McKiernan FE. A simple gait-stabilizing device reduces outdoor falls and nonserious injurious falls in fall-prone older people during the winter. J Am Geriatr Soc 2005; 53(6):943-7.

(33) Age and sex for the population of Canada, provinces, territories, Census Metropolitan Areas and Census Agglomerations, 2001 and 2006 censuses - 100% data [Internet]. Statistics Canada; [updated 2008; cited 2008 Jun 6]. Available from: http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?Temporal=2006&PID=88984&GID=837983&METH=1&APATH=3&PTYPE=88971&THEME=66&AID=&FREE=0&FOCUS=&VID=0&GC=99&GK=NA&RL=0&d1=0

(34) Information Services Group. Long-term care home system report as of March 31, 2007. Toronto, ON: Ministry of Health and Long-Term Care; Long-Term Care Planning and Renewal Branch; 2007

(35) Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60(2):187-94.

(36) Trottier H, Martel L, Houle C, Berthelot J, Légare J. Living at home or in an institution: what makes the difference for seniors? Health Rep 2000; 11(4):49-61.

(37) Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2005; 60(2):187-94.

(38) Nikolaus T, Bach M. Preventing falls in community-dwelling frail older people using a home intervention team (HIT): results from the randomized Falls-HIT trial. J Am Geriatr Soc 2003; 51(3):300-5.

(39) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997; 337(18):1279-84.

(40) Bischoff-Ferrari HA, Orav EJ, wson-Hughes B. Effect of cholecalciferol plus calcium on falling in ambulatory older men and women: a 3-year randomized controlled trial. Arch Intern Med 2006; 166(4):424-30.

(41) Porthouse J, Cockayne S, King C, Saxon L, Steele E, Aspray T et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. BMJ 2005; 330(7498):1003.

(42) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. J Am Geriatr Soc 1999; 47(7):850-3.

(43) Beck CA, Williams JV, Wang JL, Kassam A, El-Guebaly N, Currie SR et al. Psychotropic medication use in Canada. Can J Psychiatry 2005; 50(10):605-13.

(44) Beck CA, Williams JV, Wang JL, Kassam A, El-Guebaly N, Currie SR et al. Psychotropic medication use in Canada. Can J Psychiatry 2005; 50(10):605-13.

(45) McKiernan FE. A simple gait-stabilizing device reduces outdoor falls and nonserious injurious falls in fall-prone older people during the winter. J Am Geriatr Soc 2005; 53(6):943-7.

(46) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(47) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(48) Wiktorowicz ME, Goeree R, Papaioannou A, Adachi JD, Papadimitropoulos E. Economic implications of hip fracture: health service use, institutional care and cost in Canada. Osteoporos Int 2001; 12(4):271-8.

(49) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(50) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(51) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(52) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(53) Schedule of benefits for physician services under the Health Insurance Act (Internet). Ontario Ministry of Health and Long-Term Care; [updated 2008 Jun 3; cited 2008 Jun 6]. Available from: http://www.health.gov.on.ca/english/providers/program/ohip/sob/physserv/physserv_mn.html

(54) Carroll NV, Slattum PW, Cox FM. The cost of falls among the community-dwelling elderly. J Manag Care Pharm 2005; 11(4):307-16.

(55) Barnett A, Smith B, Lord SR, Williams M, Baumand A. Community-based group exercise improves balance and reduces falls in at-risk older people: a randomised controlled trial. Age Ageing 2003; 32(4):407-14.

(56) Physiotherapy: fee schedule (Internet). Workplace Safety and Insurance Board; [updated 2008 Feb 25; cited 2008 Aug 8]. Available from: http://www.wsib.on.ca/wsib/wsibobj.nsf/LookupFiles/DownloadableFilePhysiotherapy/$File/2714A.pdf

(57) Pardessus V, Puisieux F, Di PC, Gaudefroy C, Thevenon A, Dewailly P. Benefits of home visits for falls and autonomy in the elderly: a randomized trial study. Am J Phys Med Rehabil 2002; 81(4):247-52.

(58) Smith RD, Widiatmoko D. The cost-effectiveness of home assessment and modification to reduce falls in the elderly. Aust N Z J Public Health 1998; 22(4):436-40.

(59) Porthouse J, Cockayne S, King C, Saxon L, Steele E, Aspray T et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. BMJ 2005; 330(7498):1003.

(60) Swanson Premium Brand Calcium (Carbonate, Aspartate & Citrate) [Internet]. Swanson Health Products; [updated 2008; cited 2008 Jun 6]. Available from: http://www.swansonvitamins.com/ProductDisplay/catalogId/10051/productId/12902/R/19555&saleCatalogId=10051

(61) Swanson Premium Brand High Potency Vitamin D-3 [Internet]. Swanson Health Products; [updated 2008; cited 2008 Aug 8]. Available from: http://www.swansonvitamins.com/ProductDisplay/catalogId/10051/productId/16432/R/5172&saleCatalogId=10051

(62) Yaktrax [Internet]. 2006 [cited 2008 May 12]. Available from: www.yaktrax.com

(63) McKiernan FE. A simple gait-stabilizing device reduces outdoor falls and nonserious injurious falls in fall-prone older people during the winter. J Am Geriatr Soc 2005; 53(6):943-7.

(64) MedsCheck [Internet]. Ministry of Health and Long-Term Care (Ontario); [updated 2008; cited 2008 Aug 8]. Available from: http://www.medscheck.ca/faq_claim_pay.html

(65) Guidelines for the economic evaluations for health technologies: Canada [Internet]. Canadian Agency for Drugs and Technologies in Health (CADTH); [updated 2006; cited 2008 Aug 8]. Available from: http://www.acmts.ca/media/pdf/186_EconomicGuidelines_e.pdf

(66) Residential care facilities - 2003/2004 [Internet]. Ottawa, Ontario: Statistics Canada; [updated 2007; cited 2008 May 15]. Available from: http://www.statcan.ca/english/freepub/83-237-XIE/83-237-XIE2006001.pdf