

Rising Tide: The Impact of Dementia in Canada

2008 to 2038

October 2009



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ISBN 978-0-9733522-4-5

Suggested citation

Smetanin, P., Kobak, P., Briante, C., Stiff, D., Sherman, G., and Ahmad, S. Rising Tide: The Impact of Dementia in Canada 2008 to 2038. RiskAnalytica, 2009.

This report and the analysis it contains was prepared by RiskAnalytica using its Life at Risk® simulation platform.

Acknowledgements

This report was prepared by RiskAnalytica for the Alzheimer Society of Canada, funded by the Canadian Institute of Health Research (CIHR) and Pfizer. The content and findings of this report are independent and not influenced by the above mentioned. RiskAnalytica would like to acknowledge the contributions, comments, research and input from the following subject-matter experts:

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EXECUTIVE SUMMARY

INTRODUCTION AND SCOPE

The Problem

The aging of the Canadian population has led to an epidemiological shift in disease profile, resulting in age related illnesses such as dementia becoming one of the biggest challenges facing society. Over 480,600 Canadians were estimated to have dementia in 2008, with over 107,610 new cases diagnosed among seniors aged 65 years and older in 2009. This has placed a significant burden on health care and social service systems in Canada with over \$8.1 billion dollars being spent on direct health care costs alone in 2008. The debilitating effects of dementia extend further than the population with the disease to include patient families, formal and informal caregivers, health care providers, the health care system, as well as society as a whole. As a result, the current economic burden of dementia on Canadian society, including direct costs, indirect costs and informal caregiver opportunity costs is over \$14.9 billion (according to 2008 estimates). The life and economic consequences of dementia are expected to be further magnified over the next 30 years, when an estimated 1.1 million Canadians will have some form of dementia.

The Objective

The objective of the current analysis is to estimate the health and economic burden of dementia in Canada over the next 30 years and assess the potential impact of dementia management interventions on reducing this burden. The evaluation of the dementia burden and the impacts of dementia management interventions will help to demonstrate the urgent need for a national dementia strategy in Canada, to quantify, plan and mitigate the effects of this growing illness. Such a national strategy would aid in managing the health, economic and social impacts of this illness through a comprehensive understanding of the epidemiology of the disease and its overall influence on Canadian society.

A dementia model was built within RiskAnalytica's Life at Risk® platform to estimate the burden of disease over a thirty-year time horizon, using historical data inputs. The base model represents a general burden of disease model assuming that the current trends of dementia remain constant. This model allows for measures of health (incidence, prevalence and mortality) and economics (direct and indirect health care costs, taxation revenues lost due to the disease, and caregiver costs) to be compared to "what-if" scenarios taking into account the impacts of various interventions.

The Interventions

Four intervention scenarios were identified by the Alzheimer Society of Canada and its subject matter experts and used to simulate the potential impacts of dementia prevention and patient and caregiver support programs. The following intervention scenarios evaluated included:

1. **Primary Prevention #1** – the impact of physical activity programs that aim to increase physical activity by 50% on reducing dementia incidence;
2. **Primary Prevention #2** – the impact of hypothetical primary prevention programs to delay disease onset by two years;

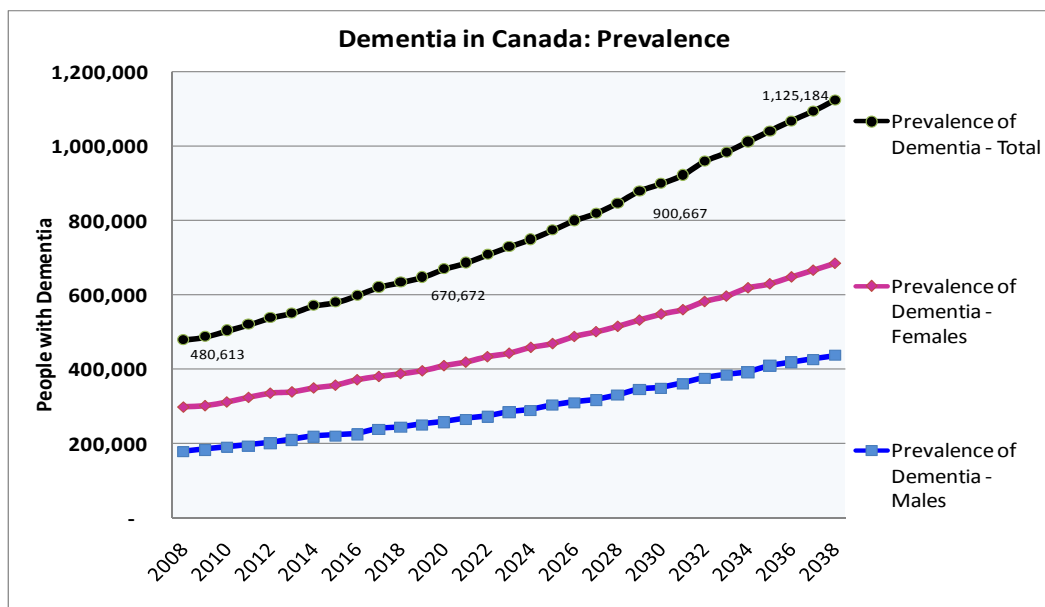
3. **Informal Caregiver Support** – the impact of hypothetical caregiver support programs on delaying admission to long term care (LTC) and reducing the caregiver burden; and
4. **System Navigation** – the impact of assigning a system navigator to all dementia patients on reducing, costs, delaying admission into LTC and reducing the caregiver burden

The differences between the outcomes of the base model and intervention scenarios provide an indication of the value proposition of the proposed interventions.

CURRENT AND FUTURE BURDEN OF DEMENTIA IN CANADA

Within the next 30 years, approximately 2.8% of the Canadian population is expected to have dementia. These 1.1 million Canadians suffering from dementia in 2038 will place a significant burden on the health care system, adding major challenges to our already scarce resources.

Current and Future Dementia Prevalence in Canada, Males and Females, All Age Groups: 2008-2038



The demand for long-term care (LTC) beds alone is expected to increase by over 10 times the current demand, leaving dementia patients requiring critical care, to rely on community-based services and informal caregivers to meet their complex needs. By 2038, the total number of hours of informal care is expected to increase 3.2 times the current estimate, to approximately 756 million hours per year. An increase in the number of individuals with dementia will also take an extraordinary toll on their caregivers. According to 2009 estimates, informal caregivers are expected to provide over 246 million hours per year of unpaid care to those with dementia. Given that advancing age is a leading risk factor for dementia, as the proportions of adults to seniors in the population changes over time, a decrease in the availability of formal and informal care resources required to tend to the elderly, will further amplify this problem. Over the next 30 years dementia is expected to burden Canadian society with over \$872 billion dollars in total direct health costs, unpaid caregiver costs and indirect costs.

Key Findings

Incidence

- According to 2008 estimates, there were over 103,700 newly diagnosed cases of dementia in seniors aged 65 years and older.
 - Of these approximately 49% were diagnosed with Alzheimer's disease, 21% with vascular dementia with the remaining 30% with other forms of dementia.
 - Approximately 60% of all newly diagnosed cases of dementia occurred in females.
- By 2038, the projected number of newly diagnosed cases of dementia for those aged 65 years and older is expected to reach over 257,800 per year (2.5 times the 2008 estimate).
 - Of these approximately 51% are expected to be diagnosed with Alzheimer's disease, 20% with vascular dementia, with the remaining 29% with other forms of dementia.
 - Approximately 55% of all newly diagnosed dementias are expected to occur in females.

New cases of dementia among Canadians are on the rise. Over the next 30 years the number of newly diagnosed cases is expected to increase 2.5 times the current estimate, reaching over 257,800 new cases. This increase is primarily due to the changing age-structure of the Canadian population.

Prevalence

- According to 2008 estimates, over 480,600 Canadians have dementia, which accounts for 1.5% of the total population.
 - Of these approximately 63% have Alzheimer's disease, 20% have vascular dementia, and the remaining 17% suffer with other forms of dementia.
 - Approximately 62% of all Canadians with dementia were female.
- By 2038, there are projected to be over 1.1 million Canadians with dementia, which will account for approximately 2.8% of the total population (2.3 times the 2008 estimate).
 - Of these approximately 69% will have Alzheimer's disease, 20% vascular dementia, and the remaining 11% will have other forms of dementia.
 - Approximately 61% of Canadians with dementia will be female.

In the next 30 years over 1.1 million Canadians will be living with dementia, accounting for 2.8% of the total population.

Mortality

Mortality in the population with dementia was compared to mortality in people of the same age and sex who did not have dementia.

- In 2008 it was estimated that there were 22,660 deaths in the demented population compared to 6,500 deaths in the population without dementia.
- By 2038 the number of deaths in the demented population is projected to be 44,360 compared to 16,250 deaths in the population without dementia.

Mortality in the population with dementia is over 3 times higher than in the same population assuming they did not have the disease.

Across Care Settings

- According to 2008 estimates, the distribution of Canadians 65 years and over with dementia across each care setting was:
 - 45.4% residing in LTC.
 - 33.3% receiving community care services.
 - 21.3% receiving no formal care.
- By 2038, the projected prevalence of Canadians 65 years and over with dementia is expected to be distributed across care settings as follows:
 - 37.6% expected to reside in LTC.
 - 42.7% expected to be receiving community care services.
 - 19.7% expected to be receiving no formal care.

Over the next 30 years the excess demand for long-term care will increase. With a bed shortage more people with dementia will rely on community care services to meet their complex needs.

Economic Burden

The total economic burden of dementia was estimated as the sum of the total direct costs, indirect costs, and opportunity costs to informal caregivers that are attributable to dementia.

- According to 2008 estimates, the total economic burden of dementia was over \$14.9 billion dollars (in 2008 present value terms).
- Within the next 30 years, the total economic burden of dementia is estimated to be over \$872 billion dollars (2008 present value terms).

Cumulatively, over the next 30 years dementia will cost Canadian society over \$872 billion dollars.

INTERVENTION SCENARIOS

The impacts of the proposed intervention scenarios were compared to the base model results to derive the expected value of the interventions. Key value propositions for each of the scenarios are reported below:

Impact of physical activity on dementia incidence

The short-term (2008-2018) impacts of increased levels of physical activity are expected to yield the following results:

- Over 5,970 new cases of dementia would be averted, a 4.3% reduction from the base model.
- Over 32,450 fewer Canadians would be suffering from dementia, a 5.1% reduction from the base model.
- There would be 2,120 fewer deaths within the population with dementia, a 7.6% reduction from the base model.
- Over 13,570 fewer Canadians over the age of 65 with dementia would be residing in LTC, a 7.4% reduction from the base model.
- Over 11,690 fewer Canadians over the age of 65 with dementia would be receiving community care, a 5.3% reduction from the base model.
- A savings of over \$5.6 billion dollars to Canadian society (in 2008 present value terms), a 2.4% reduction from the base model.

The long-term (2008-2038) impacts of increased levels of physical activity are expected to yield the following results:

- Over 10,750 new cases of dementia would be averted, a 4.2% reduction from the base model.
- Over 96,410 fewer Canadians would be suffering from dementia, an 8.6% reduction from the base model.
- There would be 5,420 fewer deaths within the population with dementia, a 12.3% reduction from the base model.
- Over 36,210 fewer Canadians over the age of 65, with dementia would be residing in LTC, an 8.2% reduction from the base model.
- Over 41,550 fewer Canadians over the age of 65, with dementia would be receiving community care, an 8.3% reduction from the base model.
- A savings of over \$51.8 billion dollars to Canadian society (in 2008 present value terms), a 5.9% reduction from the base model.

Increasing physical activity levels among Canadians is expected to significantly reduce the numbers of new and prevalent cases of dementia over the next 30 years, saving Canadian society over \$51.8 billion dollars.

Impact of prevention programs to delay disease onset:

The short-term (2008-2018) impacts of the second primary prevention are expected to yield the following results:

- Over 25,950 new cases of dementia would be averted, an 18.9% reduction from the base model.
- Over 137,500 fewer Canadians would be suffering from dementia, a 21.7% reduction from the base model.
- There would be 9,790 fewer deaths within the population with dementia, a 35.0% reduction from the base model.
- Over 57,520 fewer Canadians over the age of 65, with dementia would be residing in LTC, a 31.4% reduction from the base model.
- Over 49,740 fewer Canadians over the age of 65, with dementia would be receiving community care, a 22.4% reduction from the base model.
- A savings of over \$24.2 billion dollars to Canadian society (in 2008 present value terms), a 10.1% reduction from the base model.

The long-term (2008-2038) impacts of the second primary prevention are expected to yield the following results:

- Over 48,400 new cases of dementia would be averted, an 18.9% reduction from the base model.
- Over 409,640 fewer Canadians would be suffering from dementia, a 36.4% reduction from the base model.
- There would be 24,670 fewer deaths within the population with dementia, a 55.6% reduction from the base model.
- Over 153,870 fewer Canadians over the age of 65, with dementia would be in LTC, a 34.8% reduction from the base model.
- Over 175,860 fewer Canadians over the age of 65, with dementia would be in community care, a 34.9% reduction from the base model.
- A savings of over \$218.6 billion dollars to Canadian society (in 2008 present value terms), a 25.1% reduction from the base model.

Delaying the onset of dementia by two years will significantly reduce the numbers of people living with dementia and the number of admissions into long-term care over the next 30 years, saving Canadian society over \$218.6 billion dollars.

Informal Caregiver Support Programs:

(a) Impact of caregiver support programs on admission into LTC

The short-term (2008-2018) impacts of informal caregiver support programs are expected to yield the following results:

- Over 8,810 fewer Canadians over the age of 65 years, with dementia would be residing in LTC, a 4.8% reduction from the base model.
- A savings of over \$2.4 billion dollars to Canadian society (in 2008 present value terms), a 1.0% reduction from the base model.

The long-term (2008-2038) impacts of informal caregiver support programs are expected to yield the following results:

- Over 14,270 fewer Canadians over the age of 65 years with dementia would be residing in LTC, a 3.2% reduction from the base model.
A savings of over \$12.2 billion dollars to Canadian society (in 2008 present value terms), a 1.4% reduction from the base model

Informal caregiver support programs are expected to significantly reduce the numbers of dementia patients residing in long-term care facilities over the next 30 years, saving Canadian society over \$12.2 billion dollars.

(b) Impact of caregiver support programs on the informal caregiver burden

- The short-term (2008-2018) impacts of informal caregiver support programs are expected to provide a savings of over \$10.2 billion dollars to Canadian society (in 2008 present value terms), a 4.3% reduction from the base model.
- The long-term (2008-2038) impacts of informal caregiver support programs are expected to provide a savings of over \$50.5 billion dollars to Canadian society (in 2008 present value terms), a 5.8% reduction from the base model.

Informal caregiver support programs are expected to reduce the burden placed on informal caregivers saving Canadian society over 50.5 billion dollars over the next 30 years.

System Navigation:

(a) Impact of system navigation on admission into LTC

The short-term (2008-2018) impacts of a system navigator are expected to yield the following results:

- Over 11,690 fewer Canadians over the age of 65 years with dementia would be residing in LTC, a 6.4% reduction from the base model.
- A savings of over \$3.2 billion dollars to Canadian society (in 2008 present value terms), a 1.4% reduction from the base model.

The long-term (2008-2038) impacts of a system navigator are expected to yield the following results:

- Over 19,090 fewer Canadians over the age of 65 years with dementia would be residing in LTC, a 4.3% reduction from the base model.
- A savings of over \$16.2 billion dollars to Canadian society (in 2008 present value terms), a 1.9% reduction from the base model.

The implementation of a system navigator is expected to reduce the numbers of patients with dementia residing in long-term care facilities over the next 30 years, saving Canadian society over \$16.2 billion dollars.

(b) Impact of system navigation on the informal caregiver burden

- The short-term (2008-2018) impacts of a system navigator are expected to provide a savings of over \$19.8 billion dollars to Canadian society (in 2008 present value terms), an 8.3% reduction from the base model.
- The long-term (2008-2038) impacts of a system navigator are expected to provide a savings of over \$97.5 billion dollars to Canadian society (in 2008 present value terms), an 11.2% reduction from the base model.

System navigators are expected to reduce the burden placed on informal caregivers saving Canadian society over \$97.5 billion dollars over the next 30 years.

FUTURE DIRECTIONS

The Rising Tide project has estimated the burden of dementia in Canada over the next 30 years by looking at the impacts of dementia prevention as well as patient and caregiver support programs on reducing the health, financial and societal consequences of the illness.

An increase in the incidence, prevalence and mortality can be expected over time. This increase is primarily due to the aging of the Canadian population. The results of the analysis reveal the expected demand for LTC beds for dementia patients over the next 30 years to be over 10 times the current demand. This presents an enormous challenge for LTC facilities (currently at capacity), leaving more dementia patients who require LTC to rely on community care services. This in turn, places an additional burden on the availability of community-care resources and the demand on informal caregivers. As the Canadian population ages, there may be fewer resources available to meet the care requirements of the dementia population across all care settings, posing an enormous resource capacity issue as well as an extensive economic burden on society as a whole.

The scenarios evaluated within the Life at Risk® dementia model provide an indication of how dementia management interventions could potentially reduce the estimated burden. Prevention programs that involve increasing levels of physical activity or those that could delay disease onset, result in fewer new cases of the illness consequently reducing the strain on existing health and economic resources. Support programs for patients and their caregivers are also shown to provide significant benefits in reducing the demand placed on LTC and better equipping informal caregivers to cope and manage their needs as care providers.

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1 INTRODUCTION

The Rising Tide project evaluated the health and economic burden of dementia in Canada over the next 30 years. As part of its engagement with the Alzheimer Society of Canada (ASC), RiskAnalytica prepared this report to provide the ASC and its group of subject-matter experts with an understanding of the magnitude of overall burden by simulating future health states and economic impacts associated with dementia and providing an assessment of the effects of potential dementia management interventions on reducing this burden

1.1 SCOPE OF THE ENGAGEMENT

To achieve the engagement objectives, RiskAnalytica's Life at Risk® platform will be used to generate a base model of the current and future health and economics of dementia in Canada. Using historical data inputs, the base model will estimate the burden of dementia over a thirty-year time horizon. This model, referred to as the base model, represents the burden of dementia where measures of health (incidence, prevalence and mortality) and economics (direct and indirect health care costs, personal and corporate taxes lost due to the disease, and caregiver costs) may be compared to "what-if" or intervention scenarios.

Four intervention scenarios associated with implementing primary prevention programs and caregiver and patient support programs will be evaluated and *compared* against the base model. The intervention scenarios identified by the ASC and its group of subject-matter experts include:

- **Primary Prevention #1:** The impact of physical activity programs on dementia incidence;
- **Primary Prevention #2:** The impact of hypothetical prevention programs to delay dementia onset by two years;
- **Informal Caregiver Support:** The impact of hypothetical caregiver support programs on patient admission into long-term care and the burden on informal caregivers;
- **System Navigation:** The impact of assigning a system navigator to provide care coordination and caregiver support to all newly diagnosed dementia patients on patient admission into long-term care facilities and the total costs of dementia treatment and care.

The outcomes of the base model and intervention scenarios will be compared to demonstrate how the proposed interventions could affect the life and economic impacts of dementia in Canada over the simulated time frame. The differences between the base model and scenario outcomes will provide an indication of the value proposition associated with the proposed interventions.

The base model and intervention scenarios consider the following research questions:

- What are the expected impacts of dementia upon the Canadian population and economy over the next thirty years?
- What are the potential impacts of the proposed interventions?
- How will the expected life and economic impacts identified by the base model, change across Canada as a result of implementing the proposed interventions?

1.2 STRUCTURE OF THE REPORT

This report is divided into 6 sections:

- Section 1 provides details on the background, purposes and objectives of the evaluation;
- Section 2 highlights the general approach to the analysis and the subject-matter expert review of the approach and outcomes
- Section 3 provides details on the Life at Risk® methodology, model assumptions, input data and data assumptions applied for the analysis;
- The results of the base model, setting the landscape of the dementia problem in Canada, are summarized in Section 4;
- The impacts of the proposed dementia management intervention scenarios are summarized in Section 5;
- The major findings and conclusions as well as identified research questions are summarized in Section 6.

1.3 OVERVIEW OF DEMENTIA

Dementia is a syndrome caused by a number of disorders that affect the brain. Symptoms of dementia may include memory loss, impairments in judgment and reasoning as well as changes in mood, behaviour and communication or a decline in other cognitive abilities. There are several subtypes of dementia, associated with some distinctive symptom patterns. However, symptoms of different types of dementia can overlap and be further complicated by coexisting medical conditions¹. The most common forms of dementia are Alzheimer's disease (AD) and vascular dementia (VaD). Some structural

¹ Alzheimer's disease facts and figures 2009

brain disorders (e.g. normal-pressure hydrocephalus, or subdural hematoma), metabolic disorders (e.g. hypothyroidism or vitamin B12 deficiency), and toxins (for example lead) can also cause a slow deterioration of cognition however, these syndromes can be treated and are sometimes referred to as reversible dementia.

Epidemiology of Dementia

Dementias can be classified either according to their location or etiology as follows:

- **Cortical dementia** – dementias where the damage primarily affects the brain's cortex, or outer layer; they affect memory, language, thinking, and social behavior. For e.g. AD, Pick's disease and CJD².
- **Subcortical dementia** - dementia that affects parts of the brain below the cortex; these cause changes in emotions, movement and memory. For e.g. Huntington's disease, Parkinson's and HIV-associated dementias^{3,4}.
- **Primary dementia** - dementias such as AD that are not caused by any other disease.
- **Secondary dementia** – dementias that occur as a result of a physical disease or injury. For example; dementia resulting from Creutzfeldt - Jakob disease.

Diagnosis

Definitive diagnosis for dementia requires a postmortem examination of brain tissue. Clinical diagnosis can however distinguish dementia types in 90% of cases.

The challenges of an accurate diagnosis for dementia include distinguishing dementia from age-associated memory impairment, mild cognitive impairment, or other conditions that cause similar symptoms. Neuroimaging along with identification of biomarkers and in depth neuropsychological tests are helpful tools in the diagnosis of dementia. The 2007 Canadian Consensus Guidelines (CCG) recommends the use of the National Institute of Neurological and Communicative Disorders and Stroke - Alzheimer's disease and Related Disorders Association (NINCDS - ADRDA) diagnosis criteria due to their high degree of sensitivity as well as established reliability and validity⁵. The NINCDS - ADRDA criteria require that the presence of cognitive impairment and a suspected dementia syndrome be confirmed by

² Butters *et al.* (1998).

³ Cummings and Benson (1984).

⁴ Von Giesen *et al.* (2005).

⁵ Blacker *et al.* (1994).

neuropsychological testing for a clinical diagnosis of possible or probable AD; while histopathologic confirmation (microscopic examination of brain tissue) is required for a definitive diagnosis⁶. The CCG recommends an integrative approach to diagnose vascular dementia. This includes a review of patient history, a physical examination, neurological evaluations, cognitive and neuropsychological tests, brain scans, lab tests and psychiatric evaluations.

For more information on dementia diagnosis and recommendations, please consult the CCG⁷.

Etiology and Risk Factors

Dementia can be caused by immutable or potentially modifiable risk factors but is not considered a normal part of aging. The etiology of dementia appears to be comprised of a complex interaction of genes, lifestyle factors, and other environmental influences. Researchers have identified various genes that influence susceptibility to AD including apolipoprotein E, presenilin 1 and 2, sortilin-related receptor SORL 1. The development of other forms of dementia such as Creutzfeldt-Jakob disease (CJD), Gerstmann-Straussler-Scheinker (GSS), Huntington's disease, and frontotemporal dementia linked to chromosome 17 (FTDP-17) .

VaD is caused by cerebrovascular disease or any other condition that prevents normal blood flow to the brain. Without a regular supply of blood to the brain, brain cells cannot obtain the oxygen required to function correctly, leading them to become oxygen deprived. Post-traumatic dementia is directly related to brain cell death after injury. HIV-associated dementia is clearly tied to infection by the HIV virus, although the exact way in which the virus causes damage is not well understood. There are other forms of dementia for which underlying causes have not yet been identified.

The following table provides a list of some of the risk factors and protective factors for all forms of dementia, AD and VaD identified by the CCG and Patterson *et al.* (2007). Although causes of dementia are not well understood, they are likely a result of the complex interactions between two or more risk factors. How this interaction affects dementia onset and disease progression requires further research.

⁶ McKhann *et al.* (1984).

⁷ Canadian Consensus Guidelines (2007)

Exhibit 1 Dementia Risk Factors and Protective Factors Identified by the CGC and Patterson *et al.* (2007)

Risk Factors	Association
All Forms of Dementia	
Age	The occurrence of dementia increases with age particularly in the very elderly, over the ages of 75 and 80 ⁸ .
Genetics/Family History	A number of genes have been implicated in the development of AD. Abnormal genes have further been implicated as risk factors in Huntington's disease, FTDP-17, CJD, GSS and several other kinds of dementias.
Stroke	Longitudinal studies ⁹ , neuroimaging studies ¹⁰ , as well as prospective studies ¹¹ have all shown that stroke increases the subsequent risk of all forms of dementia ¹² .
Hypertension	Considerable evidence from longitudinal cohort studies has revealed a complex relationship between blood pressure and subsequent development of dementia ¹³ .
Cholesterol	There is good evidence that elevated serum cholesterol is associated with an increased risk of all forms of dementia ¹⁴ .
Diabetes Mellitus	There is evidence that the presence of diabetes mellitus increases the risk of all forms of dementia ¹⁵ .
Sex Hormone Levels	A large randomized controlled trial of estrogen and progesterone replacement therapy has revealed that the risk of dementia was actually increased with use of estrogen alone or in combination with progesterone ¹⁶ .
Psychological Factors (Depression)	A systematic evidence review concluded that depression is associated with an increased risk of all forms of dementia ¹⁷ .
Diet	Evidence shows that regular fish and shellfish consumption has been associated with decreased risk of dementia ¹⁸ .
Wine Consumption	Epidemiologic evidence has established that moderate consumption of wine (250–500 ml/day), compared with an intake of more or less than this amount, is associated with a reduced risk of dementia ¹⁹ .

⁸ Fratiglioni *et al.* (2000).

⁹ Ivan *et al.* (2004).

¹⁰ Vermeer *et al.* (2003).

¹¹ Henon *et al.* (2001).

¹² Honig *et al.* (2003).

¹³ Patterson *et al.* (2007).

¹⁴ Patterson *et al.* (2008).

¹⁵ Patterson *et al.* (2007).

¹⁶ Shumaker *et al.* (2004).

¹⁷ Patterson *et al.* (2007).

¹⁸ Patterson *et al.* (2007).

¹⁹ Larrieu *et al.* (2004).

Risk Factors	Association
Physical Activity	Increased levels of physical activity have been linked to a reduced risk of subsequent dementia ^{20,21} .
Alzheimer's Disease	
Genetics/Family History	A number of genes have been implicated in the development of AD; for e.g. apolipoprotein E, presenilin 1 and 2, sortilin- related receptor SORL 1 ²² .
Hypertension	Elevated systolic blood pressure(> 160 mm/Hg) has been found to be associated with an increased risk of AD ²³
Cholesterol	Longitudinal studies have established that midlife elevation of the total serum cholesterol level is associated with an increased risk of subsequent AD ²⁴ .
Stroke	Longitudinal studies ²⁵ , neuroimaging studies ²⁶ , as well as prospective studies ²⁷ have all shown that stroke increases the subsequent risk of all forms of dementia and AD ²⁸ .
Psychological Factors (Depression)	A systematic evidence review concluded that depression is associated with AD, however further research is required on the topic ²⁹ .
Diet	Dietary fat intake and reduced levels of omega 3 fatty acids have been linked to an increased risk of dementia in epidemiologic studies ³⁰ . A Mediterranean-style diet and high fish intake are associated with decreased risk of AD ³¹ .
Wine Consumption	Epidemiologic evidence has established that moderate consumption of wine (250–500 ml/day), compared with an intake of more or less than this amount, is associated with a reduced risk of AD ³² .
Physical Activity	Increased levels of physical activity have been linked to a reduced risk of AD ³³ . When compared with those who reported no regular exercise, those reporting a high level of exercise had a decreased risk of AD developing in 5 years ³⁴ .
Smoking	Longitudinal cohort studies have identified a significantly increased risk of

²⁰ Patterson *et al.* (2008).

²¹ Patterson *et al.* (2007).

²² Patterson *et al.* (2008).

²³ Patterson *et al.* (2008).

²⁴ Patterson *et al.* (2007).

²⁵ Ivan *et al.* (2004).

²⁶ Vermeer *et al.* (2003).

²⁷ Henon *et al.* (2001).

²⁸ Honig *et al.* (2003).

²⁹ Jorm (2001).

³⁰ Kalmijn *et al.* (1997).

³¹ Scarmeas *et al.* (2006).

³² Larrieu *et al.* (2004).

³³ Patterson *et al.* (2007).

³⁴ Laurin *et al.* (2001).

Risk Factors	Association
	dementia and AD among tobacco smokers ³⁵ .
Education	There is evidence from longitudinal cohort studies that the risk of AD is increased among people who have received shorter periods (less than 12 years) of education ³⁶ .
Occupation/Environmental Exposure	Occupational exposure to environmental toxins such as pesticides, fertilizers, fumigants and defoliants was associated with an increased risk of AD ³⁷ .
Vaccinations	Prior inoculations against poliomyelitis, diphtheria, or tetanus and influenza have been found to be significantly associated with a lower risk of AD ³⁸ . In addition, inoculations of any kind appear to reduce risk of AD ³⁹ .
Vascular Dementia	
Cholesterol	High levels of low-density lipoprotein (LDL) appear to significantly increase a person's risk of developing vascular dementia ⁴⁰ .
Hypertension	Elevated systolic blood pressure (> 160 mm/Hg) has been found to be associated with an increased risk of VaD in women ⁴¹ .
Stroke	The temporal relationship between stroke and onset of dementia is a diagnostic criterion for VaD ⁴² . There is compelling evidence a stroke increases the risk of VaD.
Occupation/Environmental Exposure	Occupational exposure to pesticides and fertilizers was shown to increase the risk of VaD ⁴³ .
Diabetes Mellitus	There is evidence that the presence of diabetes mellitus increases the risk of VaD ⁴⁴ .

Other risk factors may include hyperthyroidism, high plasma homocysteine levels and head injuries. However more evidence is required in order to establish whether or not these risk factors are significantly associated with the onset of dementia

³⁵ Almeida *et al.* (2002).

³⁶ Kukull *et al.* (2002).

³⁷ Tyas *et al.* (2001).

³⁸ Verreault *et al.* (2001).

³⁹ Tyas *et al.* (2001).

⁴⁰ Dementia: Hope through Research 2009.

⁴¹ Patterson *et al.* (2007).

⁴² Patterson *et al.* (2007).

⁴³ Patterson *et al.* (2007).

⁴⁴ Patterson *et al.* (2007)

Mortality

Dementia is a progressive and debilitating disease which becomes more severe over time. With no treatment to delay or cure it, dementia is invariably fatal. Compared to non-demented elderly, the elderly with dementia have been shown to have a shorter life expectancy and age of onset has been shown to be a strong predictor of survival time. The survival period, defined as the time from disease onset to death, has been shown to decrease as the age of onset increases (Wolfson *et al.* 2001). This implies that individuals with dementia onset at older ages have a shorter survival period than those with dementia onset at a younger age. Wolfson *et al.* (2001) have estimated that the median survival after the onset of dementia is approximately 3.3 years. The shorter life expectancy observed among elderly with dementia may be a result of the risks associated with declining cognitive function and memory, mortality due to the disease process that interferes with brain function, or mortality due to comorbid conditions. Furthermore, dementia-related mortality tends to be underreported on death certificates. A study by Kiely and Mitchell (2008), found that among nursing home residents with end-stage dementia, dementia was not reported on death certificates in 37% of cases with postmortem dementia. Since mortality statistics are based on death certificates, mortality due to dementia is likely underestimated. In the US, the National Center for Health Statistics (NCHS) reported that AD was the fifth leading cause of death for Americans 65 years of age and older in 2004. These data are based on death certificates. Kiley and Mitchell (2008) found that AD was not reported on approximately 33% of death certificates in decedents with postmortem AD.

1.4 WHY IS DEMENTIA A PROBLEM

Aging Population

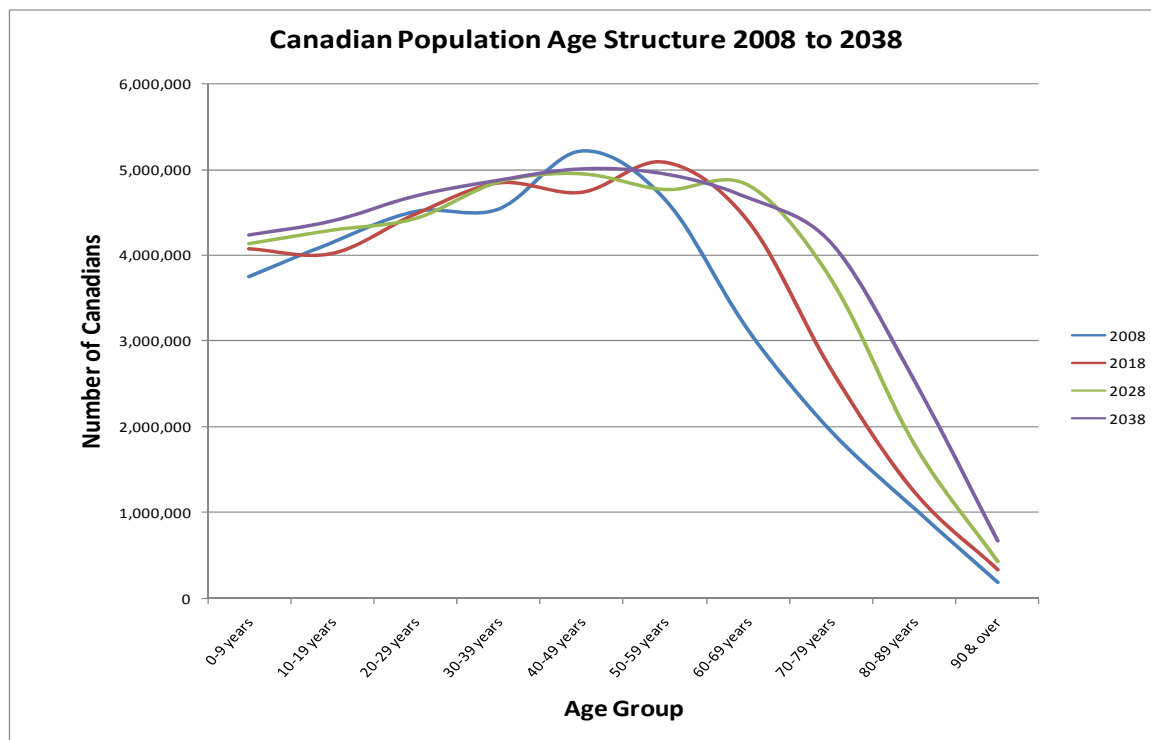
A key challenge faced by Canada is the aging of its population. As the Canadian baby boomer generation ages and the life expectancy of Canadians increases, the proportion of senior citizens relative to all other age-groups will rise. According to the Public Health Agency of Canada, the senior population in Canada is estimated to grow from 3.92 million in 2001 to 9.2 million by 2041⁴⁵. Between 1945 and 1965 the Canadian fertility rate was approximately 3 children per woman. It has since dropped and remained constant at 1.5 children per woman. This low fertility rate, coupled with an estimated life expectancy at

⁴⁵ Health Canada

birth of 81 years for men and 86 years for women by the year 2041, will significantly increase the proportion of seniors in Canadian population.

The complexities that surround the aging population will have a significant impact on the health and well-being of Canadian seniors as well as Canada's health care system and economy. Since age is a marker for many chronic health conditions and disabilities, the increasing number of seniors afflicted with chronic disease conditions and disabilities will place a significant burden on the capacity of Canada's health care system. This will also place a significant health and economic burden on the numerous informal caregivers who currently provide care to the elderly. In the future, there may be fewer adults to provide formal and informal care services to the large proportion of senior citizens in need of these services⁴⁶.

Exhibit 2 Expected Future Total Canadian Population as a Function of Age (Simulated Values): 2008 to 2038



As seen in **Exhibit 2**, the population projections generated within the Life at Risk® model show that the Canadian population is aging. Since age is an indicator for the onset of dementia, as the proportion of

⁴⁶ Cranswick and Dosman (2008)

senior citizens in Canada increases, the incidence and prevalence of dementia will also increase. Dementia places a significant and devastating impact on people with dementia, their families, caregivers and the health care system. Given the demographic shift within the Canadian population, the expected rise in dementia will place significant challenges on Canada's health care system and Canadian society as a whole.

Prevention and Early Diagnosis

The current lack of effective preventative approaches coupled with the expected increase in the incidence and prevalence of dementia has many researchers focusing on prevention strategies⁴⁷. Global research investigating preventative measures or measures to delay the onset of dementias have produced inconsistent results. However, epidemiological studies have proposed relationships between certain modifiable risk factors such as physical activity, diet, cardiovascular risks, pharmaceutical products, cognitive exercise and the likelihood of developing dementia.

Treatment and Management of Dementia

According to the CCG, patients with mild to moderate forms of dementia can be effectively managed by their primary physicians but the recommendation is that patients and their caregivers be referred to local Alzheimer Societies and other community support resources to enhance the delivery of quality care. For patients in later stages of the disease, the CCG recommends improvements in the quality of life while maintaining optimal function and comfort⁴⁸.

With an increasing understanding of mechanisms of the disease, greater attention is being given to identifying disease modifying treatments along with therapies to reduce symptoms⁴⁹. Current management of dementias such as AD is limited to the use of drugs for symptomatic treatment including cholinesterase Inhibitors and memantine hydrochloride⁵⁰:

A. Cholinesterase Inhibitors: Donepezil (Aricept™); Rivastigmine (Exelon™); Galantamine (Reminyl™)⁵¹.

⁴⁷ Carlsson and Middleton (2008)

⁴⁸ Canadian Consensus Guidelines (2007)

⁴⁹ Cummings *et al.* (2007)

⁵⁰ Gauthier *et al.* (2008)

⁵¹ Alzheimer's Society of Canada (2008)

Cholinesterase inhibitors work by preserving the ability of damaged nerve endings to transmit the nerve messages to the next cell in the chain⁵² and have been proven to benefit a significant proportion of those with diagnosed mild to moderate AD⁵³.

B. NMDA glutamate receptor blocker: Memantine Hydrochloride (Ebixa®).

Memantine is a drug used for patients with moderate to severe stages of AD and not recommended for use in mild stages of AD⁵⁴. It acts by blocking the glutamate receptors and preventing the re-uptake of glutamate into the nerve endings⁵⁵. A current development is the use of cholinesterase inhibitors in combination with drugs like Memantine Hydrochloride in selected situations⁵⁶.

For non-pharmacological therapies such as the use of antioxidants, cognitive training and rehabilitation, the CCG have concluded that there is insufficient evidence with respect to their efficacy in improving or maintaining cognitive abilities and function in patients with mild to moderate dementia and further research is required.

Caring for Patients, Families and Caregivers

Dementia not only affects patients but places a significant emotional and physical burden on families and informal caregivers. The ASC has estimated that AD is the second most feared disease of aging Canadians with approximately 36% of Canadians who know someone with AD, and 17% of Canadians who have someone with AD in their immediate family⁵⁷. Informal caregivers are usually family members, spouses or children, who provide unpaid care to recipients. Many informal caregivers are senior citizens themselves or are active participants in the labour force. This places considerable stress on their ability to effectively manage their own health and well-being while trying to perform their roles and responsibilities within the workplace creating an enormous psycho-social burden to informal caregivers.

There are many challenges faced by informal caregivers of patients with dementia. Since dementia is a progressive disease, the burden increases over time and the role of an informal caregiver evolves⁵⁸. Informal caregivers often face an emotional, physical and financial burden and the need for support

⁵² Alzheimer's Society of Canada (2008)

⁵³ Alzheimer's Society of Canada (2008)

⁵⁴ Canadian Consensus Guidelines (2007)

⁵⁵ Alzheimer's Society of Canada (2008)

⁵⁶ Alzheimer's Society of Canada (2008)

⁵⁷ Alzheimer Society 'Brain Health' Public Opinion Poll. Leger Marketing, 2006.

⁵⁸ Torjman and Makhoul (2008)

resources for informal caregivers often goes unrecognized. Support services for caregivers may include caregiver relief or respite care, education, counseling or psycho-social interventions.

Dementia patients may also rely on community-based care services. These often include a wide range of programs and support services for seniors, such as home care to assist with household tasks, nursing, adult day care, personal care, assisted living/support housing, case management, transportation and other community-based services. Dementia patients with more severe disease are often admitted into long-term care (LTC) facilities (nursing homes, residential care facilities, special care homes, continuing care centres or personal care homes) that provide accommodation, support and health care services to the chronically ill or disabled elderly who are no longer able to function independently within the community. The provision of LTC is not part of the Canadian Health Act nor is it 100% insured by any province or territory. The fees include accommodation, medical and personal care and are often out-of-pocket expenses for the patient⁵⁹.

Challenges faced for those residing in or requiring LTC include equity, access, wait times, quality of care and the burden of cost. The capacity of health care resources to meet patient needs is also a challenge. In Ontario, the need for additional resources to improve this capacity and to support an environment with a best practice approach to meeting patient needs has been identified⁶⁰. These challenges are enhanced with the specialized care required for patients with dementia. In Ontario, it is estimated that approximately 73% of LTC residents have some form of cognitive impairment or dementia⁶¹. Many of these patients also suffer from comorbid conditions.

As the baby-boomer generation ages the prevalence of chronic health conditions including dementia will increase. This will place enormous burden on the public health care system, LTC facilities and caregivers. The current challenges, such as equity of care, access to care, costs of care and quality of care will increase. As the proportion of elderly in the Canadian population increases, the health care system will likely face a human resource crisis. In the future, there may be fewer adults to provide formal and informal care services to meet the needs of Canadian seniors⁶².

⁵⁹ National Union of Public General Employees (2007)

⁶⁰ A Report of the Independent Review of Staffing and Care Standards for Long-Term Care Homes in Ontario (2008)

⁶¹ A Report of the Independent Review of Staffing and Care Standards for Long-Term Care Homes in Ontario (2008)

⁶² Cranswick and Dosman (2008)

2 APPROACH

2.1 OVERVIEW OF APPROACH TO MODELING DEMENTIA IN CANADA

Developing a model capable of evaluating the burden of dementia in Canada as well as the value proposition associated with dementia management interventions involved the following three phases:

Base Model Development

The base simulation model estimates the life and economic impacts of dementia in Canada over a 30 year period, 2008 through 2038, utilizing historical Canadian population and economic data as inputs. It further incorporates dementia-specific data including population-based epidemiological data, health care utilization data, formal and informal caregiver data, and direct and indirect costs associated with dementia. All data inputs were obtained from literature and additional sources recommended by dementia subject-matter experts.

To ensure the quality and accuracy of the base model, experts in the field of dementia participated in a workshop to develop a dementia patient care map, a step-by-step flow map that depicts the significant steps of a person with dementia through the health care system, from disease onset to death. The outcomes of this exercise were used to identify relevant data sources and to generate the base model which simulates this process. The dementia care map developed by experts is provided in Appendix C.

Scenario Development

Working with the ASC and its group of researchers and subject-matter experts, four scenarios which simulate the life and economic outcomes associated with implementing dementia prevention programs and patient and caregiver support programs were evaluated within the Life at Risk® modeling framework. The scenario development process involved the identification and definition of the proposed interventions by subject-matter experts as well as the identification of relevant data and literature sources and assumptions.

Business Case Development

The scenarios were implemented into the Life at Risk® framework and compared to the base model to derive the value proposition or business case conclusions. The business case demonstrates how the

proposed interventions could affect the life and economic impacts of dementia in Canada over the simulated period.

VALIDATION OF APPROACH AND OUTCOMES

Review and Validation of Base Model

An independent panel of recognized dementia epidemiologists was consulted to provide expert validation of the epidemiological inputs, modeling approach, assumptions and life term outputs of the base model. This included a review of the incidence, prevalence and mortality inputs and assumptions. Feedback on the appropriate population-based data sources and assumptions from the expert panel was incorporated into the base model to derive incidence, prevalence and mortality simulation results for dementia and its major sub-types, AD and VaD, over a 30 year time frame. Subsequently, the expert panel reviewed the reasonableness of the simulation outputs given the approach and assumptions applied.

Similarly, a recognized panel of health economists in the field of dementia was consulted to provide expert validation on the economic input data, modeling approach, assumptions and economic outputs of the base model. This included a review of the methods to decompose prevalence estimates into dementia care utilization groups. In addition the expert panel reviewed the direct health care costs and indirect costs associated with dementia patients and their caregivers. The feedback from the economic panel on the appropriate input data and assumptions was incorporated into the base model to derive the total direct and indirect costs associated with dementia over a 30 year time frame. Given the input data and assumptions applied, the economic panel reviewed the simulation outputs to ensure a reasonable estimate of the current and future economic burden of dementia in Canada.

3 LIFE AT RISK® METHODOLOGY

3.1 OVERVIEW OF METHODOLOGY: LIFE AT RISK®

OVERVIEW OF GENERAL MODEL AND ASSUMPTIONS

The Life at Risk® Model

The Life at Risk® simulation platform represents a cell based approach to modeling the dynamics of disease within a selected population (for example the Canadian population). Individuals are divided into independent population groups called cells, based on their individual characteristics. By definition each cell contains a set of indistinguishable individuals that be further subdivided under the criterion of the cell's description. The description of each cell is characterized by a unique **state vector** that represents a way of describing the population cell while distinguishing it from all other population cells. For example, a possible state vector associated with population cell i can be written as:

$$\vec{P}(i) = \begin{pmatrix} \text{Age} = (74, 75) \\ \text{Sex} = \text{Male} \\ \text{Location} = \text{Ontario} \\ \text{Race} = \text{Caucasian} \\ \text{Occupation} = \text{Teacher} \\ \vdots \\ \text{Dementia} = \text{No} \\ \vdots \end{pmatrix}$$

Individuals are allowed to move from one population cell to another by identifying all of the interactions or ways (represented by specific rates) at which this can happen. For example, healthy people can become sick or sick people can return to being healthy. The map that identifies all of the possible interactions is known as a **topology**⁶³ of the population. The **process** is a means by which individuals from one population cell can be moved into another population cell. Each process is identified with a specific **coupling coefficient (or rate)**⁶⁴, a mathematical way of identifying the rate at which individuals can flow from one population cell to another, say from cell A to cell B . The coupling coefficients serve as **constraints** on the number of individuals who are allowed to move from cell A to cell B within a specific

⁶³ Gemignani (1990)

⁶⁴ Brauer and Castillo-Chavez (2001)

period of time. When the coupling coefficients are stochastic, then the constraint represents a distribution or range of values instead. In this case the modeled system is stochastic⁶⁵ and therefore any simulation will be represented by an expected value along with a confidence interval. For further details please refer to the supplementary appendix titled *Dementia Model Methodology Life at Risk®: Mathematical Model*.

The number and description of population cells, each with its own unique state vector is identified with the requirements of a specific problem. The availability and quality of data will often impact the way in which the population can be split into specific population cells. Each population cell in the model is identified with a unique **coupled ordinary differential equation (CODE)**⁶⁶. This equation describes the rate of change of the individual's state vector magnitude associated with that population cell. The equation states that the rate of change is proportional to the various ways in which individuals can move into and out of other cells (as defined by the topology and coupling coefficients). The equations are automatically determined within the Life at Risk® framework once the topology and coupling coefficients are identified and implemented into the program. The full set of these equations describes the complicated network of the constrained ways in which individuals are allowed to move from one population cell to another, mathematically this represents the evolution of the state vector magnitude of each population cell. The mathematical solution of the CODE set is then simply, the evolution of the population as individuals move from one population cell into another. In the event that some or all of the coupling coefficients are stochastic, the CODE becomes a set of stochastic coupled ordinary differential equations (SCODE) and its solution will instead reflect the stochastic nature of its parameters. The key components of the Life at Risk® population model and assumptions are summarized in **Exhibit 3**.

⁶⁵ That is, randomly-determined through the incorporation of random variables.

⁶⁶ Brauer and Castillo-Chavez (2001)

Exhibit 3 Key Components of the Life at Risk® Model and Assumptions

Key Components	Assumption
Population Cell	The population is divided into population cells based on their population characteristics (such as age, sex, health state, etc.)
Net Migration	This is driven by the future immigration trends. Since immigration trends are mainly driven by unknown future policy, the future immigration is assumed to follow historical trends.
Net Flow of Individuals	The rate of change of the number of individuals within each cell can be represented by a set of first order ordinary differential equations in the continuous limit. In the discrete limit, the rate of flow can be approximated using a numerical algorithm.
Individuals within a Cell	The number of individuals within a population cell can be represented by a non integer quantity.
Fertility	Future fertility rates (average number of children per woman) follows past trends obtained from Statistics Canada.

The Life at Risk® simulation platform serves as a decision analytic policy model. In this capacity the model can be defined as an analytic tool that simulates the changes in population characteristics over time, using data imported from primary and/or secondary sources. The purpose of this tool is to estimate the effects of an intervention on valued health consequences and costs⁶⁷. The Life at Risk® approach is designed to respond to many research questions that may be proposed by different perspectives of a health care system and the community it serves. For example, the Life at Risk® approach can be used to: (1) define the magnitude of disease in patient volume, potential years of life lost in disability, mortality and economic values; (2) justify intervention programs; (3) assist in the

⁶⁷ Cohen and Neumann (2008)

allocation of research dollars on specific diseases; (4) provide a basis for policy and planning relative to prevention and control initiatives; and (5) provide a life impact and economic framework for program evaluation⁶⁸.

Within the Life at Risk[®] platform, the possible future health states of a population along with the associated disability and economic burden are simulated. By incorporating the relationships between different populations, the natural history of the disease, socio-economic risk factors, epidemiology and economic impacts, the simulation framework generates the possible future states for a series of important variables. These include the possibility of exposure to future risk factors as well as their impacts upon the prospective status of a health condition, the performance of screening examinations (if applicable), the effectiveness of treatment in various stages, the risks of complications, the competing mortality risks, and the direct and indirect loss of income from disability, death or treatment. The results of discrete event simulation provide a region of possibilities⁶⁹ which can be interpreted and managed by decision-makers. The aim of the Life at Risk[®] management framework is a reliable, robust, objective and independent means of evaluating the life and economic burden of disease and the cost-effectiveness of health interventions proposed by the literature or by researchers.

The study design of the life and economic burden of a disease and the evaluation of different health care policies in terms of cost-effectiveness and cost-benefit analyses is structured based on the following steps^{70 71 72}.

- A. **Identification of the perspective:** The Life at Risk[®] approach to simulating impacts of disease takes on different perspectives (e.g. society, federal and provincial government) and considers the financial impacts of disability regardless of who pays the costs and who benefits from the effects. The relevant direct and indirect financial impacts and disability effects are measured to the extent provided by the resource utilization (health costs) and data on incidence and mortality.

⁶⁸ Rice (2000)

⁶⁹ The results of the simulations are not just one solution trajectory but rather multiple trajectories or possibilities. The region in which all trajectories lie is known as the possibility space and represents the region of all possible future outcomes based on the information provided by peer reviewed empirical models (eg. clinical trials) and empirical data (eg. historical and surveillance data, health costs).

⁷⁰ Drummond *et al.* (1997)

⁷¹ Gold *et al.* (1996)

⁷² Rice (2000)

- B. **Identification of the quantities of concern:** The relevant quantities of interest for a burden of disease study and policy decision-making metrics are identified. Such quantities take the form of life and economic attributes:
- i. Life attributes: incidence, mortality and the associated disability take into account population demographics such as age, sex, geography and disease type;
 - ii. Economic attributes: direct health care cost components, direct non-health care cost components and indirect cost components take into account population demographics and disease impacts such as age, sex, geography, disease type and economic disability attributed to the disease
- C. **Identification of the history:** Comprehending the future requires an analysis of the past that incorporates evidence-based empirical models and empirical data such as peer reviewed journals and historical and surveillance data, respectively;
- D. **Simulation of the base case:** As derived from A and C, the future life and economic burden of disease (expressed in terms of the quantities in B is simulated *without* any proposed changes to the status quo. This is called a base simulation of population health and economic results and forms the foundation of what literature calls the burden of disease⁷³. These results represent the expected population health and economics without an intervention, with the results being derived in the perspective of health, disability, health costs and economic productivity. The base case results are derived from retrospective clinical and economic data such as historical data of a specified frequency.
- E. **Identification of the alternatives:** Candidate prevention, screening or treatment policies for implementation are 'alternate' scenarios that are required to be compared with the base case results that represent a 'usual care' scenario^{74 75}.

⁷³ Rice (2000)

⁷⁴ Drummond *et al.* (1997)

⁷⁵ Gold *et al.* (1996)

- F. **Simulation of different intervention scenarios:** As derived from *C*, *D* and *E*, the future life and economic burden of disease is simulated *with* the proposed changes to current policies on, for example, prevention strategies or treatment protocols during hospitalization. These ‘alternate’ scenarios represent the status of population health and economics under the added constraint of interventions proposed by subject matter experts.
- G. **Analysis of the value proposition of different intervention scenarios:** The differences between the base analysis in *D* and the ‘alternate’ scenario simulations in *F* yield the value proposition of a health care intervention. In the Life at Risk® framework, the test of cost-effectiveness and cost-benefit analyses is subject to specific statistical techniques^{76 77 78 79 80}. The costs and effects of the base case results and the ‘alternate’ scenario results are analyzed separately. Subsequently, the two sets of results are compared to determine a measure of the extent to which the interventions proposed by subject-matter experts are expected to influence the future health of the population as well as the related economic performance. These results support policy makers in their evaluations of simulated health care interventions in terms of cost-effectiveness analysis and cost-benefit analysis^{81 82}.

THE STRUCTURE OF THE MODEL

Conducting burden of disease simulations and the evaluation of different health care policies is a challenging task. It requires the mapping and modeling of many facets of the community that are directly related to the response to a disease and those facets that respond to the provision of health care. Given the complexity associated with the task, Life at Risk® is structured as a set of modules which allow for proper identification of inputs and outputs that are relevant to the decision-making component of the economic evaluation⁸³ and the distinction between simulation cell types. The simulation module form of Life at Risk® is:

⁷⁶ Barber and Thompson (1998)

⁷⁷ Thompson and Barber (2000)

⁷⁸ Coyle *et al.* (1998)

⁷⁹ Coyle (1996)

⁸⁰ Desgagne *et al.* (1998)

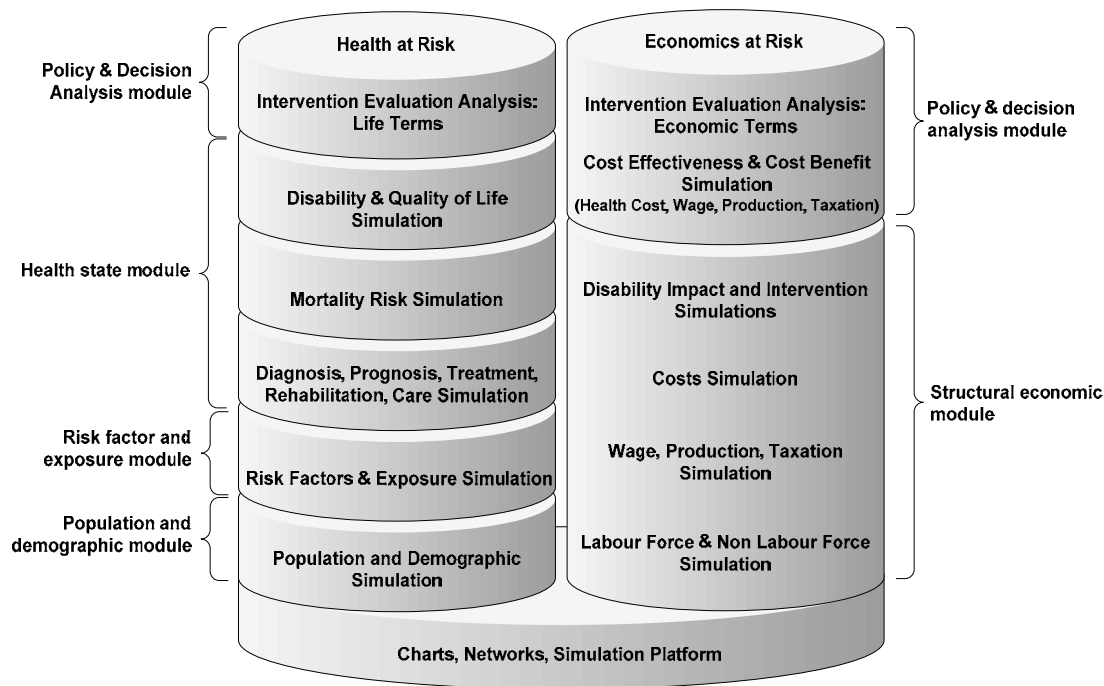
⁸¹ Drummond *et al.* (1997)

⁸² Korthals-de Bos *et al.* (2004)

⁸³ Weinstein *et al.* (2003)

- **Population and demographic module:** all model specifications and simulations of the population in terms of age, sex, race, other important demographic factors, and region.
- **Risk factor and exposure module:** all model specifications and simulations of the disease risk factor exposures, attributable risk (etiologic fractions, excess fractions, relative risk).
- **Health state:** all model specifications and simulations of screening routines, incidence (by severity/stage of the disease), mortality (by severity/stage of the disease and other causes), prevalence (by severity/stage of the disease and the disease survival time); treatment routines, after hospital care routines, disability (by severity/stage of the disease).
- **Structural economic module:** all model specifications and simulations of labour force (further by industry, employed part-time, employed full-time, unemployed), dependents and non-dependents, wages, production functions, income and consumption taxation rates (by government type), corporate revenues and profits, consumption from wages, consumption from production functions, interest rates, inflation rates (by CPI basket components), gross domestic product (key income and expenditure components), demand for health care services and products.
- **Policy and decision analysis module:** all model specifications and simulations of cost effectiveness, cost benefit, direct impact from disability (in terms of population non-participating in labour force, wages by industry, corporate profits by industry, costs and demand for health care services and products, GDP key income and expenditure components), indirect impact from disability (using same attributes as direct impact from disability).

Exhibit 4 Life at Risk® Modules:



THE LIFE AT RISK® DEMENTIA MODEL, DATA AND ASSUMPTIONS

Population Demographics

All population demographics were obtained from Statistics Canada's CANSIM database. These include:

- Provincial and Territorial populations in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0001)
- Provincial and Territorial deaths in Canada by 1 year age intervals from 1971/72 to 2006/07 (CANSIM Tables 051-0002)
- International immigration in Canada by 1 year age intervals from 1971/72 to 2006/07 (CANSIM Tables 051-0011)
- International emigration in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0012)
- Inter-provincial migration in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0013)

Epidemiological Data

Health states of the population were generated using the demographic model and static incidence and mortality rates while retaining a static prevalence proportion. Dementia prevalence and the prevalence of major subtypes (AD and VaD) were estimated from a combination of data from the 1991 Canadian Study of Health and Aging (CSHA) and European data from the EURODEM studies provided in Berr *et al.* (2005)⁸⁴.

Dementia prevalence was weighted based on each study's population sample size:

- The weight for each study was obtained from its relative sample size (the sample size within the study).
- The expert panel advised that the study by Ravaglia *et al.* (2002) contained in Berr *et al.* (2005) be omitted as a result of its highly skewed distribution.
- The prevalence from each study was combined and weighted to produce an overall distribution of prevalence. The weights were assumed to be proportional to the size of the sample in each study.
- The age-specific prevalence was then assumed to be the prevalence of the mid-points of each age-group. A cubic smoothing spline was then applied to provide a smooth fit across each age.

Dementia incidence rates and the rates of major subtypes (AD and VaD) were estimated from the CSHA 1996 follow-up study.

- The proportions of incident cases were assumed to remain constant throughout the simulation period.
 - The age-specific incidence rates were assumed to be the incidence rates of the mid-points of each age-group. A cubic smoothing spline was then applied to provide a smooth fit across each age.

Mortality was estimated using data from the CSHA (Wolfson *et al.* 2001)

- Simulations were generated using AD survival data from the CSHA (Wolfson *et al.* 2001).
- It was assumed that the AD survival rates in Wolfson *et al.* (2001) are the same as the rates for all forms of dementia.

⁸⁴ Prevalence from the Italian study was omitted as a result of its skewed distribution.

- The mean survival time for people with dementia was compared to the estimated survival times for the general population.
- The age-specific survival time was assumed to be the value at the mid-point of each age-group. A cubic smoothing spline was then applied to provide a smooth fit across each age.
- A mortality-specific odds ratio was constructed to indicate the ratio of expected deaths for those with dementia to the expected deaths assuming they did not have the disease.

Within the dementia model, dementia incidence and prevalence estimates in Canada are entirely dependent upon the Canadian demographic simulations. Since the incidence and the prevalence proportions are assumed to remain static from the CSHA, the future changes in dementia incidence and prevalence are the artefact of the simulated future changes in the population's age and sex structure. These are driven primarily by the aging of the current population (in particular the baby boomers). The model used the survival data (after the onset of dementia) from the Wolfson *et al.* (2001) study to estimate the relative survival for those with dementia against those without dementia. The study was based on the CSHA and concluded that dementia shortens the life expectancy among males and females. Mortality odds ratios were derived by comparing the results of the study against the life expectancies of those without dementia (available readily from Statistics Canada). The ratios indicated the relative possibility of death among those with dementia against those who have never before been diagnosed with the disease.

Health Care Utilization and Costs

The Canadian prevalent population, individuals alive with dementia at a specific point in time was subdivided into population cells based upon their care and treatment. Individuals were classified as receiving no formal care, receiving community-based care or residing in LTC. The 1991 CSHA estimated the proportions of LTC residents in Canada with and without dementia. However, from the LTC population it is not fully understood who is in LTC directly as a result of their dementia and who is in LTC as a result of other co-morbid conditions. In order to understand the incremental cost of LTC that can be attributed to dementia, it is important to distinguish between those who are in LTC with dementia due to their dementia and those who are in LTC with dementia due to other comorbid conditions.

The proportions of individuals entering LTC as well as those within community care in Ontario are reported in Tranmer *et al.* (2003). The historical proportion of those residing in LTC with dementia was assumed to apply to the future dementia prevalence simulations providing an estimate for the current and future numbers of people residing in LTC with dementia. A further division of dementia patients into those with co-morbid conditions as well as those suffering just from dementia was adopted from Wodchis *et al.* (2008). The study indicated that in Ontario for the year 2007/08 nearly 18% of residents admitted to LTC directly following an acute care hospitalization had AD or a related dementia as the principle diagnosis on their acute care discharge record. In this context, the current model assumed that 18% of all dementia patients residing in LTC were admitted into LTC with dementia as their primary diagnosis. However, the actual percentage of those admitted into LTC from the community or other non-acute care facilities due to their dementia is unknown. The Wodchis *et al.* (2008) study also indicated that 8% of LTC residents with dementia in Ontario between April 1, 2006 and March 31, 2008 did not have any other major co-morbidities such as cardiac conditions, hip fractures, stroke or hemiplegia.

As a result, the dementia model assumes that the 8% of those residing in LTC with dementia have no other major co-morbidities and were admitted into LTC with dementia as their primary diagnosis (because of their dementia). Wodchis *et al.* (2008) further estimated that the cost per resident per day for those with dementia is approximately 1.06 times the average cost of LTC. The simulated prevalence of dementia is subdivided into those receiving no formal care, those receiving community-based care and those residing in LTC. Based on the results from Wodchis *et al.* (2008) it was assumed that a minimum of 8% of the LTC prevalent cases are in LTC because of their dementia. This represents a lower boundary to the number of residents in LTC with dementia due to the disease.

Based on the results from Tranmer *et al.* (2003) it was assumed that a maximum of 46.8% of the LTC prevalent cases are in LTC because of their dementia. This represents a maximum boundary to the number of residents in LTC with dementia due to the disease. It can be assumed that the number of people with dementia in LTC because of their dementia lies between 8% and 46.8%. Rather than using the midpoint of this range as an approximation to the number of people with dementia in LTC as a result of their dementia, it was assumed that 18% of residents were in LTC with dementia because of the disease. This implies that the proportions of those with dementia admitted to LTC because of their dementia from the community or other non-acute care facilities is the same as those admitted from

acute care. It is further assumed that the proportions of those with dementia in LTC in Ontario are representative of the rest of Canada and that the costs of LTC for patients with dementia is 1.06 times the average cost of LTC.

In summary, the division of dementia prevalence into type of care was based on the following data and assumptions:

1. Prevalence of Dementia in LTC

- Tranmer *et al.* (2003) provides the proportions of people with dementia in LTC for 2000 by age and sex.
- Statistics Canada Table 107-5509⁸⁵ provides the number of beds, of which people with dementia occupy 64.3% in 2000.
- People with dementia in LTC beds are dependent upon the demand for beds and the supply of beds.
- The supply of beds is determined from a log function of dementia prevalence and LTC beds as determined from history (1991 to 2006).
- The demand for beds is determined by holding constant the proportions of people with dementia in LTC by age and sex from Tranmer *et al.* (2003).
- The actual number of people with dementia that occupy a bed is determined by holding the dementia occupancy rate of 64.3% of LTC beds constant.
- As of the year 2000 there is a difference between the demand for beds and the supply of beds for people with dementia.

2. Prevalence of Dementia in LTC with Dementia as the Primary Diagnosis

- Set at 18% by an assumption justified from Wodchis *et al.* (2008): In Ontario in 2007/08, 18% of residents admitted to LTC directly following an acute care hospitalization had AD or related dementia as the principle diagnosis on their acute care discharge record.

3. Prevalence of Dementia in LTC with Other Comorbid Health Conditions as the Primary Diagnosis

- Set at 100%-18% to be consistent with the previous assumptions.

⁸⁵ Occupancy based on beds staffed and in operation in residential care facilities, by principal characteristic of the predominant group of residents and size of facility, Canada, provinces and territories, annual

4. Prevalence of Dementia in Community-Based Care

- Tranmer *et al.* (2003) provides the proportions of people with dementia in community care for 1998;
- There is a difference between the demand for LTC beds and the supply of LTC beds for people with dementia. This difference is used as a correction to the simulation of people with dementia in community care over time;
- The proportion of people with dementia in community care over time is calculated as the Tranmer *et al.* (2003) proportions along with the difference between the demand for LTC beds and the supply of LTC beds for people with dementia.

5. Prevalence of Dementia in Community-based Care with Dementia as the Primary Diagnosis

- The same assumption used for the prevalence in LTC due to dementia (18%) is also assumed here.

6. Prevalence of Dementia in Community Care with Other Comorbid Health Conditions as the Primary Diagnosis

- Set at 100%-18% to be consistent with previous assumptions.

7. Prevalence of Dementia for those Receiving No Formal Care

- This is the balance of people with dementia less LTC less those in community care.

8. Prevalence of Dementia for those Receiving No Formal Care with Dementia

- The same assumption used for Prevalence in LTC Due to Dementia (18%) is assumed here.

9. Prevalence of Dementia for those Receiving No Formal Care with Other Comorbid Health Conditions

- Set at 100%-18% to be consistent with previous assumption.

Direct Health Costs Due to Dementia

The direct health costs associated with dementia are summarized in **Exhibits 5** and **6** on the following pages. Direct costs were estimated via three modes of dementia care: those who reside in LTC facilities, those who receive community-care support and services, and those who receive no formal care. Each care mode was then subdivided into those who entered each care mode with a diagnosis of dementia (as a result of their dementia) or those whose dementia onset occurred while receiving care for an unrelated or comorbid health condition. Incremental costs are calculated for those with dementia as a comorbid condition, to isolate the costs of care attributable to dementia alone.

In summary the costs were derived from the following sources:

- The costs of medication reported in Hux *et al.* (1998) were used as proxies to estimate the annual costs of prescription medication;
- The costs published in Hollander *et al.* (2002) were used as proxies to estimate the following:
 - Long-term care costs;
 - Physician services costs;
 - Home care services costs;
 - Community care services costs;
 - Costs of purchased services and facility user fees; and
 - Caregivers' out-of-pocket expenses.
- It is further assumed that the proportions of those with dementia in LTC in Ontario are representative of the rest of Canada and that the costs of LTC for patients with dementia is 1.06 times the average cost of LTC;
- It is assumed that there are no direct health care costs for those people living with dementia that are not using formal care services;
- These costs were simulated, adjusting for inflation over time.

Exhibit 5 Dementia, Health System Direct Costs, Dementia Clients in LTC Facility

Variable	Value	Source
Health System Direct Costs		
Annual Costs of Medication (1996 dollars)	\$81.00	Hux <i>et al.</i> (1998)
Annual Long-Term Care Staff Costs (1991/1992 dollars)	\$19,228.60	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Annual Support Staff Costs (1991/1992 dollars)	\$9,263.75	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Annual Administrative Costs (1991/1992 dollars)	\$15,512.50	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Annual Physician & Hospital Costs (1991/1992 dollars)	\$518.01	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Personal out-of-pocket costs (caregivers and clients)		
Annual Facility User Fees (1991/1992 dollars)	\$11,849.81	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Out-of- Pocket Expenses (1991/1992 dollars)	\$1,379.10	Hollander, Chappell, Havens, McVilliam, & Miller (2002)

Exhibit 6 Dementia, Health System Direct Costs, Dementia Clients in Community

Variable	Value	Source
Health System Direct Costs		
Annual Costs of Medication (1996 dollars)	\$39.00	Hux <i>et al.</i> (1998)
Annual Long-Term Care Staff Costs (1991/1992 dollars)	\$16,164.27	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Annual Physician & Hospital Costs (1991/1992 dollars)	\$1,625.12	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Variable	Value	Source
Personal out-of-pocket costs (caregivers and clients)		
Annual Purchased Services (1991/1992 dollars)	\$947.39	Hollander, Chappell, Havens, McVilliam, & Miller (2002)
Out-of- Pocket Expenses (1991/1992 dollars)	\$2,780.95	Hollander, Chappell, Havens, McVilliam, & Miller (2002)

Direct Health Costs Due to Comorbid Dementia

- Incremental LTC direct health care costs due to dementia as a comorbid condition is 6%.
- Incremental community care direct health care costs due to dementia as a comorbid condition is 52.9% as taken from Shapiro and Tate (1997), by using incremental average costs of home care for dementia.
- It is assumed that there are no direct health care costs for people living with dementia that are not using formal care services.

Out-of-Pocket Expenses for Dementia Prevalence for those Not Receiving Formal Care

- **Not receiving formal care due to dementia**
 - It is assumed that this is equal to out-of-pocket expenses when in community care due to dementia.

- **Not receiving formal care due to comorbid dementia**
 - It is assumed that this is equal to out-of-pocket expenses when in community care due to comorbid dementia.

Informal Caregivers

Exhibits 7 through 12 summarize the data used to approximate informal caregiver hours and costs across each care mode. These were calculated as costs directly due to dementia and costs due to dementia as a comorbid condition.

Exhibit 7 **Dementia, Informal Caregiver Hours, Dementia Clients in LTC Facility due to Dementia**

Variable	Value	Source
Net supervision (hour/month) when person in facility care	9.47hrs	Weighted for Mild, Moderate, Severe: Hux <i>et al.</i> (1998)
Direct care (hour/month) when person in facility care	29.8hrs	

Exhibit 8 **Dementia, Informal Caregiver Hours, Dementia Clients in LTC Facility due to a Comorbid Condition**

Variable	Value	Source
Incremental net supervision (hour/month) when person in facility care	3.9hrs	Adjusted proportionally for difference between average hours per home care user for no cognitive impairment and average hours per home care user for dementia: Shapiro and Tate (1997).
Incremental direct care (hour/month) when person in facility care	12.2hrs	

Exhibit 9 **Dementia, Informal Caregiver Hours, Dementia Clients in Community due to Dementia**

Variable	Value	Source
Net supervision (hour/month) when person in community	54.95hrs	Weighted for Mild, Moderate, Severe: Hux <i>et al.</i> (1998)
Direct care (hour/month) when person in community	112.3hrs	

Exhibit 10 **Dementia, Informal Caregiver Hours, Dementia Clients in Community due to a Comorbid Condition**

Variable	Value	Source
Incremental net supervision (hour/month) when person in community	22.53hrs	Adjusted proportionally for difference between average hours per home care user for no cognitive impairment and average hours per home care user for dementia: Shapiro and Tate (1997).
Incremental direct care (hour/month) when person in community	46.05hrs	

Exhibit 11 **Dementia, Informal Caregiver Hours, Dementia Clients not in Formal Care due to Dementia**

Variable	Value	Source
Net supervision (hour/month) when person not in formal care	19.4hrs	Taken from Hux <i>et al.</i> (1998) for mild dementia only.
Direct care (hour/month) when person not in formal care	68.8hrs	

Exhibit 12 **Dementia, Informal Caregiver Hours, Dementia Clients not in Formal Care due to a Comorbid Condition**

Variable	Value	Source
Incremental net supervision (hour/month) when person not in formal care	7.95hrs	Hux <i>et al.</i> (1998) for mild dementia adjusted proportionally for difference between average hours per home care user for no cognitive impairment and average hours per home care user for dementia: Shapiro and Tate (1997).
Incremental direct care (hour/month) when person not in formal care	28.21hrs	

Economic Model

The economic model considers the effects of dementia with respect to one's ability to be productive in their workplace. In this context, the simulated Canadian dementia population is further divided into employed and unemployed. In addition, the unpaid informal caregivers (assigned to each dementia patient within the model) are likewise identified as employed and unemployed. The amount of time lost due to dementia or unpaid care for those with dementia is assumed to be directly linked with loss of production in one's place of employment. The state of the employed population's health at any particular time was assumed to be a key parameter of the Canadian production capacity and therefore the economic welfare of the entire country. In this respect a coupled economic model capable of estimating the costs of dementia in terms of lost productivity in the workplace has been incorporated. This represents a macro-economic model in which the demand for labour and other relevant economic variables are simulated directly from the underlying industry data. A change in the health status of an employed individual will have an impact upon production. Both, the disability due to dementia as well as lost time from the place of employment sacrificed as a result of unpaid informal care was assumed to be associated with work absenteeism, resulting in an overall decrease in labour hours and therefore a decrease in production. This loss in production is directly linked to the loss of income, consumption and investment. The benefits of a healthier population, from the standpoint of the economy are an increase in the possible choices of production. The economic model embedded in the current study is a version of a model known as Klein's Model⁸⁶. The frequency of the data is typically annual and applies to either provinces or territories or Canada as a whole. For more information on the economic model please refer to the supplementary appendix titled Life at Risk® Economic Framework.

Economic Model Summary and Assumptions

- Economic disability is assumed to correspond to one's reduction in productivity in their work place. The reduction is computed with respect to the production capacity of a healthy individual with no disease-attributable disability within their workplace;
- The disability associated with dementia is computed among the employed population only;
- The disability associated with dementia is computed from Statistics Canada Labour Force Survey and the Statistics Canada Participation and Activity Limitation Survey (PALS 2001) disability study;
- Unpaid caregivers exhibit the same employment rates as the general Canadian population;

⁸⁶ Klein (1950)

- The number of hours which an employed unpaid caregiver devotes for the provision of care to a dementia patient is directly proportional to the amount of time lost within his/her workplace;
- The amount of time which is lost at work is proportional to the loss of productivity. As a result, the amount of time which is spent on care-giving is indistinguishable from an economic disability.

Dementia Intervention Scenarios

The base dementia model represents the status quo of the current and projected dynamics or burden of dementia in Canada. That is, it represents the projected trend of dementia prevalence under the assumption that the current treatment of dementia in Canada continues and no additional interventions (from the status quo) are introduced into the system. The dementia intervention scenarios represent a series of “what if” scenarios under which specific input parameters of the base model change. The resulting effects on the future dynamics of dementia prevalence, health care costs and the related economic burden are attributed directly to this intervention. In the present study four independent interventions are considered:

- **Intervention scenario 1:** A primary prevention of new dementia cases is implemented through the increase in physical activity. This intervention targets the population of individuals without dementia by reducing their relative risk of dementia diagnosis as their daily physical activity levels are increased by 50%.
- **Intervention scenario 2:** This scenario will examine the impact of prevention programs that could delay the onset of dementia by 2 years.
- **Intervention scenario 3:** This scenario will examine the impact of caregiver support programs on admission into LTC facilities and caregiver burden. It is assumed that the admission into LTC can be (on average) delayed by 1.5 years. In addition the program will reduce the number of hours which caregivers devote to the care of dementia patient through program services and support.
- **Intervention scenario 4:** This scenario will examine the impacts of assigning a system navigator to all newly diagnosed dementia patients, (to provide care coordination and caregiver support) on delaying admission into LTC and reducing the overall care costs.

The assumptions and input data used for each of the dementia intervention scenarios are further outlined in Section 5.

4 THE CURRENT AND FUTURE BURDEN OF DEMENTIA IN CANADA

4.1 HEALTH BURDEN OF DEMENTIA IN CANADA

NUMBER OF NEW CASES OF DEMENTIA IN CANADA

In 2008, the simulation results estimated a total of 103,728 new cases of dementia in Canada among those ages 65 and older. Of these approximately 49% (50,336 cases) were estimated to be diagnosed with Alzheimer's disease (AD) and 21% (21,837 cases) with vascular dementia (VaD). **Exhibit 13** shows the current and projected dementia incidence in Canada for males and females over the next 30 years. The number of new cases of dementia as well as major subtypes, AD and VaD, are increasing over time. By 2038, new cases of dementia will more than double to reach 257,811. Within the next 30 years, AD and VaD incidence is estimated to be 2.6 and 2.4 times higher respectively, than current estimates.

Exhibit 13 **Current and Future Dementia Incidence in Canada, Selected Years, Ages 65+ by Sex: 2008-2038**

Incidence of Dementia in Canada			
Year	Males	Females	Total
2008	42,660	61,068	103,728
2018	59,597	78,061	137,658
2028	86,295	107,369	193,664
2038	115,461	142,350	257,811

Exhibit 14 on the following page illustrates the changes in the annual number of newly diagnosed dementia cases. The annual number of new cases is higher in women than men, with an average ratio of approximately 1.3 throughout the simulation period. The average female to male ratio of new AD cases is approximately 2 and approximately 1.8 for VaD cases throughout the simulation period.

Exhibit 14 Current & Future Dementia Incidence in Canada, Ages 65+ by Sex: 2008-2038

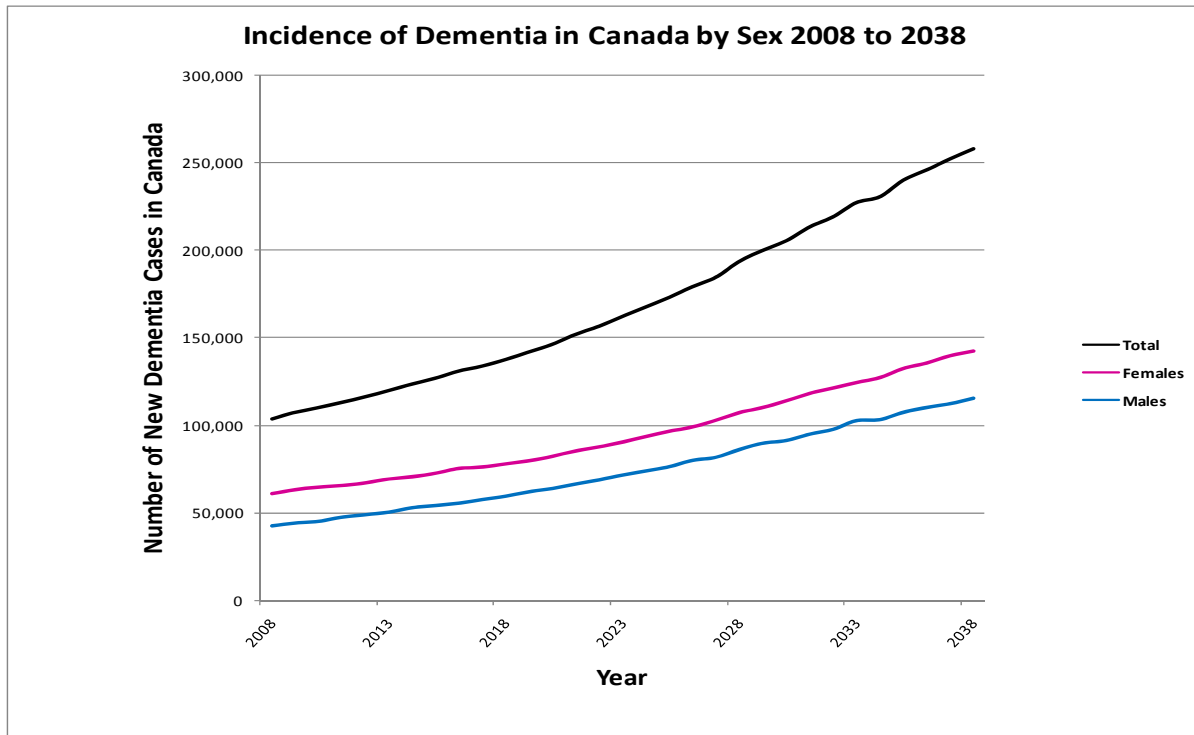
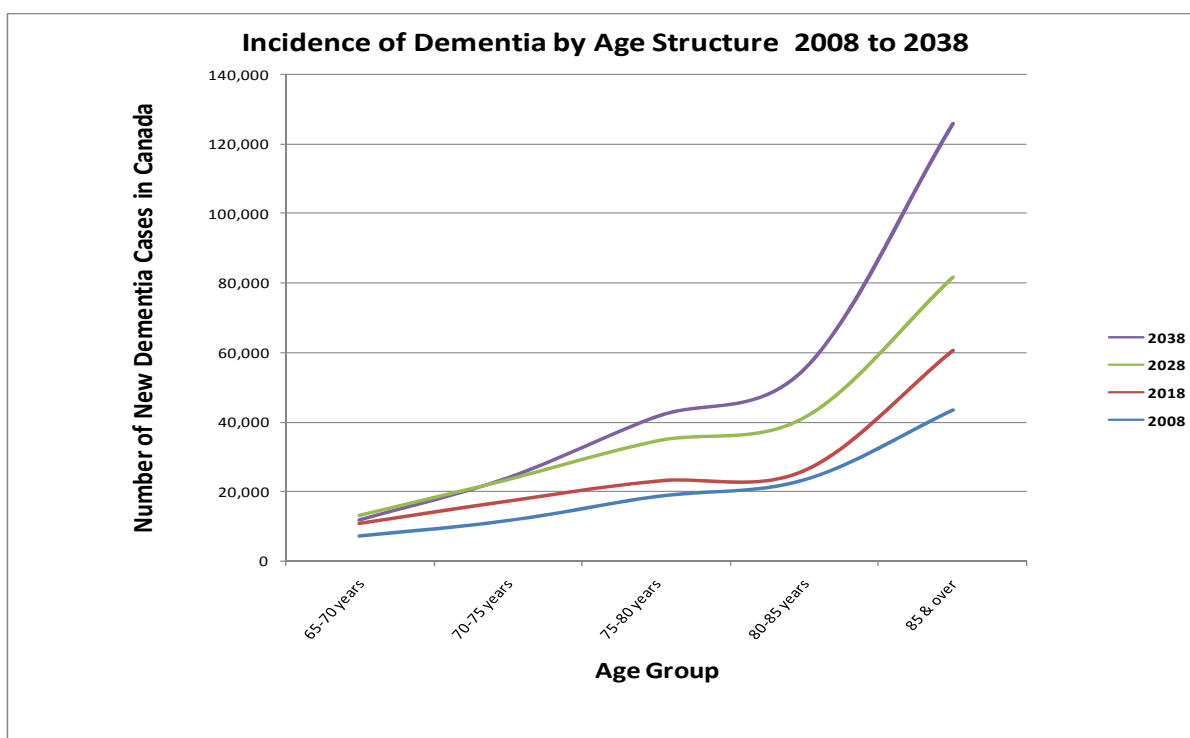


Exhibit 15 illustrates the simulated future incidence of dementia in Canada by year and age-group. The age-specific incidence results indicate that age is a major risk factor for dementia and over time the number of older Canadians with new diagnoses of dementia, is expected to increase on an annual basis. In 2008, 33% of men diagnosed with dementia were over the age of 85. This number is expected to increase to 43% by 2038. In 2008 approximately 46% of women diagnosed with dementia were over the age of 85. Similarly, this number is expected to increase to 52% by 2038.

Exhibit 15 **Current & Future Dementia Incidence in Canada, by Year & Age-Structure for those 65+: 2008-2038**



For additional details on the age and sex distribution of dementia incidence and its major subtypes please refer **Appendices F** through **G**.

NUMBER OF PEOPLE LIVING WITH DEMENTIA IN CANADA

Simulation results for the year 2008 estimated a total of 480,618 Canadians living with dementia. Of these approximately 63% (303,878) were estimated to be living with AD and 19.5% (94,183) with VaD.

Exhibit 16 shows the current and projected dementia prevalence in Canada for males and females over the next 30 years. The number of people living with dementia as well as its major subtypes, AD and VaD, is increasing in Canada over time. By 2038, this number is expected to reach over 1.1 million. Within the next 30 years, AD and VaD prevalence is estimated to be 2.5 and 2.3 times higher, respectively than current estimates.

Exhibit 16 **Current & Future Dementia Prevalence in Canada, Selected Years, Total Population by Sex:**
2008-2038

Prevalence of Dementia in Canada						
Year	Males	% of Canadian Male Population	Females	% of Canadian Female Population	Total	% of Canadian Population
2008	180,653	1.1	299,961	1.8	480,613	1.5
2018	245,418	1.4	389,711	2.2	635,129	1.8
2028	331,899	1.8	516,435	2.7	848,334	2.2
2038	439,621	2.2	685,563	3.4	1,125,184	2.8

Note: The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 17 **Current & Future Dementia Prevalence in Canada, Total Population: 2008-2038**

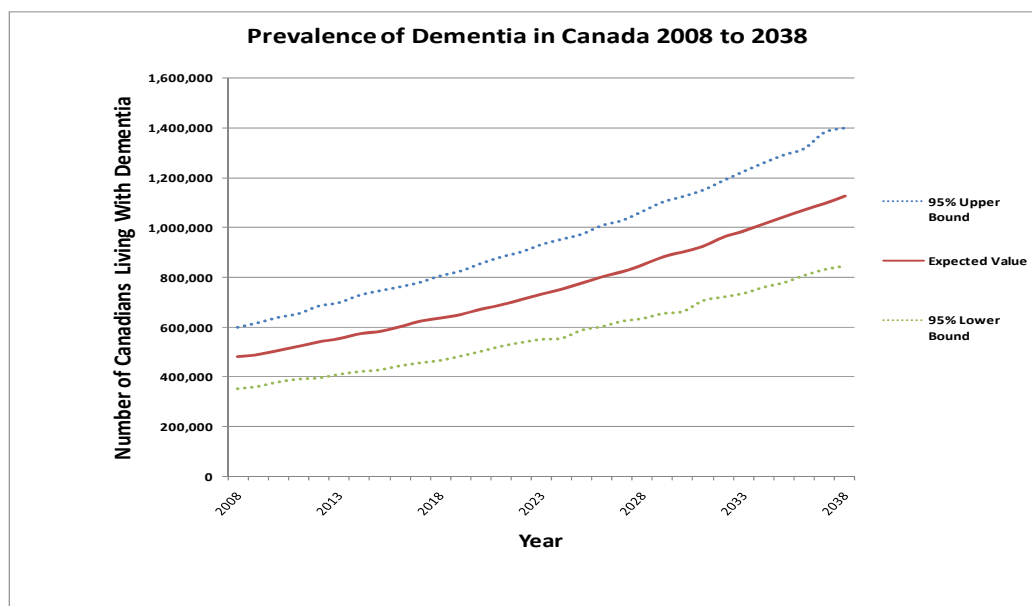


Exhibit 18 illustrates the projected dementia prevalence by sex. The prevalence of dementia is higher in women than men, with a ratio of approximately 1.36 throughout the simulation period. The average female to male ratio for the prevalence of AD and VaD is approximately 2.29 and 0.85, respectively throughout the simulation period.

Exhibit 18 **Current & Future Dementia Prevalence in Canada, Total Population by Sex: 2008-2038**

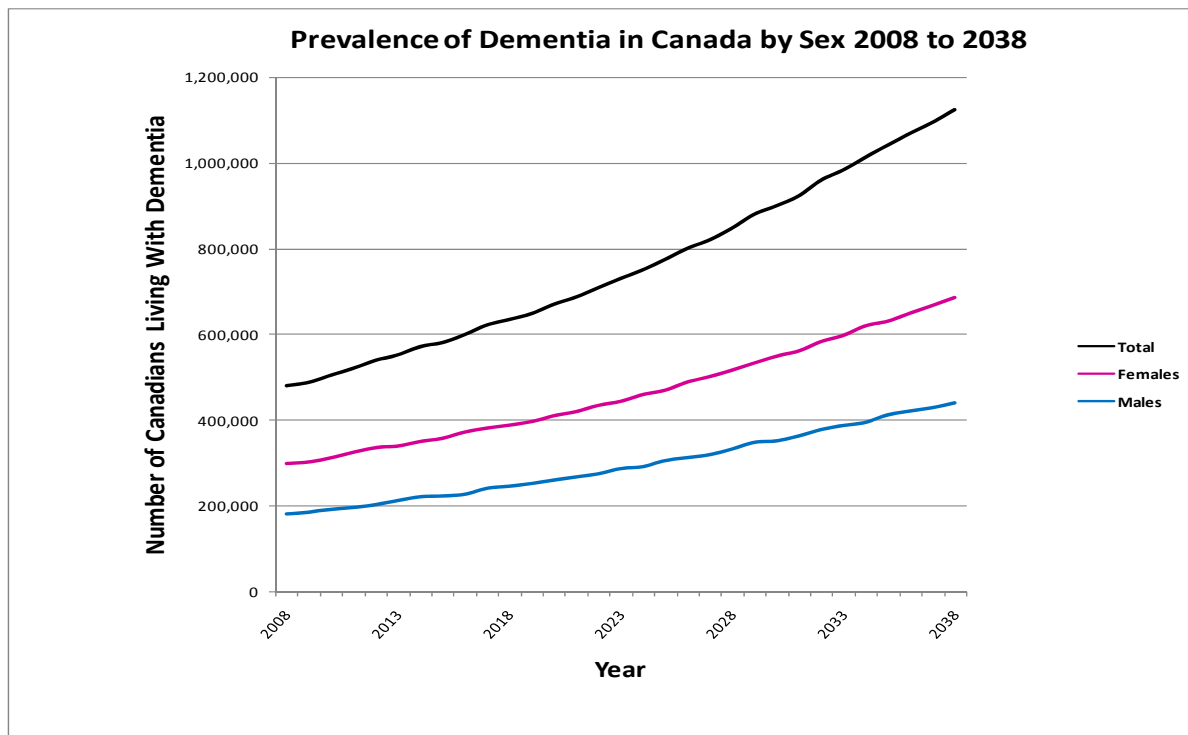
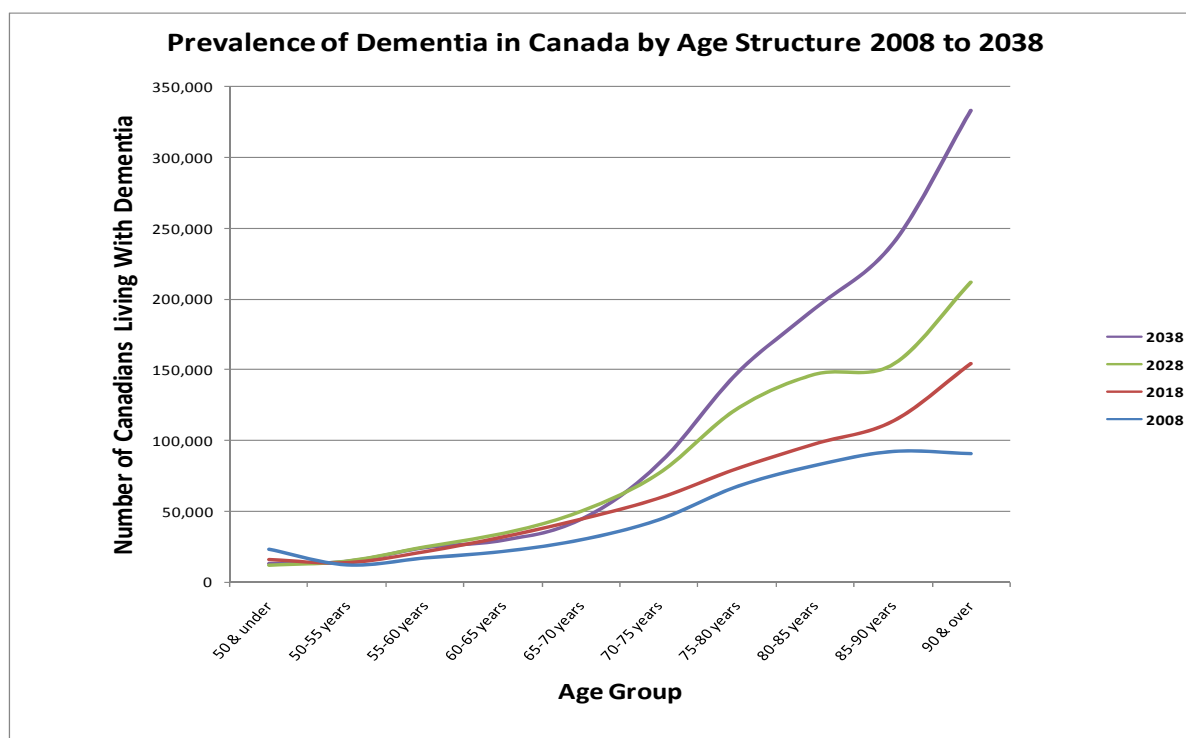


Exhibit 19 illustrates the simulated future prevalence structure of dementia in Canada by year and age-group. Over time, the results show that the number of older Canadians living with dementia is expected to increase. In 2008, approximately 60% of females and 45% of males living with general dementia were over the age of 80. By 2038, these numbers are expected to increase to approximately 73% of females and 60% of males. Approximately 71% of males and females living with AD in 2008 were over the age of 80. Within the next 30 years, approximately 78% of individuals living with AD will be over the age of 80. For the prevalent VaD population approximately 51% were estimated to be over the age of 80 in 2008. By 2038, this number is expected to increase by an additional 10%.

Exhibit 19 **Current & Future Dementia Prevalence in Canada, Total Population by Year & Age-Structure:**
2008- 2038



In 2008 approximately 7% of Canadian seniors over the age of 60 were estimated to be living with general dementia. Within the next 30 years this number is expected to increase to 9%. As the Canadian population ages, dementia prevalence is increasing and is highest among those over the age of 90. In 2008, approximately 49% of Canadian seniors over the age of 90 were living with dementia. By 2038, this number is expected to increase to 50%. For additional details on dementia prevalence by subtype, age-group and sex please refer **Appendices F** through **G**.

MORTALITY

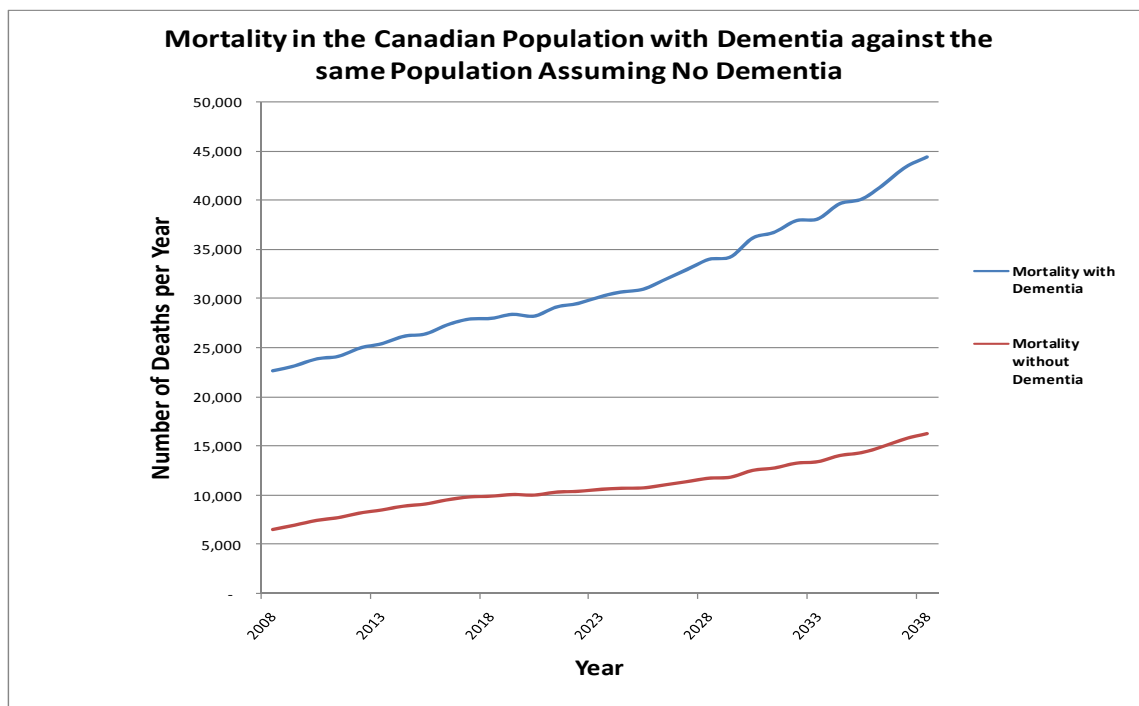
People with dementia have a lower life expectancy than those without the disease. In order to assess how these numbers compare to the general population without dementia, the mortality of the healthy population was simulated. The simulations were conducted under the condition that all deaths (death among those with and without dementia) had to reproduce the total mortality rates obtained from Statistics Canada. **Exhibits 20** and **21** show the mortality rates of the population with dementia as compared to the population assuming they did not have the disease.

Exhibit 20 Mortality of the Population With Dementia against the same Population assuming they do not have the Disease, Ages 65+, by Sex: 2008-2038

Mortality of the Population with Dementia against the same Population assuming they do not have the disease						
Year	Males with Dementia	Females with Dementia	Total with Dementia	Males without Dementia	Females without Dementia	Total without Dementia
2008	8,688	13,975	22,662	2,358	4,165	6,523
2018	11,678	16,300	27,977	3,865	6,036	9,901
2028	14,889	19,080	33,969	4,958	6,768	11,726
2038	20,344	24,016	44,360	7,239	9,014	16,253

Mortality rates for people with dementia are increasing over time. In 2008, the number of deaths for those with dementia was estimated to be 22,662. By 2038 this number is expected to almost double to 44,360. The mortality of this population, under the assumption that they had no dementia is much lower. Although it still increases over time, as an effect of the changing population demographics, the mortality counts remain much lower throughout the simulation period. Under the assumption of no dementia, the numbers of deaths in 2008 were estimated to be 6,523. Over the 30 year simulation period, this number increases to 16,253.

Exhibit 21 Mortality of the Population with Dementia against the same Population assuming they do not have the Disease, Ages 65+: 2008-2038



For each sex, **Exhibit 22** on the following page illustrates the change in the mortality for the population with dementia against the changes in mortality for that same population assuming they had no dementia. The mortality in the populations with and without dementia indicates that rates are higher in females than males throughout the simulation period. However, the female to male ratio is decreasing over time. This may be an effect of the change in life expectancy over time. For the population with dementia, the female to male ratio decreases from 1.61 to 1.18 over the 30 year simulation period. Within that same population, under the assumption that they did not have dementia (removing the excess risk of death associated with dementia); the female to male ratio is shown to decrease from 1.77 in 2008 to 1.25 in 2038.

Exhibit 22 Mortality of the Population with Dementia against the same Population assuming they do not have the Disease, Ages 65+, by Sex: 2008-2038

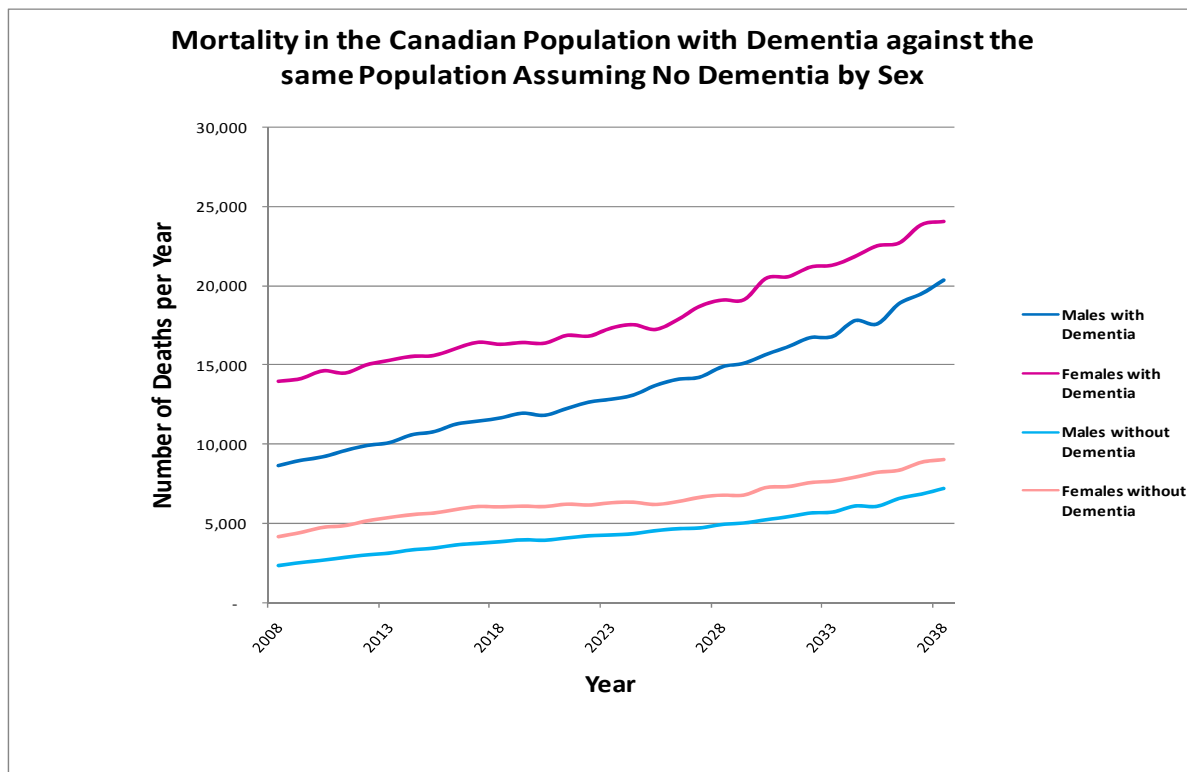


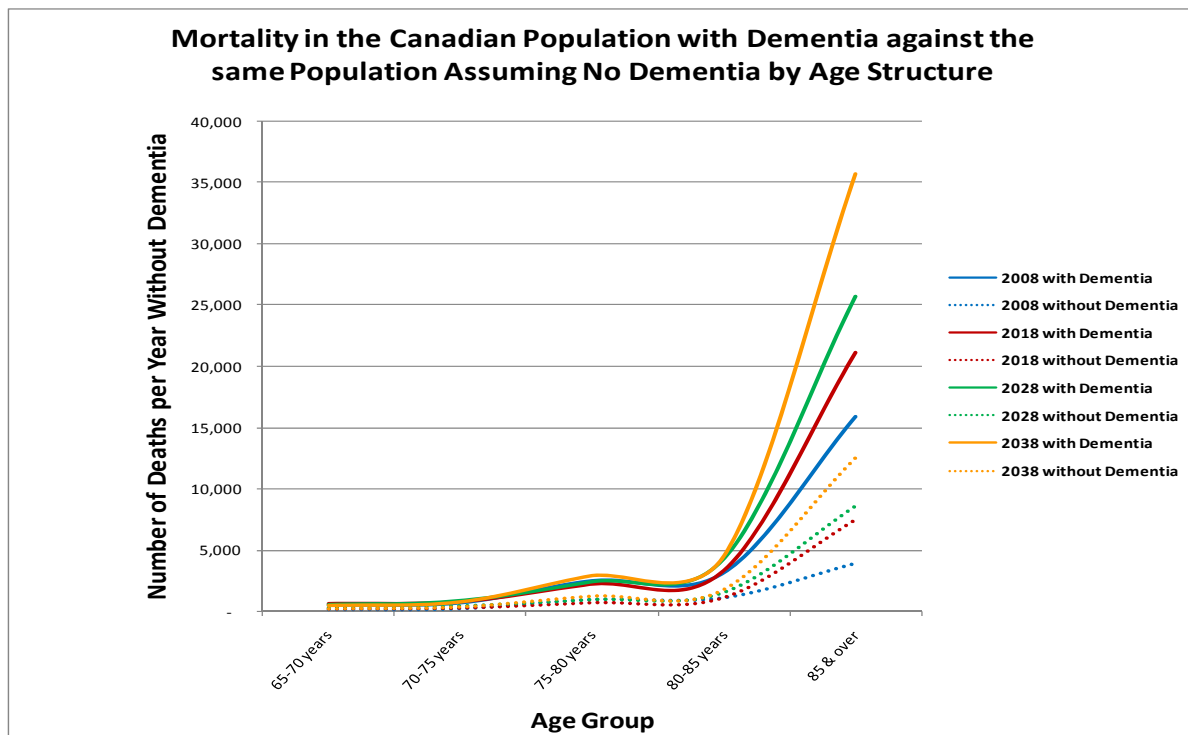
Exhibit 23 provides the simulated future mortality structure of dementia and the mortality structure removing the higher risk of death associated with dementia for those aged 85+.

Exhibit 23 Mortality of the Population with Dementia against the same Population assuming they do not have the Disease, Ages 85+ by Sex: 2008-2038

Mortality of the Population with Dementia against the same Population assuming they do not have the disease for the Population Over the Age of 85						
Year	Males with Dementia (Ages 85+)	Females with Dementia (Ages 85+)	Total with Dementia (Ages 85+)	Males without Dementia (Ages 85+)	Females without Dementia (Ages 85+)	Total without Dementia (Ages 85+)
2008	5,168	10,753	15,921	1,070	2,839	3,909
2018	7,969	13,163	21,132	2,592	4,892	7,484
2028	10,447	15,254	25,701	3,306	5,258	8,564
2038	15,839	19,855	35,694	5,340	7,156	12,496

The higher risk associated with dementia mortality by age-group is shown in **Exhibit 24**. The effects of the general aging of the Canadian population are clearly evident among Canadian seniors.

Exhibit 24 Mortality of the Population with Dementia against the same Population assuming they do not have the Disease, Ages 65+, by Year and Age-Structure: 2008-2038



For additional details on dementia mortality please refer **Appendix D**.

4.2 DEMENTIA AND HEALTH CARE UTILIZATION

The current Life at Risk® model monitors the trends in health care utilization among individuals suffering from dementia. Individuals are classified into three care modes/settings: long-term care (LTC), community care (CC) or no formal care. Under the assumption that the proportions of people with dementia across each care mode remain constant throughout the simulation period and taking into account the number of beds available in LTC facilities, **Exhibit 25** presents the prevalence of dementia, for those ages 65 and older, according to the each care mode. Similar to the total prevalence results in Section 4.1, the prevalence of dementia is increasing across each care setting over the 30 year simulation period. This increase in prevalence across each setting is primarily driven by the changing age-structure of the Canadian population.

Exhibit 25 Dementia Prevalence by Care Setting, Ages 65+: 2008-2038

Prevalence of General Dementia by Care Type in Canada (Ages 65+)						
Year	Prevalence of Dementia in LTC	% of Prevalence: People with Dementia in LTC	Prevalence of Dementia in CC	% of Prevalence: People with Dementia in CC	Prevalence of People with Dementia in No Formal Care	% of Prevalence: People with Dementia in No Formal Care
2008	183,268	45.4%	134,416	33.3%	85,938	21.3%
2018	249,268	41.8%	221,970	37.3%	124,553	20.9%
2028	335,882	39.4%	337,682	39.6%	178,747	21.0%
2038	442,682	37.6%	503,661	42.7%	232,146	19.7%

Exhibit 26 illustrates the trend in the type of care utilized by dementia patients over the age of 65. The number of people receiving community-based care is expected to increase at a slightly faster rate than those in LTC, while the growth in the number of people receiving no care maintains a constant rate. The most dramatic increase in prevalence was associated with the number of people receiving community-based care. The number of dementia patients in community care is expected to increase by approximately 370,000 over the next thirty years. This number is considerably larger than the projected increases of 260,000 and 140,000 for those residing in LTC or those receiving no formal care, respectively. The simulation results show community care overtaking LTC as the dominant mode of

dementia care in Canada by the year 2028. This is likely a result of the limited number of beds available in LTC facilities, here it was assumed that the number of people with dementia that occupy LTC beds remains constant at 64.3% throughout the simulation time frame. This higher growth rate of community care utilization, as compared to LTC and no formal care, is expected to remain constant throughout the simulated period.

Exhibit 26 **Prevalence of Dementia by Care Setting, Ages 65+: 2008-2038**

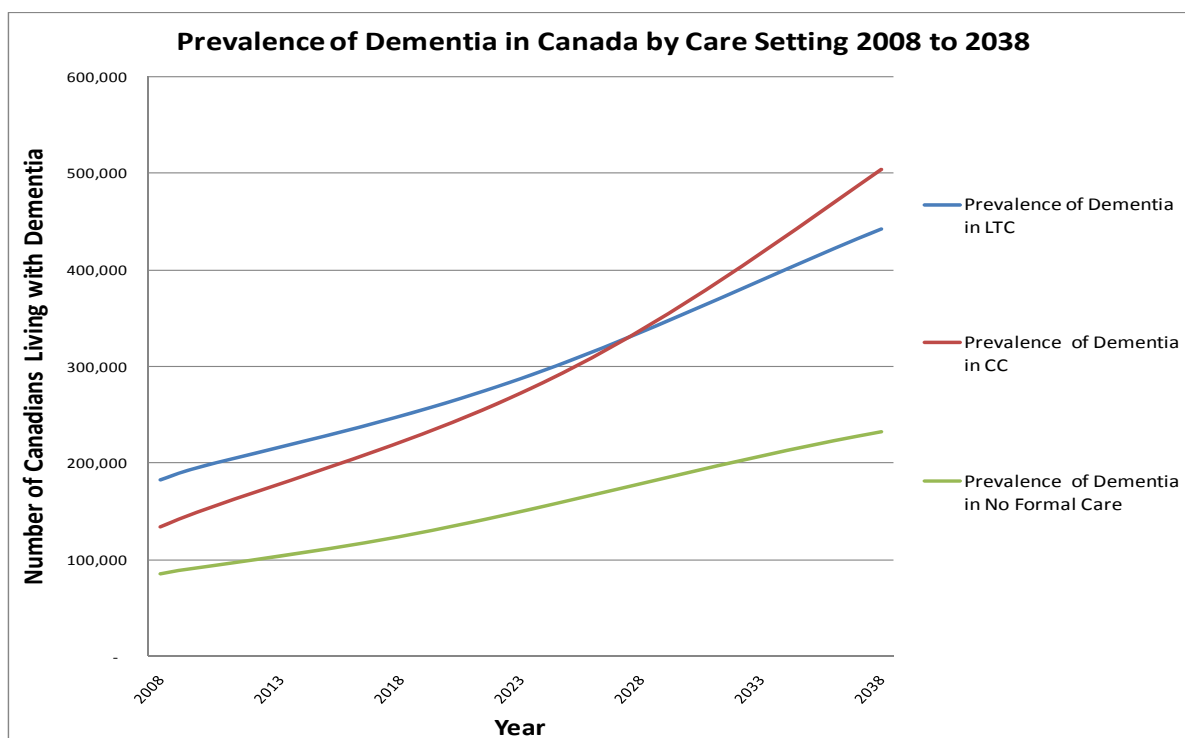
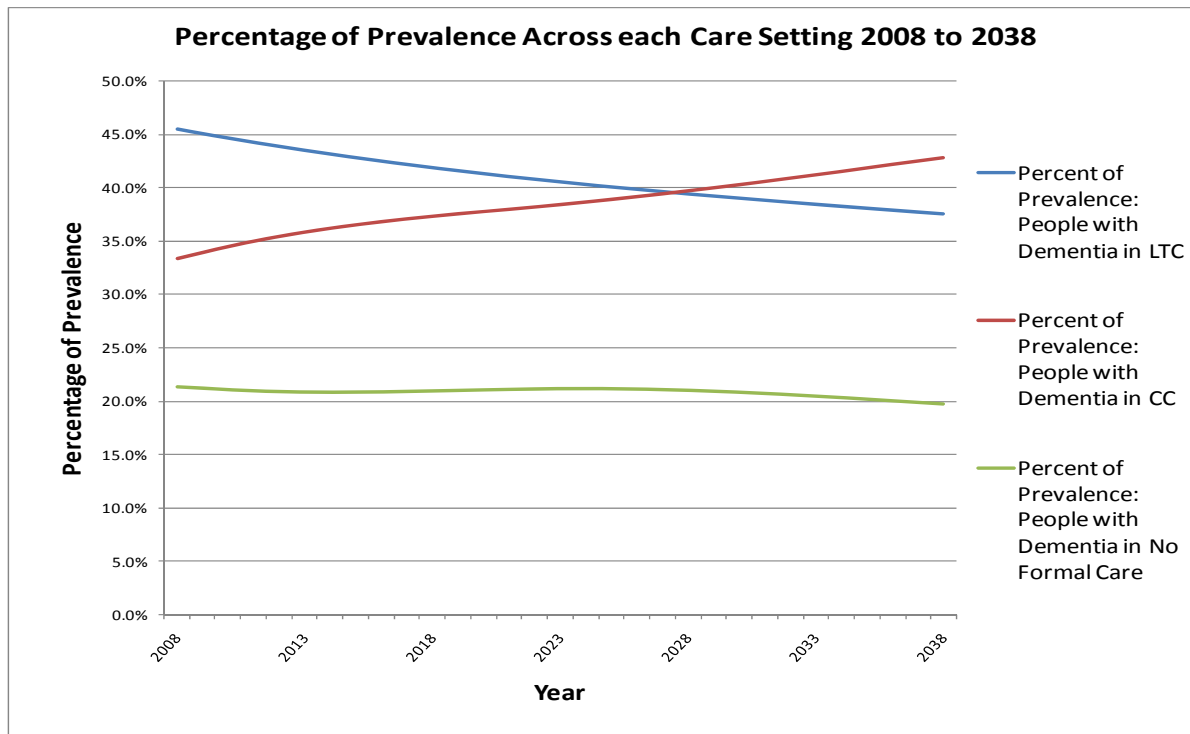


Exhibit 27 on the following page provides the percentage of those aged 65 and older living with dementia in each of the three care settings. The simulation results show the percentage of dementia patients in community care increasing from 33.3% in 2008 to 42.7% by 2038. Conversely, the percentage of dementia prevalence in LTC is expected to steadily decline from 45.4% in 2008 to 37.6 % by 2038, while those receiving no formal care remains constant at around 21% throughout the simulation period. The rate of growth in community care appears to be the inverse of the rate of decline in LTC. This is due to the fact that not all individuals are able to enter into LTC due to resource limitations and as a result they are assumed to receive community-based care. In other words, the results suggest that those requiring LTC may be relying on community care as a result of the unavailability of LTC beds.

Exhibit 27 **Division of Dementia Prevalence into Care Settings, Ages 65+: 2008-2038**



The total supply of LTC beds and the number of beds occupied by dementia patients (ages 65+) was simulated over a thirty year period beginning in 2008, under the assumption that the percentage of LTC beds occupied by dementia patients maintains its current value of 64.3%. The simulation results presented in **Exhibit 28** indicate an increase in the supply of LTC beds from approximately 280,000 in 2008 to nearly 690,000 by the year 2038. Under the current assumptions, this produced a proportional increase in the number of beds occupied by dementia patients. Also presented in **Exhibit 28** is the simulated number of people, over the age of 65, with dementia that would have been in LTC if there were an adequate supply of services available. This value was determined by applying the historic fraction of the total prevalence of dementia in LTC, to all future years in the simulated period. The projected shortage of LTC beds or “excess demand” for LTC services was calculated as the difference between the “the number of people living with dementia that would have been in LTC” and the “number of LTC beds occupied by dementia patients.” The simulation results show the excess demand for LTC services, measured by a shortage of beds, is increasing to approximately 160,000 people by the year 2038. This excess demand leading to shortage in the availability of LTC beds is expected to produce an increase in the utilization of community-based care as individuals unable to obtain LTC services turn to community based services.

Exhibit 28 **Supply of Long-term Care Beds and Number of Beds Occupied by Dementia Patients, Ages 65+: 2008-2038**

Supply and Demand of LTC Beds in Canada for Dementia Patients Ages 65+				
Year	Number of LTC Beds	Number of LTC Beds Occupied by Dementia Patients	Prevalence of Dementia That Would Have Been in LTC	Excess Demand for LTC Among Dementia Patients
2008	285,178	183,268	198,659	15,392
2018	387,880	249,268	296,473	47,204
2028	522,657	335,882	422,351	86,469
2038	688,846	442,682	600,142	157,461

For further details on dementia prevalence by care mode and the supply and demand for LTC please refer to **Appendix D**.

INFORMAL CARE HOURS

Exhibit 29 **Hours of Informal Care per Year, Long-term Care (LTC), Community Care (CC), No Formal Care: 2008-2038**

Hours of Informal Care For Long-Term Care (LTC) , Community Care (CC), No Formal Care				
Year	Informal Caregiver Hours in LTC	Informal Caregiver Hours in CC	Informal Caregiver Hours in No Formal Care	Total Hours of Informal Care
2008	44,593,849	139,289,343	46,955,109	230,838,301
2018	60,653,577	230,017,730	68,053,794	358,725,101
2028	81,728,906	349,924,438	97,664,641	529,317,984
2038	107,716,208	521,920,684	126,841,507	756,478,399

Exhibit 29 above summarizes the total number of hours worked by informal caregivers across each of the care modes. The total number of hours of informal care is expected to increase from over 230 million hours per year in 2008 to over 750 million hours per year by the year 2038. Informal caregivers within community care settings are estimated to provide the largest amount of care as compared to the amount of care provided when dementia patients are in LTC or are receiving no formal care. The

informal care hours within the community care setting are estimated to increase from approximately 140 million hours in 2008 to over 520 million hours in 2038. This increase is primarily a response to the increase of dementia prevalence within the community care setting.

4.3 ECONOMIC BURDEN OF DEMENTIA IN CANADA

Within the Life at Risk[®] economic framework, the economic burden of dementia is calculated as the sum of direct health costs, opportunity costs of unpaid informal caregivers and indirect costs. The following section provides a detailed analysis of each of the components that comprise the total economic burden of dementia.

Direct health costs are incurred during treating a particular disease. These costs can accrue within the formal health care system or outside of it. Direct health costs within the formal health care system, pertaining to dementia, include the cost of prescription medication, LTC staff costs, support staff costs, LTC administrative costs, physician and hospital costs. Direct health costs outside the formal health care system include the cost of over the counter medication and out of pocket expenses. All direct health costs are presented for dementia patients ages 65 and over.

The second element of the total economic burden of dementia is the opportunity cost of unpaid informal caregivers. Opportunity costs associated with providing informal care are the wages that could have been earned by informal caregivers, were they able to participate in the labour force. Analysis of the opportunity costs associated with the provision of informal care is provided in Section 4.3.2.

In order to obtain an accurate measure of the economic burden of dementia in Canada indirect costs must also be considered in addition to direct and opportunity costs. Indirect costs are costs that have no direct connection to dementia, but are a consequence of it. These costs represent the reduction in labour productivity resulting from disability due to dementia itself and the disability incurred by the provision of informal care to dementia care recipients. The indirect costs associated with dementia are derived from the simulated disability for individuals suffering from dementia and the burden placed on informal caregivers. The indirect costs include the lost wages and corporate profits resulting from disability associated with dementia and informal care. Furthermore, from the reduction in wages and corporate profits other indirect costs arise that cannot be directly related attributable to dementia. The reduced wages and corporate profits result in a decrease in consumer demand and a decrease in the amount of taxation revenue collected by both the federal and provincial governments. Lost domestic

demand and taxation revenue represent the cost of dementia borne by society but cannot be directly related to dementia attributable disability. For this reason, lost domestic demand and taxation revenue are not included when determining the total indirect costs of the disability associated with dementia. However, these costs do represent a substantial cost to society and are reported in Section 4.3.4.

All direct and indirect costs are presented in annual future values and 2008 cumulative present values. Future values are the nominal costs incurred in a particular year and provide an estimate of the changing annual cost of dementia. Future values are then converted to 2008 present values to determine the value of the future cost of dementia in the current period. The 2008 present values are summed, over ten year intervals, to determine cumulative total economic burden of dementia in 2008 dollars.

DIRECT HEALTH COSTS

Similar to the prevalence estimates, direct costs were estimated across each mode of care: for people with dementia that reside in LTC facilities, those with dementia who receive community-care support and services, and those with dementia who receive no formal care. Each group was then further categorized into those who entered their current form of care with a primary diagnosis of dementia and for those whose dementia onset occurred after receiving care for an unrelated or comorbid health condition. The total costs of care for those with dementia as a primary diagnosis as well as the isolated dementia-attributable incremental cost for those with dementia as a secondary disease or comorbid condition were reported.

The simulated direct health costs for individuals with dementia and informal caregivers are presented in **Exhibit 30**. The simulation results indicate that both total and incremental direct health costs are expected to more than double, every ten years for the next thirty years across each care setting. In addition to the direct health costs of individuals suffering from dementia, **Exhibit 30** includes the excess health costs associated with providing informal care. Informal caregivers often experience negative health outcomes due to the stressful nature of providing support to dementia patients, the costs of treating these negative health outcomes are captured within the excess health cost. The simulation results show the annual, excess direct health costs of caregivers increasing substantially every ten years, ultimately reaching a value of approximately \$979 million by the year 2038.

Exhibit 30 Dementia, Total and Incremental Direct Health Costs, Long-term Care (LTC), Community Care (CC), No Formal Care, and Informal Care, Future Values: 2008-2038

Direct Health Costs For Long-Term Care (LTC) , Community Care (CC), No Formal Care, and Caregivers, Future Values								
Year	Direct Cost LTC Due to Dementia	Incremental Direct Cost LTC Due to Comorbid	Direct Cost CC Due to Dementia	Incremental Direct Cost CC Due to Comorbid Dementia	Direct Cost No Formal Care Due to Dementia	Incremental Direct Cost No Formal Care Due to Comorbid Dementia	Excess Health Costs Associated with Caregivers	Total Direct Cost – All Modes of Care and Caregivers
2008	\$3,488,976,859	\$899,673,278	\$899,663,518	\$2,171,161,676	\$148,158,636	\$357,551,846	\$98,548,155	\$8,063,733,967
2018	\$7,814,993,328	\$2,015,186,959	\$2,446,654,228	\$5,904,520,732	\$340,327,241	\$821,313,134	\$230,551,918	\$19,573,547,540
2028	\$16,589,338,377	\$4,277,753,921	\$5,863,632,470	\$14,150,728,409	\$724,283,584	\$1,747,916,558	\$489,101,815	\$43,842,755,134
2038	\$33,243,745,344	\$8,572,286,535	\$13,297,576,167	\$32,091,095,371	\$1,361,996,359	\$3,286,911,426	\$979,197,580	\$92,832,808,780

Exhibit 31 converts the future values presented in **Exhibit 30** to their 2008 present values using the historic yields on the government of Canada bonds obtained from the Bank of Canada. The yield on zero coupon government of Canada bonds⁸⁷ with terms of maturity ranging from 0.25 years to 30 years were used to determine the appropriate discount factor to apply to each year of future costs. This was done to capture the time value of money by converting all future costs into 2008 dollars. The results presented in show cumulative total direct health costs of approximately \$490 billion dollars over the entire simulated period.

Exhibit 31 Dementia, Cumulative Total and Incremental Direct Health Costs, Long-Term Care (LTC), Community Care (CC), No Formal Care, and Informal Care, 2008 Canadian Present Values: 2008-2038

Cumulative Direct Health Costs For Long-Term Care (LTC) , Community Care (CC), No Formal Care, and Caregivers, 2008 Present Values								
Year	Direct Cost LTC Due to Dementia	Incremental Direct Cost LTC Due to Comorbid Dementia	Direct Cost CC Due to Dementia	Incremental Direct Cost CC Due to Comorbid Dementia	Direct Cost No Care Due to Dementia	Incremental Direct Cost No Care Due to Comorbid Dementia	Excess Health Costs Associated with Caregivers	Total Direct Cost – All Methods of Care and Caregivers
2008	\$3,488,976,859	\$899,673,278	\$899,663,518	\$2,171,161,676	\$148,158,636	\$357,551,846	\$98,548,155	\$8,063,733,967
2018	\$49,483,790,230	\$12,759,971,066	\$14,355,120,812	\$34,643,272,222	\$2,119,405,842	\$5,114,770,853	\$1,435,371,005	\$119,911,702,031
2028	\$107,898,793,861	\$27,822,959,423	\$33,963,531,583	\$81,964,330,756	\$4,687,316,392	\$11,311,919,968	\$3,162,657,570	\$270,811,509,553
2038	\$188,201,526,525	\$48,529,953,381	\$64,495,526,295	\$155,647,319,436	\$8,077,102,509	\$19,492,504,775	\$5,528,291,293	\$489,972,224,214

For a complete list of the costs in each year included in the analysis and a detailed breakdown of the components that comprise each cost category please refer to **Appendix D**.

⁸⁷ A zero Coupon bond is a debt security that doesn't pay interest (a coupon), rendering profits at maturity when the bond is redeemed for its full face value.

OPPORTUNITY COSTS OF INFORMAL CAREGIVERS

The second component of the total economic burden of dementia in Canada is the opportunity cost of providing informal care. This cost represents the lost wages that result from an individual's restriction from participating in the labour force because of informal care responsibilities. The opportunity costs associated with community care are considerably greater than those for LTC and those associated with no formal care. The higher costs reflect the larger role that informal caregivers play when providing care to dementia care recipients in the community. The annual total opportunity cost of unpaid caregivers is projected to increase from approximately \$5 billion dollars in 2008 to over \$55 billion dollars by the year 2038 (in Canadian future values). The costs in **Exhibit 32** are evaluated using the adult average hourly wage of \$21.64 in 2008⁸⁸ (for results evaluated at the minimum adult wage in Canada (\$8.37) please refer to **Appendix D**

Exhibit 32 Dementia, Total and Incremental Informal Care Opportunity Costs at Average Wages, Long-Term Care (LTC), Community Care (CC), and No Formal Care, Future Values: 2008-2038

Informal Caregiver Opportunity Costs for Dementia Patients in Long-Term Care (LTC), Community Care (CC), No Formal Care, At Average Wages, Future Values							
Year	Cost LTC Due to Dementia	Incremental Cost LTC Due to Comorbid Dementia	Cost CC Due to Dementia	Incremental CC Due to Comorbid Dementia	Cost No Formal Care Due to Dementia	Incremental Cost No Formal Care Due to Comorbid Dementia	Total Unpaid Caregivers Opportunity Cost
2008	\$336,476,524	\$628,534,364	\$1,050,987,865	\$1,963,233,516	\$354,293,079	\$661,815,489	\$4,995,340,836
2018	\$725,331,408	\$1,354,910,916	\$2,750,688,306	\$5,138,254,833	\$813,827,595	\$1,520,220,798	\$12,303,233,856
2028	\$1,449,381,353	\$2,707,428,073	\$6,205,563,971	\$11,591,923,737	\$1,731,985,851	\$3,235,330,099	\$26,921,613,083
2038	\$2,765,867,093	\$5,166,608,637	\$13,401,541,610	\$25,033,929,072	\$3,256,954,147	\$6,083,953,734	\$55,708,854,294

⁸⁸ 282-0071 Labour force survey estimates (LFS), wages of employees by type of work, North American Industry Classification System (NAICS), sex and age group, monthly (Dollars), Jan 1997-Sep 2006

The cumulative discounted opportunity costs of informal caregivers of dementia patients are reported in **Exhibit 33**. The results show the total opportunity costs exceeding \$300 billion dollars when calculated thirty years into the future.

Exhibit 33 Dementia, Cumulative Total and Incremental Informal Care Opportunity Costs at Average Wages, Long-Term Care (LTC), Community Care (CC), and No Formal Care, 2008 Present Values: 2008-2038

Cumulative Opportunity Costs of Informal Caregivers for Dementia Patients in Long-Term Care (LTC), Community Care (CC), and No Formal Care, At Average Wages, 2008 Present Values							
Year	Cost LTC Due to Dementia	Incremental Cost LTC Due to Comorbid Dementia	Cost CC Due to Dementia	Incremental Cost CC Due to Comorbid Dementia	Cost of No Formal Care Due to Dementia	Incremental Cost No Formal Care Due to Comorbid Dementia	Total Unpaid Caregiver Opportunity Cost
2008	\$336,476,524	\$628,534,364	\$1,050,987,865	\$1,963,233,516	\$354,293,079	\$661,815,489	\$4,995,340,836
2018	\$4,678,537,056	\$8,739,454,625	\$16,429,374,630	\$30,689,887,115	\$5,068,154,260	\$9,467,255,183	\$75,072,662,869
2028	\$9,925,658,275	\$18,541,018,076	\$37,751,455,816	\$70,519,295,072	\$11,208,821,864	\$20,937,953,236	\$168,884,202,340
2038	\$16,739,291,093	\$31,268,807,583	\$69,117,064,165	\$129,109,898,864	\$19,314,847,907	\$36,079,918,758	\$301,629,828,371

For further details on the opportunity costs associated with the provision of informal care please refer to **Appendix D**.

ECONOMIC DISABILITY

Within the Life at Risk[®] economic framework, economic disability is measured in terms of an individual's ability to perform in the labour force. A greater severity of disease results in a lower productivity level which reduces output and ultimately determines the indirect cost of disease. In order to obtain an accurate measure of the disability attributed to dementia, a disability index was applied to both individuals suffering from dementia and informal caregivers. The disability index was applied to informal caregivers to account for the reduced productivity resulting from the stress and fatigue associated with the provision of informal care. Given that the disability measure captures the purely economic aspect of any disease, namely the effects on productivity; the general disability of the Canadian population was computed as a function of the disease prevalence within the employed Canadian labour force. The total wages earned by Canadians as well as the number of employed by disability level were obtained from the Labour force survey and the PALS 2001 disability study from Statistics Canada. The economic model uses the disability level to compute the effects on presenteeism, absenteeism, and leaving the labour force as a result of the disease-attributable disability. The model further assumes that informal care can be treated as a form of economic disability and considers the impacts on presenteeism, absenteeism and leaving the labour force as a result of providing care to the care recipient. In this regard, informal caregiving is analogous to having a chronic health condition.

The total wages earned by Canadians were assumed to scale linearly according to their disability level:

$$W_{a,g}(t) = \sum_k W_{a,g}^k(t) E_{a,g}^k(t) (1 - d_{a,g}^k)$$

Where the average wages W associated with the number of employed individuals E (age a and sex s) are associated with a disability weight, d . Four levels of disability (k) are considered; no disability (functioning at normal capacity), mild disability, moderate disability and severe disability. The equation was solved for disability, d , under the constraint that the total wages earned by Canadians were satisfied. As shown in **Exhibit 35** mean values of 0.06, 0.24 and 0.65 were obtained for mild, moderate and severe disability respectively. The disability associated with dementia was reflected within this scale.

Individuals suffering from dementia and informal caregivers were categorized across each mode of care to account for patients in LTC, community care, and those not receiving any formal care. Each mode of

care was further subdivided into dementia patients who entered their mode of care with dementia as a primary diagnosis and those where dementia onset occurred while receiving care for an unrelated health condition (comorbid dementia).

Exhibit 34 shows the percentage of people with dementia in each severity category, according to the type of care received. It was assumed that there is no difference between disability levels of those in community care and those who received no formal care. Furthermore, it was assumed that there is no difference in the disability level of those within each care setting “due to dementia” and those “due to comorbid dementia.” Nearly 100% of dementia patients in LTC and over 80% both in community care and no formal care were considered severely disabled. This can be attributed to the nature of the disease itself. The onset of dementia typically requires an individual to leave the labour force, either from an inability to perform daily tasks or for health and safety concerns.

Exhibit 34 **Percentage of Dementia Patients Disabled, By Severity Level and Mode of Care, Ages 65+**

Disability of General Dementia Patients In Long-Term Care (LTC), Community Care (CC), and No Care							
Disability Level	Mean Disability Index	% Disabled in LTC Due to Dementia	%Disabled in LTC Due to Comorbid Dementia	% Disabled in CC Due to Dementia	% Disabled in CC Due to Comorbid Dementia	% Disabled No Formal Care, Due to Dementia	% Disabled No Formal Care, Due to Comorbid Dementia
Good Functioning	0	0.00%	0.00%	6.70%	6.70%	6.70%	6.70%
Mild Disability	0.06	0.08%	0.08%	2.91%	2.91%	2.91%	2.91%
Moderate Disability	0.024	0.37%	0.37%	10.20%	10.20%	10.20%	10.20%
Severe Disability	0.65	99.55%	99.55%	80.19%	80.19%	80.19%	80.19%

Exhibit 35 illustrates the trend in the total number of people with severe dementia and the sum of those with mild, moderate and no disability. The simulation results show the prevalence of those with severe dementia continues to represent the majority of total prevalence of dementia over the thirty year simulated period.

Exhibit 35 Prevalence of Dementia by Disability Level, Ages 65+: 2008-2038

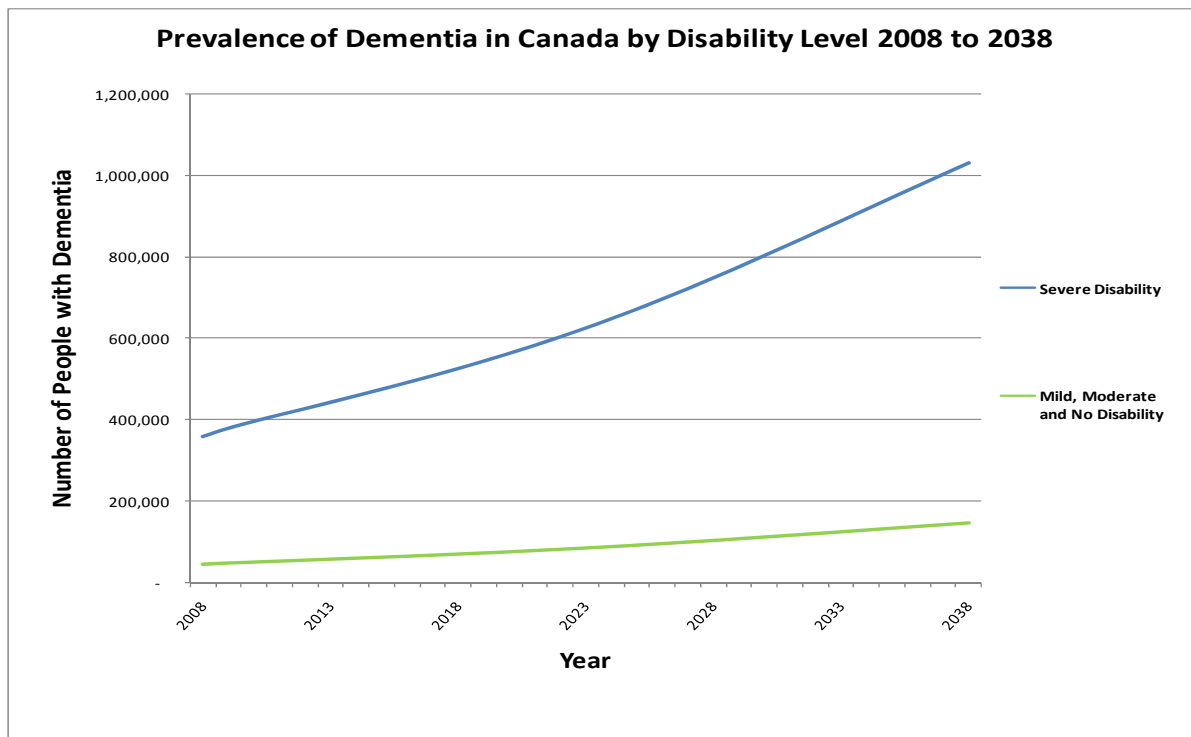


Exhibit 36 provides the percentage of informal caregivers in each disability category across each mode of care utilized by the dementia patient. To obtain an accurate measure of the informal caregiver disability for those that provide care to patients with dementia as a comorbid condition, only the incremental caregiver disability that can be attributed to providing care to a person with comorbid dementia was considered. The majority of health conditions that require informal care tend to be those with a high disability level. Given the already high disability without dementia, the onset of dementia is not considered to contribute substantially to the total disability. This results in a large percentage of informal caregivers providing care to patients with comorbid dementia being categorized as “good functioning” or mildly disabled.

The percentage of informal caregivers with moderate and severe disability was highest among those who provide care to patients in community care. The percentage of informal caregivers with moderate disability was 7% higher for those that provide informal care to patients in community care as compared to those that provide informal care to patients in LTC. Similarly, the percentage of informal caregivers with severe disability was approximately 1% higher for those that provide informal care to patients in community care as compared to those that provide informal care to patients in LTC. This greater disability level of informal caregivers in community care will have a substantial impact on the economy as the prevalence of dementia in community is expected to increase over the next thirty years.

Exhibit 36 Percentage of Informal Caregivers Disabled, By Severity Level Across Care Modes for Patients Ages 65+ in LTC, CC and No Formal Care

Disability of Informal Caregivers for Patients in Long-Term Care (LTC), Community Care (CC) and No Formal Care							
Disability Level	Mean Disability Index	% Disabled in LTC Due to Dementia	Incremental Disability, (%) in LTC Due to Comorbid Dementia	% Disabled in CC Due to Dementia	Incremental Disability, (%) in CC Due to Comorbid Dementia	% Disabled, No Formal Care Due to Dementia	Incremental Disability, (%) No Formal Care Due to Comorbid Dementia
Good Functioning	0	0.00%	41.01%	0.00%	41.01%	68.89%	81.65%
Mild Disability	0.06	96.80%	57.11%	89.45%	52.77%	30.11%	17.76%
Moderate Disability	0.024	2.72%	1.61%	8.96%	5.29%	0.85%	0.50%
Severe Disability	0.65	0.48%	0.28%	1.59%	0.94%	0.15%	0.09%

INDIRECT COSTS

The Life at Risk® economic simulation module evaluates the indirect impact of a health condition by examining its affect on production. The lost production resulting from dementia was estimated by comparing the level of production that would result if dementia were completely eliminated from society representing the “absence of” dementia case as compared to the base case simulation results. The value of lost production was then expressed as a reduction in wages and corporate profits which jointly represent the indirect cost of dementia.

Associated with the reduction in wages and corporate profits is a reduction in consumption and lost government taxation revenue. These costs represent derivative indirect costs of dementia from a societal perspective and are not included in the final determination of the economic burden of dementia (otherwise double counting would occur).

Lost Production due to Patient and Informal Caregiver Disability

Dementia negatively impacts production (GDP) in two ways. First, there is the indirect impact on production associated with disability from the disease itself. Individuals suffering from health condition such as dementia that are participating in the labour force are assumed to work at a lower productivity level than otherwise healthy individuals. This reduced productivity translates into a reduction in productivity.

The second impact on production is the effect that health conditions such as dementia have on informal caregivers that participate in the labour force. Employed informal caregivers face reduced productivity due to the fatigue and stress associated with providing care for an individual suffering from the disease. This reduced productivity is measured in terms of lost production. For more information on lost production due to a disease please refer to the supplementary appendix titled Life at Risk® Economic Framework.

Exhibits 37 and 38 present the lost production attributable to dementia over the thirty year simulation period in annual future values. The initial difference in production between the “absence of” simulation and the base case results was approximately \$3 billion in 2008. In the initial year of the “absence of” simulation the economy lacks the production capacity to completely absorb the initial increase in labour associated with eliminating dementia from society. The following years witness a spike in lost GDP as the economy rapidly expands its production capacity to take advantage of the increase in labour. This

spike is associated with a value of lost production of over \$9 billion in the year 2011. However, the benefits of the sudden increase in labour are not sustainable and lost production slowly declines as the economy transitions to its long run growth rate. The annual lost production attributed to dementia was estimated to be close to \$6.7 billion by the year 2038.

Exhibit 37 **Lost Production (GDP) Attributed to People with Dementia and Informal Caregivers, Future Values: 2008-2038**

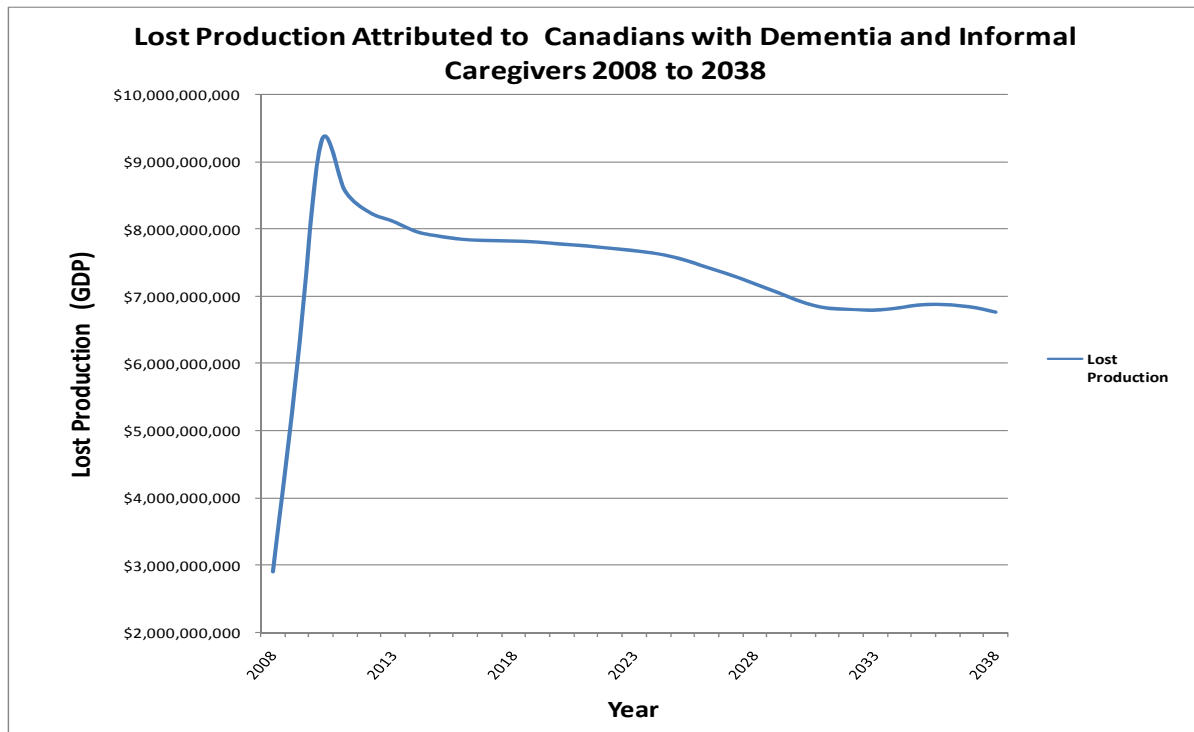


Exhibit 38 Annual Lost Production Attributed to the Disability Due to Dementia and Informal Care, Future Values: 2008-2038

Year	Annual Lost Production from Dementia (Including Informal Care), Future Values
2008	\$2,909,240,693
2018	\$7,821,560,906
2028	\$7,186,325,477
2038	\$6,765,521,872

Exhibit 39 shows the cumulative value of lost production expressed in 2008 present value dollars. After discounting the value of lost production over the entire thirty year simulated period the disability associated with dementia and informal care giving represents a cost of over \$129 billion in 2008 present value dollars. For a complete list the lost production, in future and present values terms for each year of the analysis please refer to **Appendix D**.

Exhibit 39 Cumulative Lost Production Attributed to the Disability Due to Dementia and Informal Care, 2008 Present Values: 2008-2038

Year	Cumulative Lost Production form Dementia (Including Informal Care), 2008 Present Values
2008	\$2,909,240,693
2018	\$69,463,141,959
2028	\$107,348,702,524
2038	\$129,846,366,889

Wage Impacts due to Patient and Informal Caregiver Disability

The value of lost production presented above can be expressed in terms of lost wages. **Exhibit 40** shows the wage impacts of dementia in Canada over the thirty year simulation period. The initial difference in wages between the “absence of” simulation and the base case results is approximately \$1.5 billion dollars in 2008. The wage impact increases to over \$3.36 billion dollars by the year 2018 as the

economy absorbs the initial shock to labour productivity associated with completely eliminating dementia from society. The economy's transition to its long run growth rate can be seen in the value of lost production in the year 2038. The annual wage impact of dementia is estimated decline to approximately \$3.4 billion dollars by the year 2038.

Exhibit 40 Annual Wage Impact of Disability Due to Dementia and Informal Care: Future Values: 2008-2038

Year	Annual Wage Impact of Dementia (Including Informal Care), Future Values
2008	\$1,487,257,049
2018	\$3,945,147,720
2028	\$3,588,194,528
2038	\$3,360,464,928

Exhibit 41 shows the cumulative wage impact of dementia in 2008 present value terms. The simulation results indicate a cumulative cost exceeding \$56 billion when accounting for the wage impact of dementia over the thirty year simulation period. For a complete list of the lost wages, in future and present values, for each year of the analysis please refer to **Appendix D**.

Exhibit 41 Cumulative Wage Impact of Disability Due to General Dementia and Informal Care: 2008 Present Values: 2008-2038

Year	Cumulative Wage Impact of Dementia (Including Informal Care), 2008 Present Values
2008	\$1,487,257,049
2018	\$35,282,225,387
2028	\$54,287,882,025
2038	\$65,484,620,435

Corporate Profit Impacts of Dementia Patient and Informal Caregiver Disability

In addition to the wage impact the reduced production due to disability is associated with a reduction in corporate profits. Summing the wage impact and lost corporate profit yields the total indirect cost of the disability associated with dementia and the provision of informal care. The annual reduction in corporate profits follows the same pattern as lost production and the wage impact. The initial annual loss to corporate profits due to dementia and the provisions of informal care is approximately \$380,000 in 2008 as shown in **Exhibit 42**. Lost corporate profits increase to over \$900 million in the year 2018 before declining to approximately \$740 million in the year 2038 in annual future values.

Exhibit 42 Corp. Profit Impact of Disability Due to Dementia and Informal Care, Future Values: 2008-2038

Year	Annual Corporate Profits Impact of Dementia (Including Informal Care), Future Values
2008	\$377,698,616
2018	\$900,015,676
2028	\$791,979,523
2038	\$737,367,003

Exhibit 43 presents the cumulative loss to corporate profits over the thirty year simulated period in 2008 Canadian present value dollars. The simulation results indicate a cost associated with dementia and the provision of informal care exceeding \$15 billion dollars when discounting lost corporate profits thirty years into the future. For a complete list of the lost corporate profits in future and present values for each year of the analysis please refer to **Appendix D**.

Exhibit 43 Cumulative Corp. Profit Impact of Disability Due to Dementia & Informal Care, 2008 Present Values: 2008-2038

Year	Cumulative Corporate Profits Impact of Dementia (Including Informal Care), 2008 Present Values
2008	\$377,698,616
2018	\$8,420,777,029
2028	\$12,670,100,186
2038	\$15,131,263,992

Demand Impacts Associated With Dementia Patient and Informal Caregiver Disability

Associated with the reduction in wages and corporate profits described above, is a proportional reduction in domestic demand. The value of reduced demand attributed to dementia and the provision of informal care was determined in the same manner as the wage impact and lost corporate profits: by comparing total domestic demand in the “absence of” case to the base case simulation results. Lost domestic demand represents a cost of dementia borne by society in terms of reduced demand for goods and services. The reduction in domestic demand directly results from lost wages and corporate profits, not the disability attributed to dementia and was therefore not included in the calculation of total indirect costs.⁸⁹

Exhibit 44 presents the simulation results for lost domestic demand over the thirty year period beginning in 2008. The initial loss to domestic demand is approximately \$2.8 billion in 2008 this was followed by an increase to over \$7.5 billion in the year 2018. After the initial shock of completely eliminating dementia from society, the value of lost domestic demand begins to fall, reaching a value of approximately \$6.4 billion by the year 2038.

Exhibit 44 Annual Reduction in Domestic Demand Associated with the Disability Due to Dementia and Informal Care, Future Values: 2008-2038

Year	Lost Domestic Demand from Dementia (Including Informal Care), Future Values
2008	\$2,831,535,079
2018	\$7,534,869,269
2028	\$6,873,002,329
2038	\$6,431,205,503

⁸⁹ Including lost domestic demand in total indirect costs would be counting a fraction of the wage and corporate profits impact twice.

Exhibit 45 presents the cumulative lost domestic demand in 2008 present value terms. The simulation results show the total cost of reduced demand exceeding \$125 billion dollars when considering costs thirty years into the future. For a complete list of lost domestic demand in future and present values for each year of the analysis please refer to **Appendix D**.

Exhibit 45 Cumulative Reduction in Domestic Demand Associated with the Disability Due to Dementia and Informal Care, 2008 Present Values: 2008-2038

Year	Lost Domestic Demand from Dementia (Including Informal Care), 2008 Present Values
2008	\$2,831,535,079
2018	\$67,238,343,659
2028	\$103,598,512,167
2038	\$125,045,859,726

Taxation Revenue Impacts associated with Dementia Patient and Informal Caregiver Disability

Presented below are the simulated differences in taxation revenue between the “absence of” case and the base case. The reduction in wages, corporate profits and consumption produces a proportional reduction in the amount of taxation revenue collected by both the federal and provincial governments. By applying the appropriate taxation rate to lost wages, corporate profits and domestic demand the value of lost income, corporate and sales taxation revenue can be determined. Lost taxation revenue represents the cost of dementia borne by both the government in terms of lost revenue and society in terms of a reduction in the availability of government services. Much like domestic demand, lost taxation revenue is not directly related to the disability attributed to dementia and as a result was not included in the calculation of indirect costs.⁹⁰ As demonstrated in **Exhibits 46** and **47** on the following page, lost taxation revenue follows a similar trend to that of lost production. The loss to personal income tax revenue represents the most substantial cost; contributing more to the total tax burden than GST and corporate taxes combined. The simulation results presented in **Exhibit 46** show an initial

⁹⁰ Because lost taxation revenue is derived from lost wage, corporate profits and domestic demand including it in indirect costs would result in a double counting of costs and an overestimation of the indirect cost of dementia.

annual loss in personal income tax revenue of approximately \$340 million in the year 2008, remaining significant in the year 2038 at an annual cost of over \$600 million dollars.

Across all forms of taxation revenue, the initial total taxation burden attributed to dementia is over \$576 million in the year 2008. This value is expected to increase to approximately \$1.38 billion in 2018 before declining to approximately 1 billion dollars in 2038. Discounting the value, lost taxation revenue over the entire simulated period and cumulative loss in total taxation revenue represents a cost of over \$23 billion in 2008 present value terms.

Exhibit 46 Total Provincial and Federal Taxation Revenue Impact Attributed to Dementia and Informal Care, Future Values: 2008-2038

Annual Taxation Revenue Impact of General Dementia (Including Informal Care), Future Values				
Year	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$339,689,660	\$108,156,885	\$128,911,100	\$576,757,645
2018	\$824,874,443	\$251,550,110	\$310,364,315	\$1,386,788,867
2028	\$671,576,309	\$195,067,993	\$278,818,133	\$1,145,462,435
2038	\$611,845,032	\$168,068,630	\$304,910,116	\$1,084,823,778

Exhibit 47 Cumulative Total Provincial and Federal Taxation Revenue Impact Attributed to Dementia and Informal Care, 2008 Present Values: 2008-2038

Cumulative Taxation Revenue Impact of All- Cause Dementia (Including Informal Care), 2008 Present Values				
Year	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$339,689,660	\$108,156,885	\$128,911,100	\$576,757,645
2018	\$7,868,800,769	\$2,483,319,710	\$2,879,407,671	\$13,231,528,150
2028	\$11,624,047,995	\$3,597,437,535	\$4,356,437,694	\$19,577,923,224
2038	\$13,646,542,078	\$4,174,593,678	\$5,266,659,109	\$23,087,794,865

For a complete list of the lost taxation revenue in future and 2008 present values for each year included in the analysis please refer to **Appendix D**.

ECONOMIC BURDEN CONCLUSIONS

The total economic burden attributed to dementia and the provision of informal care can be calculated as the sum of direct costs, opportunity costs of informal caregivers and indirect costs. This section distinguishes between the total economic burden and the monetary economic burden which considers only the actual dollar costs attributable to dementia and the provision of informal care. Monetary economic burden is defined as the total economic burden less the opportunity cost of informal caregivers.

Exhibits 48 and **49** present the simulation results of the annual total economic burden of dementia in future values. The total annual economic burden is shown to increase substantially from approximately \$15 billion in 2008 to close to \$160 billion by the year 2038. Total direct costs comprise the largest component of the economic burden in all simulated years representing over 50% of the total economic burden. The annual value of direct costs is expected to increase to over \$90 billion by the year 2038. After subtracting the opportunity costs associated with informal caregivers, the monetary burden of dementia and the provision of informal care are expected to reach approximately \$97 billion by the year 2038. For a complete list of the costs in future and present values for each year of the analysis please refer to **Appendix D**.

Exhibit 48 **Total Economic Burden Attributed to Dementia and Informal Care, Future Values: 2008-2038**

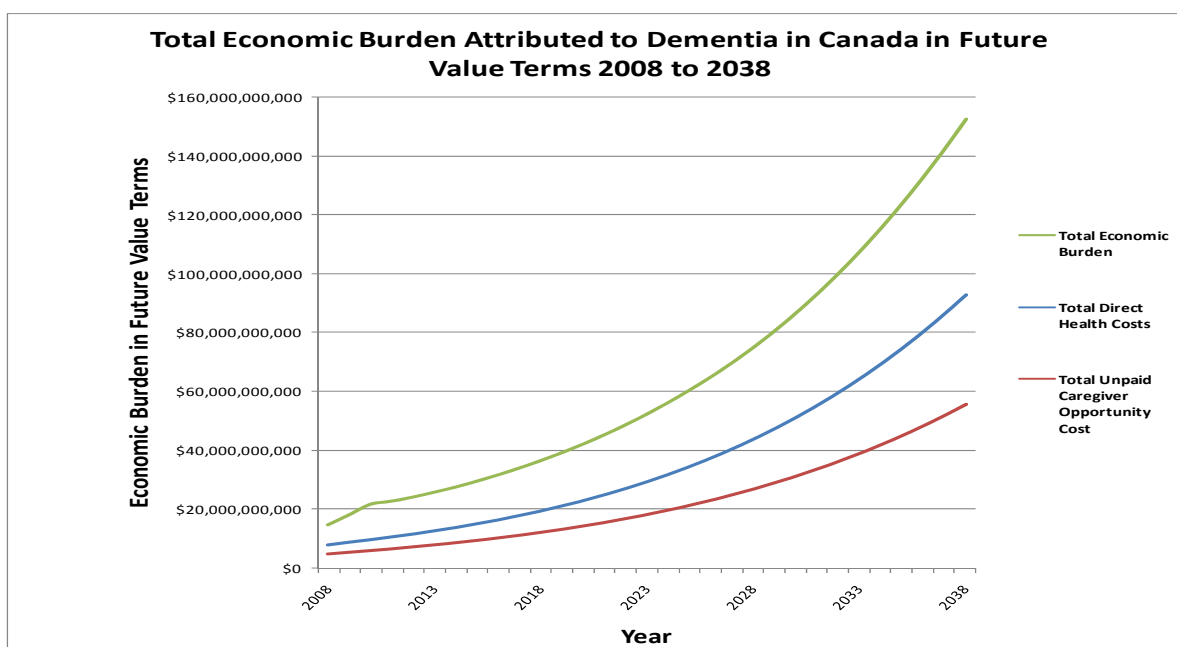


Exhibit 49 Total Economic Burden Attributed to Dementia and Informal Care, Future Values: 2008-2038

Total Economic Burden of Dementia (Including Informal Care), Future Values					
Year	Total Direct Costs	Total Unpaid Caregivers Opportunity Cost	Total Indirect Costs	Monetary Economic Burden	Total Economic Burden
2008	\$8,063,733,967	\$4,995,340,836	\$1,864,955,665	\$9,928,689,632	\$14,924,030,467
2018	\$19,573,547,540	\$12,303,233,856	\$4,845,163,396	\$24,418,710,937	\$36,721,944,792
2028	\$43,842,755,134	\$26,921,613,083	\$4,380,174,051	\$48,222,929,184	\$75,144,542,267
2038	\$92,832,808,780	\$55,708,854,294	\$4,097,831,931	\$96,930,640,711	\$152,639,495,005

Exhibit 50 on the following page presents the cumulative burden of dementia and informal care giving in 2008 present value dollars. Once again total direct costs are significantly greater than total indirect costs. When considering costs over the entire thirty year period, total direct costs accrued are over \$489 billion; whereas, indirect costs account for approximately \$80 billion of the total economic burden. The relatively lower value of indirect costs can be attributed to the fact that few individuals suffering from dementia participate in the labour force and the disability associated with employed informal care giving tends to be mild. However, the total opportunity cost of informal caregivers, represents a substantial cost to society.

The simulation results indicate a cumulative opportunity cost of over \$300 billion by the year 2038 attributed to the provision of informal care. After summing all costs attributable to dementia in Canada, the total economic burden is expected to reach approximately \$872 billion when considering costs over the entire simulation period.

Exhibit 50 Cumulative Total Economic Burden Attributed to Dementia and Informal Care, 2008 Present Values: 2008-2038

Cumulative Total Economic Burden of Dementia (Including Informal Care), 2008 Present Values					
Year	Total Direct Costs	Total Unpaid Caregiver Opportunity Cost	Total Indirect Costs	Monetary Economic Burden	Total Economic Burden
2008	\$8,063,733,967	\$4,995,340,836	\$1,864,955,665	\$9,928,689,632	\$14,924,030,467
2018	\$119,911,702,031	\$75,072,662,869	\$43,703,002,416	\$163,614,704,446	\$238,687,367,315
2028	\$270,811,509,553	\$168,884,202,340	\$66,957,982,212	\$337,769,491,765	\$506,653,694,104
2038	\$489,972,224,214	\$301,629,828,371	\$80,615,884,427	\$570,588,108,641	\$872,217,937,012

For a complete list of the costs both future and present values included in each year of the analysis please refer to **Appendix D**.

5 SCENARIO ANALYSIS OF DEMENTIA INTERVENTIONS

5.1 PROPOSED INTERVENTION SCENARIOS

Four intervention scenarios that simulate the health, social and economic associated with implementing dementia prevention and patient and caregiver support programs were generated. As outlined in Section 2, each of these scenarios were identified and defined by the ASC and its expert panel, along with relevant, evidence-based data and literature sources, and validation of scenario assumptions.

Scenario 1 **PRIMARY PREVENTION #1:**

The primary prevention scenario examines the impact of a hypothetical physical activity intervention on dementia incidence. This intervention will focus on increasing the current level of physical activity among the Canadian population without dementia. Prevalence data on the current physical activity levels were obtained from the Statistics Canada CANSIM database and the baseline study population of the Canadian Study of Health and Aging (CSHA) (Laurin *et al.* 2001). The CANSIM data are grouped into inactive, moderately active and active levels; whereas the CSHA physical activity levels were defined by combining responses from the baseline questionnaire on the frequency and intensity of physical activity to low, medium and high.

Odds ratios associated with the dementia diagnosis were obtained for the three categories of physical activity from Laurin *et al.* (2001). The odds ratios were used as a measure of the decreased likelihood of dementia diagnosis with respect to the reference population (no or limited physical activity). The data on physical activity levels for Canadian males and females have been obtained from CANSIM from 1994 to 2004 and represented the trend in physical activity among 65+ males and females. The future trends in physical activity were assumed to follow those observed between 1994 and 2004. A hypothetical intervention under which the expected future physical activity levels increase by 50% is considered. The intervention is applied to moderate and high levels of physical activity for all males and females over the age of 65. The effects of this increase in physical activity on dementia incidence are studied in this scenario.

Scenario 2 **PRIMARY PREVENTION #2:**

The second prevention scenario examines the impact of a hypothetical prevention program that could delay the onset of dementia by an estimated two years. The prevention program will be targeted at the

entire dementia-free Canadian population. A comprehensive study by Brookmeyer *et al.* (2007) is used in order to estimate the relative (expected) effect of the prevention program upon the overall annual incidence rate. The study concluded that an overall relative risk estimate of 0.77 is equivalent to a 2 year delay in disease onset. In this context, the current scenario assumes that the relative risk estimate from the Brookmeyer *et al.* (2007) study for AD is equally applicable across all dementia disease types, both sexes and age group over 65.

Scenario 3 INFORMAL CAREGIVER SUPPORT:

The impacts of a hypothetical informal caregiver support program will be evaluated in this scenario to determine how this type of intervention could delay admission into LTC and reduce the health and economic burden placed on informal caregivers. The informal caregiver support intervention will be applied to all informal caregivers and dementia patients receiving informal care within the model.

The effects of this program on the informal caregiver burden will be based on a study by Graff *et al.* (2008). This study examined the impact of enhanced training and support services for informal caregivers as compared to usual care. Within the Life at Risk® model, the informal caregiver burden is estimated based on the number of hours spent providing care to dementia patients. As a result, the impacts of the hypothetical support program (based on the Graff *et al.* 2008 study) on reducing the number of hours providing care will be assessed.

The Graff *et al.* (2008) study examined the impact of a community-based occupational intervention that aimed to provide occupational therapy to both patients and their informal caregivers. The objectives of this intervention were to improve the competence and skills of informal caregivers during supervision of activities of daily living by teaching them practical skills and communication strategies. In addition, the intervention taught caregivers more effective coping strategies for dealing with patient behaviours and the overall burden of care. The results of the study showed that the intervention reduced the number of informal caregiver hours by an average of 212.3 hours over a 3 month timeframe. The average reduction in informal caregiver time will be applied to the Life at Risk® model to examine the impacts of the hypothetical intervention program on the caregiver burden.

The informal caregiver support program is also estimated to impact patient admissions into LTC by delaying the time to admission. The effects of this program will be based on a study by Mittleman *et al.* (2006) that examined the impacts of enhanced caregiver support services for informal caregivers on the

delay to institutionalization. Specifically, this study examined the effects of a counselling and support intervention program for spousal caregivers in delaying the time to nursing home placement for patients with AD. Spousal caregivers were assigned to a treatment group that received enhanced counselling and support or to a control group that received usual care or routine services provided to patients with AD and their family members. The difference in the median time to nursing home placement from the baseline was 557 days. Patients whose informal caregivers received the intervention were placed into nursing homes at 72% of the rate observed for those in the usual care group.

The effects observed in the Mittleman *et al.* (2006) study will be applied to the Life at Risk® model to examine the impact of caregiver support services on the delay to institutionalization. It is assumed that the impacts on spousal caregivers will behave similarly to the impacts on all other informal caregivers and that the timing to nursing home placement for those with AD is the same for all other types of dementia. After the 557 day delay, it is assumed that those patients, who would have been admitted into LTC under the status quo, are admitted into LTC.

Scenario 4 SYSTEM NAVIGATOR:

The fourth scenario will examine the impact of assigning a system navigator to all newly diagnosed dementia patients on delaying admission into LTC and reducing the overall economic burden of dementia. The goal of the system navigator or case manager is to provide care coordination to patients and caregiver support to informal caregivers. This intervention scenario will be applied to all dementia patients and their informal caregivers within the model.

The effects of a system navigator will be estimated based on the Lewisham Case Management Scheme from a study by Challis *et al.* (2002). The Lewisham Case Management Scheme is an intensive care management service that brings together secondary health care in the community and intensive care management. Within the Challis *et al.* (2002) study, patients with dementia and their caregivers were assigned to receive intensive care management services or to receive usual care. The results of the study showed that those receiving the intensive care management (cases) remained in the community longer, had a reduced informal caregiver burden and had reduced overall costs than those receiving usual care (controls).

The results on the delay in institutionalization from the Challis *et al.* (2002) study over a two year period are provided in **Exhibit 51** below. These outcomes will be applied to examine the impact of a system

navigator on the delay to institutionalization and the overall costs within the Life at Risk® model. After the 24 month period it will be assumed that those patients, who would have been admitted into LTC under the status quo, are admitted into LTC. This implies that the system navigator will delay LTC admission by 2 years.

Exhibit 51 Challis *et al.* (2002) 24 Month Destination Outcomes for the Intensive Care Management Services Group (Cases) vs. the Usual Care Group (Controls)

Months after Referral	At Home		Long-Term Care Placement		Died	
	Cases	Control	Cases	Control	Cases	Control
0	43	43	0	0	0	0
6	37 (86%)	39 (91%)	5 (12%)	3 (7%)	1 (2%)	1 (2%)
12	32 (74%)	32 (74%)	8 (19%)	8 (19%)	3 (7%)	3 (7%)
18	24 (56%)	22 (51%)	12 (28%)	12 (28%)	7 (16%)	9 (21%)
24	22 (51%)	14 (33%)	9 (21%)	14 (33%)	12 (28%)	15 (35%)

A system navigator is also expected to have an impact on informal caregivers. The changes in caregiver needs and quality of life as a result of the intensive care management services were examined over a 12 month period in the Challis *et al.* (2002) study. The results showed mean reduction in caregiver input hours from the baseline to the 12 month follow-up period of 11.19 and 3.15 for cases and controls, respectively. The average reduction in informal caregiver time will be applied to the Life at Risk® model to examine the impacts of a system navigator on the informal caregiver burden.

5.2 LIFE AND ECONOMIC IMPACTS OF SCENARIOS

The impacts of the proposed dementia intervention scenarios were compared to the base model results to derive the value proposition of the interventions. The following section summarizes the value proposition of each scenario over the simulation period. It is important to note, that since each of these scenarios represent a hypothetical intervention the costs of implementing these types of interventions at a national level has not been taken into account. It is also important to note that many of the interventions considered here will have additional benefits not taken into consideration within this analysis. These additional benefits may include, but are not limited to, improvements in patient activities of daily living, social participation, quality of life and independence; as well as improvements in

caregiver depressive symptoms or overall health status, competence, social support satisfaction, and well-being with reduction in overall stress. It is further noted that the impacts of the scenarios are not always additive; the benefits associated with the implementation of each scenario may not always be used in conjunction with one another and therefore their effects may not always be cumulative. This is particularly true in scenarios 3 and 4 which both strive to delay the admission into LTC and reduce the burden on informal care givers. By adding the effects of both scenarios, the delay in admission into LTC and reduction in the burden on the care givers could be double counted. The current evaluation did not consider the cumulative impacts of all four scenarios.

Scenario 1: PRIMARY PREVENTION #1

The primary prevention of dementia through a hypothetical physical activity intervention that aims to increase the daily physical activity levels by 50% will reduce the risk of developing dementia. **Exhibit 52** provides a summary of the value proposition outcomes over the next 30 years. The key economic value propositions are reported in cumulative 2008 present value terms.

Exhibit 52 **Scenario 1: Primary Prevention #1, Impact of Physical Activity on General Dementia Incidence: 2008 - 2038**

Scenario 1: Primary Prevention #1, Impact of Physical Activity on Dementia Incidence					
Impacts on Life Terms					
Year	Incidence	Prevalence	Mortality		
2018	-5,978	-32,454	-2,124		
2028	-8,243	-64,189	-3,833		
2038	-10,758	-96,412	-5,425		
Impacts on Health Care Utilization (Ages 65+)					
Year	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia in No Formal Care		
2018	-13,578	-11,698	-7,178		
2028	-25,296	-25,454	-13,439		
2038	-36,216	-41,556	-18,641		
Impacts on Economic Terms (Cumulative 2008 Present Value Terms)					
Year	Total Direct Health Care Costs	Total Unpaid Caregiver Opportunity Costs	Indirect Wage Impact	Indirect Corporate Profit Impact	Total Economic Burden
2018	-\$3,385,855,647	-\$2,127,624,745	-\$122,283,860	-\$29,645,387	-\$5,665,409,639
2028	-\$13,686,500,180	-\$8,529,091,994	-\$532,274,656	-\$124,825,659	-\$22,872,692,489
2038	-\$31,180,831,406	-\$19,120,537,780	-\$1,232,947,001	-\$285,207,023	-\$51,819,523,210

Health Impact

Relative to the base model, the short-term (2008-2018) impacts of increased levels of physical activity are expected to yield the following results:

- Over 5,970 new cases of dementia would be averted, a 4.3% reduction from the base model.
- Over 32,450 fewer Canadians would suffer from dementia, a 5.1% reduction from the base model⁹¹.
- There would be 2,120 fewer deaths within the population with dementia, a 7.6% reduction from the base model.
- Over 13,570 fewer Canadians over the age of 65 with dementia would be residing in LTC, a 7.4% reduction from the base model.
- Over 11,690 fewer Canadians over the age of 65 with dementia would be receiving community care, a 5.3% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts of increased levels of physical activity are expected to yield the following results:

- Over 10,750 new cases of dementia would be averted, a 4.2% reduction from the base model.
- Over 96,410 fewer Canadians would be suffering from dementia, an 8.6% reduction from the base model⁹².
- There would be 5,420 fewer deaths within the population with dementia, a 12.3% reduction from the base model.
- Over 36,210 fewer Canadians over the age of 65, with dementia would be residing in LTC, an 8.2% reduction from the base model.
- Over 41,550 fewer Canadians over the age of 65, with dementia would be receiving community care, an 8.3% reduction from the base model.

Economic Impact

Relative to the base model, the short-term (2008-2018) impacts associated with increased levels of physical activity are expected to result in:

- A reduction in direct health costs by over \$3.3 billion dollars, a 2.8% reduction from the base model.

⁹¹ The percentage reduction from the base model was calculated with respect to the total prevalent population in the base model (all age-groups).

⁹² The percentage reduction from the base model was calculated with respect to the total prevalent population in the base model (all age-groups).

- A reduction in total unpaid caregiver opportunity costs by over \$2.1 billion dollars, a 2.8% reduction from the base model.
- A reduction in total indirect costs by over \$151.9 million dollars, a 0.4% reduction from the base model.
- A savings of over \$5.6 billion dollars to Canadian society, a 2.4% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts associated with increased levels of physical activity are expected to result in:

- A reduction in direct health costs by over \$31.1 billion dollars, a 6.4% reduction from the base model.
- A reduction in total unpaid caregiver opportunity costs by over \$19.1 billion dollars, a 6.3% reduction from the base model.
- A reduction in total indirect costs by over \$1.5 billion dollars, a 1.9% reduction from the base model.
- A savings of over \$51.8 billion dollars to Canadian society, a 5.9% reduction from the base model.

A 50% improvement in physical activity level for those without dementia was shown to significantly reduce the number of people diagnosed with dementia in the short- and long-term. As a result, fewer people living with dementia and a reduction in the constraints placed on LTC, community-care and informal care was shown to produce significant savings in health costs, unpaid caregiver opportunity costs and indirect costs.

Scenario 2: PRIMARY PREVENTION #2

This primary prevention scenario examined the impact of hypothetical prevention programs that could delay the onset of dementia by 2 years. **Exhibit 53** provides a summary of the value proposition over the next 30 years. The key economic value propositions are reported in cumulative 2008 present value terms.

Exhibit 53 Scenario 2: Primary Prevention #2, Impact of Delaying Disease Onset: 2008-2038

Scenario 2: Primary Prevention #2, Impact of Early Diagnosis on Delay in Disease Onset					
Impacts on Life Terms					
Year	Incidence	Prevalence	Mortality		
2018	-25,951	-137,502	-9,791		
2028	-36,353	-269,736	-17,379		
2038	-48,409	-409,647	-24,676		
Impacts on Health Care Utilization (Ages 65+)					
Year	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia in No Formal Care		
2018	-57,529	-49,748	-30,226		
2028	-106,298	-106,942	-56,495		
2038	-153,878	-175,868	-79,901		
Impacts on Economic Terms (Cumulative 2008 Present Value Terms)					
Year	Total Direct Health Care Costs	Total Unpaid Caregiver Opportunity Costs	Indirect Wage Impact	Indirect Corporate Profit Impact	Total Economic Burden
2018	-\$14,442,029,463	-\$9,074,731,356	-\$556,647,414	-\$135,013,264	-\$24,208,421,497
2028	-\$57,808,986,147	-\$36,024,947,299	-\$2,329,458,341	-\$546,597,397	-\$96,709,989,184
2038	-\$131,676,392,947	-\$80,750,710,864	-\$5,037,965,302	-\$1,166,583,594	-\$218,631,652,707

Health Impact

Relative to the base model, the short-term (2008-2018) impacts of this primary prevention are expected to yield the following results:

- Over 25,950 new cases of dementia would be averted, an 18.9% reduction from the base model.
- Over 137,500 fewer Canadians would suffer from dementia, a 21.7% reduction from the base model⁹³.
- There would be 9,790 fewer deaths within the population with dementia, a 35.0% reduction from the base model.
- Over 57,520 fewer Canadians over the age of 65, with dementia would be residing in LTC, a 31.4% reduction from the base model.
- Over 49,740 fewer Canadians over the age of 65, with dementia would be receiving community care, a 22.4% reduction from the base model.

⁹³ The percentage reduction from the base model was calculated with respect to the total prevalent population in the base model (all age-groups).

Relative to the base model, the long-term (2008-2038) impacts associated with this primary prevention are expected to result in:

- A reduction in number of new cases of dementia by over 48,400, an 18.9% reduction from the base model.
- A reduction in the number of Canadians living with dementia by over 409,640, a 36.4% reduction from the base model⁹⁴.
- A reduction in the number of deaths within the population with dementia by over 24,670, a 55.6% reduction from the base model.
- Over 153,870 less Canadians over the age of 65 living with dementia in LTC a 34.8% reduction from the base model.
- Over 175,860 less Canadians over the age of 65 living with dementia in community care, a 34.9% reduction from the base model.

Economic Impact

Relative to the base model, the short-term (2008-2018) impacts associated with this primary prevention are expected to result in:

- A reduction in direct health costs by over \$14.4 billion dollars, a 12.0% reduction from the base model.
- A reduction in total unpaid caregiver opportunity costs by over \$9.0 billion dollars, a 12.1% reduction from the base model.
- A reduction in total indirect costs by over \$691.6 million dollars, a 1.6% reduction from the base model.
- A reduction in the total economic burden by over \$24.2 billion dollars, a 10.1% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts associated with this primary prevention are expected to result in:

- A reduction in direct health costs by over \$131.6 billion dollars, a 26.9% reduction from the base model.
- A reduction in total unpaid caregiver opportunity costs by over \$80.7 billion dollars, a 26.8% reduction from the base model.

⁹⁴ The percentage reduction from the base model was calculated with respect to the total prevalent population in the base model (all age-groups).

- A reduction in total indirect costs by over \$6.2 billion dollars, a 7.7% reduction from the base model.
- A reduction in the total economic burden by over \$218.6 billion dollars, a 25.1% reduction from the base model.

Relative to the base model, a delay on the onset of dementia by two years resulted in fewer people living with dementia and significantly reduced the constraints placed on health care resources and the health care system. This hypothetical intervention was shown to produce significant savings in health costs, unpaid caregiver opportunity costs and indirect costs associated with dementia and informal care throughout the simulated timeframe.

Scenario 3: INFORMAL CAREGIVER SUPPORT

The informal caregiver support scenario examined the impact of caregiver support programs on admission into long term care facilities and the caregiver economic burden placed on informal caregivers. It is assumed that the admission into LTC can be delayed by 1.5 years, on average. In addition the program will reduce the number of hours which caregivers devote to the care of dementia patients through better care delivery and support. **Exhibit 54** and **Exhibit 55** provide a summary of the value proposition outcomes over the next 30 years. The key economic value propositions are reported in cumulative 2008 present value terms.

Exhibit 54 Scenario 3 (a): Informal Caregiver Support, Impact of Caregiver Support Programs on Admission into Long-Term Care: 2008-2038

Scenario 3(a): Informal Caregiver Support, Impact of Caregiver Support Programs on Admission into LTC					
Impacts on LTC Admission					
Year	Prevalence of Dementia in LTC				
	2018	-8,813			
	2028	-13,355			
	2038	-14,270			
Impacts on Economic Terms (Cumulative 2008 Present Value Terms)					
Year	Total Direct Health Care Costs	Total Unpaid Caregiver Opportunity Costs	Indirect Wage Impact	Indirect Corporate Profit Impact	Total Economic Burden
2018	-\$4,720,740,315	\$2,241,144,070	\$14,345,869	\$3,533,610	-\$2,461,716,766
2028	-\$12,363,624,312	\$5,709,864,958	\$54,358,941	\$12,846,813	-\$6,586,553,600
2038	-\$22,534,463,075	\$10,072,095,845	\$135,646,031	\$31,457,453	-\$12,295,263,746

(a) Impact of caregiver support programs on admission into LTC

Relative to the base model, the short-term (2008-2018) impacts associated with informal caregiver support programs are expected to result in:

- Over 8,810 less Canadians over the age of 65 living with dementia in LTC, 4.8% reduction from the base model.
- A reduction in direct health costs by over \$4.7 billion dollars, a 3.9% reduction from the base model.
- An increase in total unpaid caregiver opportunity costs by over \$2.2 billion dollars, a 3.0% increase from the base model.
- An increase in total indirect costs by over \$17.8 million dollars, a 0.04% increase from the base model.
- A reduction in the total economic burden by over \$2.4 billion dollars, a 1.0% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts associated with informal caregiver support programs are expected to result in:

- Over 14,270 less Canadians over the age of 65 living with dementia in LTC, a 3.2% reduction from the base model.
- A reduction in direct health costs by over \$22.5 billion dollars, a 4.6% reduction from the base model.
- An increase in total unpaid caregiver opportunity costs by over \$10.0 billion dollars, a 3.3% increase from the base model.
- An increase in total indirect costs by over \$167.1 million dollars, a 0.2% increase from the base model.
- A reduction in the total economic burden by over \$12.2 billion dollars, a 1.4% reduction from the base model.

The hypothetical caregiver support program that delays admission into LTC is expected to reduce the constraints placed on LTC resources producing significant savings in health costs. With fewer people admitted into LTC, there will be more people receiving care in a community-based care or informal care setting. As a result this is expected to increase the unpaid caregiver opportunity costs and indirect costs associated with dementia and informal care. However, the savings in health costs will outweigh the costs associated with informal care, producing a significantly lower total economic burden throughout the simulation period, as compared to the base model.

Exhibit 55 Scenario 3 (b): Informal Caregiver Support, Impact of Caregiver Support Programs on the Informal Caregiver Burden: 2008-2038

Scenario 3(b): Informal Caregiver Support, Impact of Caregiver Support Programs on the Informal Caregiver Burden

Impacts on Economic Terms (Cumulative 2008 Present Value Terms)

Year	Total Unpaid Caregiver Opportunity Costs	Indirect Wage Impact	Indirect Corporate Profit Impact	Total Economic Burden
2018	-\$10,231,165,526	-\$39,164,418	-\$9,507,720	-\$10,279,837,664
2028	-\$26,715,147,944	-\$144,407,047	-\$33,937,116	-\$26,893,492,107
2038	-\$50,173,500,166	-\$305,146,802	-\$70,732,866	-\$50,549,379,834

(b) Impact of caregiver support programs on the informal caregiver burden

Relative to the base model, the short-term (2008-2018) impacts associated with informal caregiver support programs are expected to result in:

- A reduction in total unpaid caregiver opportunity costs by over \$10.2 billion dollars, a 13.6% reduction from the base model.
- A reduction in total indirect costs by over \$48.6 million dollars, a 0.1% reduction from the base model.
- A reduction in the total economic burden by over \$10.2 billion dollars, a 4.3% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts associated with informal caregiver support programs are expected to result in:

- A reduction in total unpaid caregiver opportunity costs by over \$50.1 billion dollars, a 16.6% reduction from the base model.
- A reduction in total indirect costs by over \$375.8 million dollars, a 0.5% reduction from the base model.
- A reduction the total economic burden by over \$50.5 billion dollars, a 5.8% reduction from the base model.

The hypothetical caregiver support program is expected to reduce the economic disability placed on informal caregivers. As compared to the base model, this is expected to produce significant savings in the unpaid caregiver opportunity costs as well as the indirect costs associated with informal care provision throughout the simulated timeframe.

Scenario 4: SYSTEM NAVIGATOR

This system navigator scenario examined the impacts of assigning a system navigator to all newly diagnosed dementia patients, to provide care coordination and support for informal caregivers, on delaying admission into LTC and reducing the overall care costs. **Exhibits 56** and **57** provide a summary of the value proposition over the next 30 years. The key economic value propositions are reported in cumulative 2008 present value terms.

Exhibit 56 **Scenario 4 (a): System Navigator, Impact of Implementing a System Navigator on Admission into Long-Term Care: 2008-2038**

Scenario 4(a): System Navigation, Impact of System Navigation on Admission into LTC					
Impacts on LTC Admission					
Year	Prevalence of Dementia in LTC				
	2018	-11,691			
	2028	-17,708			
	2038	-19,093			
Impacts on Economic Terms (Cumulative 2008 Present Value Terms)					
	Total Direct	Total Unpaid		Indirect Corporate	Total Economic
Year	Health Care Costs	Caregiver Opportunity Costs	Indirect Wage Impact	Profit Impact	Burden
2018	-\$6,154,810,083	\$2,921,162,482	\$16,229,642	\$3,991,095	-\$3,213,426,864
2028	-\$16,275,405,812	\$7,514,362,369	\$67,633,929	\$15,953,949	-\$8,677,455,565
2038	-\$29,827,007,373	\$13,326,371,848	\$174,806,333	\$40,490,895	-\$16,285,338,297

(a) Impact of system navigation on admission into LTC

Relative to the base model, the short-term (2008-2018) impacts associated with system navigation are expected to result in:

- Over 11,690 less Canadians over the age of 65 living with dementia in LTC, a 6.4% reduction from the base model.
- A reduction in direct health costs by over \$6.1 billion dollars, a 5.1% increase from the base model.
- An increase in total unpaid caregiver opportunity costs by over \$2.9 billion dollars, a 3.9% increase from the base model.
- An increase in total indirect costs by over \$20.2 million dollars, a 0.05% reduction from the base model.

- A reduction in the total economic burden by over \$3.2 billion dollars, a 1.4% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts associated with system navigation are expected to result in:

- Over 19,090 less Canadians over the age of 65 living with dementia in LTC, a 4.3% reduction from the base model.
- A reduction in direct health costs by over \$29.8 billion dollars, a 6.1% reduction from the base model.
- An increase in total unpaid caregiver opportunity costs by over \$13.3 billion dollars, a 4.4% increase from the base model.
- An increase in total indirect costs by over \$215 million dollars, a 0.3% increase from the base model.
- A reduction in the total economic burden by over \$16.2 billion dollars, a 1.9% reduction from the base model.

The implementation of a system navigator is anticipated to delay admission into LTC and as a result this is expected to reduce the constraints placed on LTC resources producing significant savings in health costs. Delaying admission into LTC will result in more people with dementia relying on community-based care and informal care resources. The implications of this are expected to produce an increase in the unpaid caregiver opportunity costs and indirect costs associated with dementia and informal care. However, the savings in health costs will outweigh the costs associated with informal care, producing a significantly lower total economic burden throughout the simulation period, as compared to the base model.

Exhibit 57 Scenario 4 (b): System Navigator, Impact of Implementing a System Navigator on Informal Caregiver Burden

Scenario 4(b): System Navigation, Impact of System Navigation on the Informal Caregiver Burden				
Impacts on Economic Terms (Cumulative 2008 Present Value Terms)				
Total Unpaid Caregiver Opportunity				
Year	Costs	Indirect Wage Impact	Indirect Corporate Profit Impact	Total Economic Burden
2018	-\$19,767,575,038	-\$62,551,207	-\$15,186,335	-\$19,845,312,580
2028	-\$51,616,180,998	-\$226,717,455	-\$53,295,581	-\$51,896,194,034
2038	-\$96,939,926,041	-\$464,702,999	-\$107,775,061	-\$97,512,404,101

(b) Impact of system navigation on the informal caregiver burden

Relative to the base model, the short-term (2008-2018) impacts associated with a system navigator are expected to result in:

- A reduction in total unpaid caregiver opportunity costs by over \$19.7 billion dollars, a 26.3% reduction from the base model.
- A reduction in total indirect costs by over \$77.7 million dollars, a 0.2% reduction from the base model.
- A reduction in the total economic burden by over \$19.8 billion dollars, an 8.3% reduction from the base model.

Relative to the base model, the long-term (2008-2038) impacts with a system navigator are expected to result in:

- A reduction in total unpaid caregiver opportunity costs by over \$96.9 billion dollars, a 32.1% reduction from the base model.
- A reduction in total indirect costs by over \$572.4 million dollars, a 0.7% reduction from the base model.
- A reduction in the total economic burden by over \$97.5 billion dollars, an 11.2% reduction from the base model.

The implementation of a system navigator is also anticipated to reduce the economic disability placed on informal caregivers. As compared to the base model, this is expected to produce significant savings in the unpaid caregiver opportunity costs as well as the indirect costs associated with informal care provision throughout the simulated timeframe.

6 CONCLUSIONS

6.1 GENERAL CONCLUSIONS

The crisis of dementia poses an enormous resource capacity issue as well as an extensive economic burden to society. Over the next 30 years, dementia is expected to cost society over \$872 billion dollars in health costs, unpaid caregiver opportunity costs and indirect costs associated with dementia and the provision of unpaid care.

The results of the Rising Tides project provide an indication of this burden and demonstrate how dementia management intervention scenarios could reduce this burden. Since age is a primary and immutable risk factor for dementia, the dementia problem in Canada is expected to become more severe with its aging demographic. This is expected to place a significant burden on the capacity of the public and private health care systems to provide essential health care services, community care as well as patient and caregiver support services, potentially overwhelming the Canadian health care system.

The current analysis estimates that the prevalence of dementia is expected to double its current estimates within the next 30 years and eventually affect over 1.1 million Canadians, accounting for approximately 2.8% of the total Canadian population. The results suggest that in the next 30 years, the excess demand for LTC required by dementia patients will increase over 10 times the current (2008 values) demand.

This excess demand is expected to cause more dementia patients with higher severity levels and requiring more complex care, to rely on community-based care and informal care support. In the next 30 years, the total number of hours of informal care is expected to increase to over 756 million hours per year, over 3.2 times the current estimate. Many informal caregivers have less than adequate resources and support available which places an additional burden on their ability to cope while providing the level of quality care required. This is further amplified by the fewer number of Canadian adults available to provide formal and informal care services to the large proportion of senior citizens requiring care, as the population demographics and ratio of young to old shifts.

6.2 BUSINESS CASE IMPLICATIONS

The results of the Rising Tides analysis provide a comprehensive understanding of the burden of the disease and its impacts on Canadian society. The study itself has looked at how dementia management

interventions could potentially alleviate the dementia crisis. The enormity of this burden emphasizes the urgency of a national dementia strategy to quantify, plan and mitigate the impacts of dementia in Canada. Through a comprehensive understanding of the dementia burden in Canada, a national strategy can guide and develop recommendations to manage and mitigate the health, economic and social impacts of dementia.

This study has looked at four intervention scenarios associated with 2 primary prevention programs, and caregiver and patient support programs evaluated against the base model. The value proposition of each scenario has highlighted how dementia management scenarios could potentially reduce the health and economic burden of dementia over the simulation period.

Prevention programs such as increasing physical activity levels or a hypothetical program that could delay disease onset, were shown to produce the most significant benefits. These scenarios were estimated to reduce the number of people diagnosed or living with dementia. With fewer Canadians living with dementia, the burden placed on health care resources across all types of care would be reduced, producing significant savings for Canadian governments and society.

The burden of dementia was also shown to be further reduced through interventions that provide support for patients and their informal caregivers. These scenarios show significant benefits from a policy perspective, in delaying entry in to LTC facilities for people with dementia. Firstly the financial benefits to both individuals and governments are clear in the savings from LTC costs by a reduction in the demand placed on LTC resources. Secondly there are emotional and quality of life benefits by a decrease in the burden placed on informal caregivers by reducing the number of hours of care through the provision of adequate support resources.

6.3 LIMITATIONS

The availability of recent Canadian dementia-specific data was a limiting factor in this project. As a result the true burden of dementia in Canada is likely underestimated. Under the advice of leading dementia experts, the epidemiological utilization data and costs used in this evaluation were based on the 1991 CSHA and its 1996 follow-up study, European data from the EURODEM studies, and approximations from subject-matter experts. Although these data do allow us to approximate the burden of dementia in Canada, it is unknown how trends are changing over time. It is further assumed within the Life at Risk® dementia model that prevalence rates and proportions of dementia patients

across different care modes remain static or constant throughout the simulation period. The progression of the disease was also not considered within this analysis as a result of the challenges around the general lack of availability of data and the rates of progression from one severity level to the next, over time.

The results of this evaluation were primarily driven by the changing age-structure of the Canadian population. Additional immutable or behaviour risk factors that may increase the risk of dementia onset and its progression were not taken into consideration. Currently, there is a lack of information about the interaction of risk factors and their contribution to disease onset and progression and a lack of population based studies on how dementia actually progresses as well as what methods can be used to track this inevitable progression. Similarly, this study could not consider the coexistence of one or more diseases for dementia patients. Since age is a primary risk factor for many health conditions, it is likely that dementia patients suffer from one or more comorbid diseases. Comorbid conditions are likely to increase the resources required to provide adequate care, therefore increasing the costs of care.

The Rising Tides project evaluated the informal caregiver burden based on the economic disability only. The opportunity cost for informal caregivers and indirect costs associated with the provision of care were based on the time (number of hours) providing care to dementia care recipients. Since the majority of informal caregivers are spouses or family members of the patient, the provision of care and progression of the disease adds a significant amount of emotional distress to informal caregivers which may manifest in depressive symptoms or give rise to other health conditions. The health disability of informal caregivers was not taken into consideration in the Rising Tides project, likely underestimating the true informal caregiver burden associated with dementia.

6.4 FUTURE RESEARCH PRIORITY AREAS

The Rising Tides project has identified several dementia research priority areas. The limitations in Canadian dementia-specific data and assumption settings for the current project gave rise to the following research priorities and questions for future evaluation.

1. A national population-based study in Canada has not been conducted since the groundbreaking and world renowned Canadian Study of Health and Aging (CSHA) in the 1990's. A Canadian longitudinal

population-based study would provide valuable information and further insight into the problem of dementia in Canada today and how dementia is changing over time.

2. The Rising Tides project has assumed that the rates and proportions of dementia prevalence remained constant. It is unknown how Canadian dementia prevalence is actually changing over time. If quality annual data on the incidence and mortality of dementia were available in Canada, the annual prevalence could be calculated to assess longitudinal trends.
3. The population-based dementia data used in the Rising Tides project do not distinguish between severity levels and the rate of the progression of the disease as this information is unavailable. Many challenges also arise as a result of the heterogeneity of the dementing diseases themselves. Data by severity level would allow researchers to evaluate interventions targeted towards slowing disease progression.
4. The Rising Tides project did not evaluate the additional risk of dementia across the several risk factors that have been outlined in the Canadian Consensus Guidelines. These were not taken into consideration because it is unknown how the prevalence of more than one risk factor (2 or more) interacts and contributes to disease onset and progression.
5. The Rising Tides project isolated dementia from other comorbid diseases and it is unknown how a comorbid health condition could change the dynamics of dementia in Canada; or conversely, how the dementia-specific interventions could impact comorbid diseases.
6. The proportion of dementia patients across each type of care in Canada is unknown and the rate of admission into LTC for dementia patients is also unknown.
7. Knowledge about informal caregivers of dementia patients is very limited. This includes lack of population demographics as well as labour force metrics. Understanding how dementia impacts informal caregivers and the economic value of an informal caregiver would provide further insight on the indirect burden of the disease.
8. The health burden or health disability of informal caregivers is not well understood and was not taken into account in the Rising Tides project. How the health status disability relates to the informal caregiver burden is not well understood.
9. Rising Tides provides a current and future national perspective of dementia. Currently, is unknown how dementia varies across provinces and territories or across specific population groups.

GLOSSARY OF TERMS

Absence of simulation – a simulation of future life and economic variables assuming the non-existence of a particular disease.

Acetylcholine - a neurotransmitter important for the formation of memories. Studies have shown that levels of acetylcholine are reduced in the brains of people with Alzheimer's disease.

Algorithm - a finite set of unambiguous instructions performed in a prescribed sequence to achieve a goal, especially a mathematical rule or procedure used to compute a desired result.

Alzheimer's disease - the most common cause of dementia in people aged 65 and older. Nearly all brain functions, including memory, movement, language, judgment, behavior, and abstract thinking, are eventually affected.

Amyloid plaques - unusual clumps of material found in the tissue between nerve cells. Amyloid plaques, which consist of a protein called beta amyloid along with degenerating bits of neurons and other cells, are a hallmark of Alzheimer's disease.

Amyloid precursor protein - a normal brain protein that is a precursor for beta amyloid.

Antioxidant - any of various phosphorus-containing lipids, such as lecithin and cephalin that are composed mainly of fatty acids, a phosphate group, and a simple organic molecule.

Apolipoprotein E - a gene that has been linked to an increased risk of Alzheimer's disease. People with a variant form of the gene, called apoE epsilon 4, have about ten times the risk of developing Alzheimer's disease.

Apoptosis - a genetically determined process of cell self-destruction that is marked by the fragmentation of nuclear DNA.

Asymptomatic - presenting no symptoms of disease.

Ataxia - a loss of muscle control.

Atherosclerosis - a blood vessel disease characterized by the buildup of plaque, or deposits of fatty substances and other matter in the inner lining of an artery.

Base Case - the simulated future life and economic burden of diseases without the effects of a health intervention.

Benzodiazepine – a class of psychoactive drugs (acts primarily upon the central nervous system) has varying sedative, hypnotic (sleep inducing), anxiolytic (anxiety), anticonvulsant, muscle relaxant and amnesic properties.

Behavioral risk - excess risk of disease that can be attributed to the actions of an individual and can therefore be altered. For example, smoking and high BMI can be classified as behavioral risks since they can be changed.

Beta amyloid - a protein found in the characteristic clumps of tissue (called plaques) that appear in the brains of Alzheimer's patients.

Binswanger's disease - a rare form of dementia characterized by damage to small blood vessels in the white matter of the brain. This damage leads to brain lesions, loss of memory, disordered cognition, and mood changes.

Biomarker - a distinctive biological or biologically derived indicator (as a biochemical metabolite in the body) of a process, event, or condition.

Cell - a population segment categorized by unique characteristics. Each cell contains an equivalence class of individuals who cannot be further de-identified under the criterion of the cell's description.

Cerebral - of or relating to the brain or the intellect.

Cerebrospinal fluid - a colorless liquid that is comparable to serum, is secreted from the blood into the lateral ventricles of the brain, and serves chiefly to maintain uniform pressure within the brain and spinal cord.

Cerebrovascular disease - disease of the blood vessels and, especially, the arteries that supply the brain with blood.

Cholinesterase inhibitors - drugs that slow the breakdown of the neurotransmitter acetylcholine.

Cognitive - of, relating to, being, or involving conscious intellectual activity

Cognitive training - a type of training in which patients practice tasks designed to improve mental performance. Examples include memory aids, such as mnemonics, and computerized recall devices.

Comorbid - existing simultaneously with another medical condition.

Computed tomography (CT) scans - a type of brain scan that uses X-rays to detect brain structures.

Continuous - of or relating to a line or curve that extends without a break or irregularity.

Cortical atrophy - degeneration of the brain's cortex (outer layer). Cortical atrophy is common in many forms of dementia and may be visible on a brain scan.

Cortical dementia - a type of dementia in which the damage primarily occurs in the brain's cortex, or outer layer.

Corticobasal degeneration - a progressive disorder characterized by nerve cell loss and atrophy in multiple areas of the brain.

Counterfactual - running contrary to the facts, or existing conditions.

Coupled ordinary differential equation (CODE) - an equation that describes the rate at which individuals move into and out of population cells. The equation states that the rate of change is proportional to the various ways in which such individuals can move into and out of other cells (as defined by the topology and coupling coefficients).

Coupling Coefficient (or rate) - a mathematical way of identifying the rate at which individuals can move from one population cell to another, say from cell A to cell B.

Cubic smoothing spline – a curve fitted to existing observations in order to predict unobserved values.

Creutzfeldt-Jakob disease - a rare, degenerative, fatal brain disorder believed to be linked to an abnormal form of a protein called a prion.

Defoliant - is any chemical sprayed or dusted on plants to cause its leaves to fall off.

Dehydroepiandrosterone(DHEA) - a steroid produced by the adrenal gland.

Delirium - a mental disturbance characterized by confusion, disordered speech, and hallucinations.

Dementia -a term for a collection of symptoms that significantly impair thinking and normal activities and relationships.

Dementia pugilistica - a form of dementia caused by head trauma such as that experienced by boxers. It is also called chronic traumatic encephalopathy or Boxer's syndrome.

DemTect - cognitive screening test to support the diagnosis of mild cognitive impairment and early dementia.

Derivative - represents an infinitesimal change in the function with respect to one of its variables.

Diabetes mellitus - a variable disorder of carbohydrate metabolism caused by a combination of hereditary and environmental factors and usually characterized by inadequate secretion or utilization of insulin, by excessive urine production, by excessive amounts of sugar in the blood and urine, and by thirst, hunger, and loss of weight.

Diphtheria - an upper respiratory tract illness characterized by sore throat, low fever, and an adherent membrane on the tonsils, pharynx, and/or nasal cavity.

Direct costs - economic costs associated with treating a particular health condition. (eg. the cost of prescription medication)

Discrete - defined for a finite or countable set of values; not continuous.

Discrete event simulation - represents the operation of a system as a chronological sequence of events.

Economic burden of dementia - the sum of direct, opportunity, and indirect costs.

Electroencephalogram (EEG) - a medical procedure that records patterns of electrical activity in the brain.

Epidemiology - a branch of medical science that deals with the incidence, distribution, and control of disease in a population.

Etiology - a branch of medical science concerned with the causes and origins of diseases.

Excess risk of mortality - a mortality ratio greater than one. When the observed deaths of a particular population segment is greater than the expected deaths, given the age and gender of a population.

Fatal familial insomnia - an inherited disease that affects a brain region called the thalamus, which is partially responsible for controlling sleep. The disease causes dementia and a progressive insomnia that eventually leads to a complete lack of sleep.

Frontotemporal dementias - a group of dementias characterized by degeneration of nerve cells, especially those in the frontal and temporal lobes of the brain.

FTDP-17 - one of the frontotemporal dementias, linked to a mutation in the tau gene. It is much like other types of the frontotemporal dementias but often includes psychiatric symptoms such as delusions and hallucinations.

Gerstmann-Straussler-Scheinker disease - a rare, fatal hereditary disease that causes ataxia and progressive dementia.

Glutamate - a non-essential amino acid.

Hemiplegia - total or partial paralysis of one side of the body that results from disease of or injury to the motor centers of the brain.

HIV-associated dementia - a dementia that results from infection with the human immunodeficiency virus (HIV) that causes AIDS. It can cause widespread destruction of the brain's white matter.

Homocysteine - a type of amino acid that is produced in animal metabolism.

Huntington's disease - a degenerative hereditary disorder caused by a faulty gene for a protein called huntington. The disease causes degeneration in many regions of the brain and spinal cord and patients eventually develop severe dementia.

Hyperlipidemia - the presence of excess fat or lipids in the blood.

Hypothyroidism - deficient activity of the thyroid gland.

Identity - an equation that is satisfied for all values of the symbols.

Immutable - not capable of or susceptible to change.

Incidence - in disease epidemiology, the incidence is the number of newly diagnosed cases during a specific time period.

Inclusions - a passive usually temporary product of cell activity (as a starch grain) within the cytoplasm or nucleus.

Indirect costs - costs that have no immediate connection with a health condition, but are a consequence of it. (eg. lost production from disability)

Intervention scenario - the simulated future life and economic burden of disease which includes the effects of a health initiative.

Lewisham Case Management Scheme - an intensive dementia care management service that combines secondary health care in the community and intensive care management.

Lewy body dementia - one of the most common types of progressive dementia, characterized by the presence of abnormal structures called Lewy bodies in the brain. In many ways the symptoms of this disease overlap with those of Alzheimer's disease.

Longitudinal cohort studies - involving the repeated observation or examination of a set of subjects over time with respect to one or more study variables.

Low-density lipoprotein - a biochemical assembly that contains both proteins and lipids which transports cholesterol and triglycerides from the liver to peripheral tissues.

Macroeconomic - a branch of economics that deals with the performance, structure, and behavior of a national or regional economy as a whole.

Magnetic resonance imaging (MRI) - a diagnostic imaging technique that uses magnetic fields and radio waves to produce detailed images of body structures.

Mild cognitive impairment - a condition associated with impairments in understanding and memory not severe enough to be diagnosed as dementia, but more pronounced than those associated with normal aging.

Mini-Mental State Examination - a test used to assess cognitive skills in people with suspected dementia. The test examines orientation, memory, and attention, as well as the ability to name objects, follow verbal and written commands, write a sentence spontaneously, and copy a complex shape.

Modules - A portion of a simulation platform that carries out a specific function and may be used alone or combined with other modules of the same program.

Mortality - the number of deaths in a given time or place.

Mortality ratio - the ratio of observed deaths to expected deaths given the age and gender of a population.

Mortality-specific odds ratio - an odds ratio comparing expected deaths with dementia to the expected deaths without dementia.

Multi-infarct dementia - a type of vascular dementia caused by numerous small strokes in the brain.

Myelin - a fatty substance that coats and insulates nerve cells.

Necrosis - death of a portion of tissue differentially affected by local injury.

Neurobiology - a branch of the life sciences that deals with the anatomy, physiology, and pathology of the nervous system.

Neurofibrillary tangles - bundles of twisted filaments found within neurons, and a characteristic feature found in the brains of Alzheimer's patients. These tangles are largely made up of a protein called tau.

Neuroimaging - a clinical specialty concerned with producing images of the brain by noninvasive techniques.

Neuropsychological - a science concerned with the integration of psychological observations on behavior and the mind with neurological observations on the brain and nervous system.

Neurosyphilis - an infection of the brain or spinal cord. It occurs in persons with untreated syphilis many years after they are first infected.

Neurotransmitter - a type of chemical, such as acetylcholine, that transmits signals from one neuron to another. People with Alzheimer's disease have reduced supplies of acetylcholine.

Normal-pressure hydrocephalus - an abnormal expansion of cavities (ventricles) within the brain that is caused by the accumulation of cerebrospinal fluid

Observational study - a type of study in which individuals are observed or certain outcomes are measured. No attempt is made to affect the outcome (for example, no treatment is given).

Odds Ratio – a method for comparing the likelihood of a certain event occurring between two groups. An odds ratio of 1 implies that the event is equally likely in both groups. An odds ratio greater than one implies that the event is more likely in the first group. An odds ratio less than one implies that the event is less likely in the first group.

Omega 3 fatty acid – a fatty acid found in fish, such as salmon, tuna, and halibut, other marine life such as algae and krill, certain plants (including purslane), and nut oils.

Opportunity costs - The cost of an alternative that must be forgone in order to pursue a certain action. The opportunity cost of informal care is the wages that would have been earned if employed.

Ordinary differential equation - an equality involving a function and its derivatives.

Organic brain syndrome - a term that refers to physical disorders (not psychiatric in origin) that impair mental functions.

Oxidative stress - caused by an imbalance between the production of reactive oxygen and a biological system's ability to readily detoxify the reactive intermediates or easily repair the resulting damage.

Parkinson's dementia - a secondary dementia that sometimes occurs in people with advanced Parkinson's disease, which is primarily a movement disorder. Many Parkinson's patients have the characteristic amyloid plaques and neurofibrillary tangles found in Alzheimer's disease, but it is not yet clear if the diseases are linked.

Pathology - the scientific study of the nature of disease and its causes, processes, development, and consequences.

Pathophysiology - the functional changes that accompany a particular syndrome or disease.

Pick's disease - a type of frontotemporal dementia where certain nerve cells become abnormal and swollen before they die. The brains of people with Pick's disease have abnormal structures, called Pick bodies, inside the neurons. The symptoms are very similar to those of Alzheimer's disease.

Plaques - unusual clumps of material found between the tissues of the brain in Alzheimer's disease. See also amyloid plaques.

Poliomyelitis - an acute infectious disease, marked by inflammation of nerve cells in the spinal cord, characterized by fever, motor paralysis, and atrophy of skeletal muscles often with permanent disability and deformity.

Polyphenols – a group of chemical substances found in plants that tend to prevent or neutralize the damaging effects of free radicals.

Positron Emission Tomography (PET) - a nuclear medicine imaging technique which produces a three-dimensional image or picture of functional processes in the body.

Postmortem pathologic examination – an autopsy performed to diagnosis a disease.

Post-traumatic dementia - a dementia brought on by a single traumatic brain injury. It is much like dementia pugilistica, but usually also includes long-term memory problems.

Prednisone - an oral, synthetic (man-made) corticosteroid used for suppressing the immune system and inflammation.

Presenilin 1 and 2 - proteins produced by genes that influence susceptibility to early-onset Alzheimer's disease.

Present Value - the current worth of a future sum of money or stream of cash flows given a specified rate of return.

Prevalence - the proportion of individuals in a population having a disease. Prevalence is a statistical concept referring to the number of cases of a disease that are present in a particular population at a given time.

Primary Data – original data derived from a new research study and collected at source, as opposed to previously published material.

Primary dementia - a dementia, such as Alzheimer's disease, that is not the result of another disease.

Primary prevention – the undertaking of activities that avoids the development of a disease.

Primary progressive aphasia - a type of frontotemporal dementia resulting in deficits in language functions. Many, but not all, people with this type of aphasia eventually develop symptoms of dementia.

Primary risk factor – a variable associated with an increased risk of disease onset.

Prion diseases - a group of progressive conditions linked to a mutation in the Prion Protein ,that affect the brain and nervous system.

Production function – an equation that expresses the relationship between the quantities of productive factors (such as labour and capital) used and the amount of output produced.

Process - the means by which individuals from one population cell can be moved into another population cell.

Progesterone - steroid hormone involved in the female menstrual cycle, pregnancy and embryogenesis of humans and other species.

Progressive supranuclear palsy - a neurodegenerative disease that affects cognition, eye movements, and posture.

Prospective study – a study that watches for outcomes, such as the development of a disease, during the study period and relates this to other factors such as suspected risk or protection factor(s).

Relative risk - the probability that a member of an exposed group will develop a disease relative to the probability that a member of an unexposed group will develop that same disease. A relative risk equal to 1 implies that the

event is equally probable in both groups. A relative risk greater than 1 implies that the event is more likely in the first group. A relative risk less than 1 implies that the event is less likely in the first group.

Secondary data – data that is neither collected directly by the user nor specifically for the user, often under conditions not known to the user.

Secondary dementia - dementia that occurs as a consequence of another disease or injury.

Senile dementia - an outdated term that reflects the formerly widespread belief that dementia was a normal part of aging. The word senile is derived from a Latin term that means, roughly, "old age."

Skew - A distribution is skewed if one of its tails is longer than the other.

State vector - a way of describing a population cell that distinguishes it from the rest of the population.

Stochastic - of or pertaining to a random variable.

Stochastic Coupled Ordinary Differential Equations (SCODE) - an equation that describes the range of rates (stochastic) at which individuals move into and out of population cells. A coupled ordinary differential equation with a stochastic coupling coefficient.

Structural brain disorders - mental disorders which are connected with known physical abnormalities of the brain.

Subcortical dementia - dementia that affects parts of the brain below the outer brain layer, or cortex.

Subdural hematoma - a collection of blood on the surface of the brain.

Substance-induced persisting dementia - dementia caused by abuse of substances such as alcohol and recreational drugs that persists even after the substance abuse has ended.

Symptomatic drugs – medication designed to treat the symptoms of disease.

Synapses - the place at which a nerve impulses pass from one neuron to another.

Systolic blood pressure - the highest arterial blood pressure of a cardiac cycle occurring immediately after contraction of the left ventricle of the heart.

Tau protein - a protein that helps the functioning of microtubules, which are part of the cell's structural support and help to deliver substances throughout the cell. In Alzheimer's disease, tau is changed in a way that causes it to twist into pairs of helical filaments that collect into tangles.

Tetanus - an acute infectious disease characterized by tonic spasm of voluntary muscles especially of the jaw.

Topology - a map that identifies all possible ways that individuals can move from one population cell to another.

Total serum cholesterol – the total level of cholesterol found in the bloodstream.

Transmissible spongiform encephalopathies - part of a family of human and animal diseases in which brains become filled with holes resembling sponges when examined under a microscope. CJD is the most common of the known transmissible spongiform encephalopathies.

Value Proposition - The difference between the base case simulation results and the simulated results that include the health intervention.

Vascular dementia - a type of dementia caused by brain damage from cerebrovascular or cardiovascular problems (usually strokes). It accounts for up to 20 percent of all dementias.

Volatile solvents - liquids that vaporize at room temperature, found in domestic and industrial products such as glue, aerosol, paints, industrial solvents, lacquer thinners, gasoline, and cleaning fluids

Zero coupon bond - a debt security that doesn't pay interest (a coupon), rendering profits at maturity when the bond is redeemed for its full face value

APPENDIX A: BIBLIOGRAPHY

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APPENDIX B: DATA SOURCES

Population Data

- Provincial and Territorial populations in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0001)
- Provincial and Territorial deaths in Canada by 1 year age intervals from 1971/72 to 2006/07 (CANSIM Tables 051-0002)
- International immigration in Canada by 1 year age intervals from 1971/72 to 2006/07 (CANSIM Tables 051-0011)
- International emigration in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0012)
- Inter-provincial migration in Canada by 1 year age intervals from 1971 to 2007 (CANSIM Tables 051-0013)

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Health Care Utilization and Economic Data

- Statistics Canada Table 107-550995 provides the number of beds, of which people with dementia occupy 64.3% in 2000;
- 282-0071 Labour force survey estimates (LFS), wages of employees by type of work, North American Industry Classification System (NAICS), sex and age group, monthly (Dollars), Jan 1997-Sep 2006
- 282-0001 Labour force survey estimates (LFS), by sex and detailed age group, monthly (Persons), Jan 1976-Sep 2006

⁹⁵ Occupancy based on beds staffed and in operation in residential care facilities, by principal characteristic of the predominant group of residents and size of facility, Canada, provinces and territories, annual

- 282-0072 Labour force survey estimates (LFS), wages of employees by type of work, North American Industry Classification System (NAICS), sex and age group, annual (Dollars), 1997-2006
- 380-0015 Gross Domestic Product (GDP) and Gross National Product (GNP) at market prices and net national income at basic prices, quarterly (Dollars), Mar 1961-Jun 2006
- 380-0016 Gross Domestic Product (GDP), income-based, annual (Dollars), 1961-2006
- 380-0017 Gross Domestic Product (GDP), expenditure-based, annual (Dollars), 1961-2006
- 380-0001 Gross Domestic Product (GDP), income-based, quarterly (Dollars), Mar 1961-Jun 2006
- 380-0002 Gross Domestic Product (GDP), expenditure-based, quarterly (Dollars), Mar 1961-Jun 2006
- 326-0001 Consumer price index (CPI), 2001 basket content, monthly (Index, 1992=100), Jan 1914-Aug 2006
- 326-0002 Consumer price index (CPI), 2001 basket content, annual (Index, 1992=100), 1914-2006

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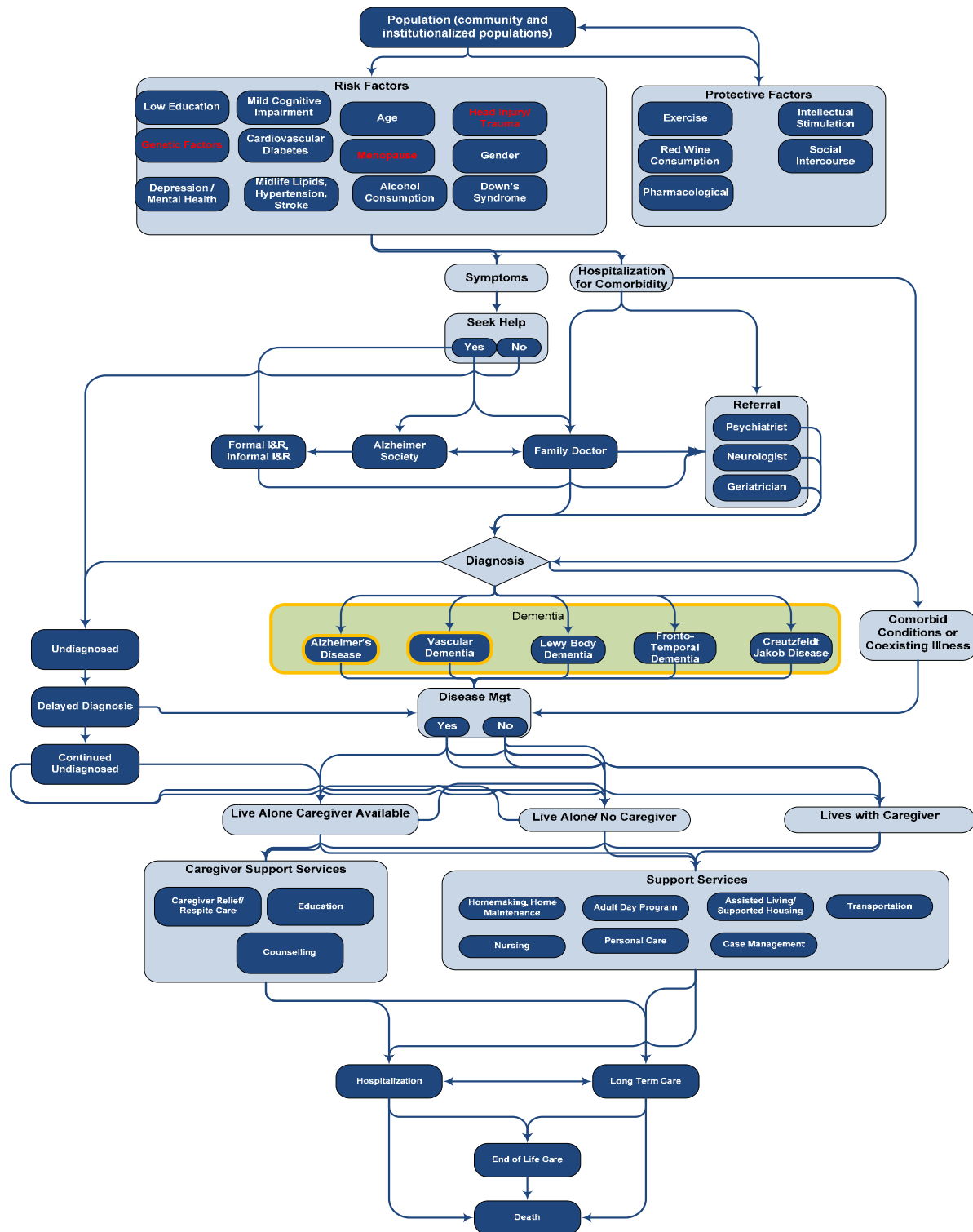
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APPENDIX C: DEMENTIA CARE MAP



APPENDIX D: ALL CAUSE DEMENTIA RESULTS

Note: All estimates of prevalence are measured at a specific point in time and incorporate all changes from the previous period. Therefore, the value in a column representing a certain year represents a finite moment in time. For example, the value in the column representing 2011 is a measure of prevalence on Jan 1st 2011.

All estimates of incidence are measured over a specific period (one year period). Therefore, the specific value in the column representing a certain year actually refers to a period of time over which incidence was measured. For example, 2011 refers to the period 2010 to 2011 (Jan 1st 2010 to Dec. 31st 2010).

LIFE TERMS**PREVALENCE****Exhibit 58** All-Cause Dementia Prevalence: Expected Value (Males & Females, By Age Group: 2008-2038)

Year	Prevalence: Expected Value (Males & Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	480,613	407,531	29,690	44,024	67,591	82,618	92,563	91,045
2009	488,465	417,458	29,549	44,361	66,638	82,903	96,802	97,206
2010	505,351	432,301	32,222	46,605	67,074	83,724	99,396	103,280
2011	521,280	447,860	34,201	48,091	68,032	84,622	101,883	111,031
2012	539,993	461,277	36,083	49,205	68,126	85,090	105,018	117,755
2013	552,562	473,872	36,961	50,307	69,518	86,401	105,932	124,753
2014	571,912	492,232	38,674	52,048	71,450	88,434	107,983	133,643
2015	581,252	502,765	39,174	53,078	73,136	90,262	109,112	138,003
2016	599,849	520,256	41,515	55,579	75,111	92,425	110,838	144,788
2017	622,435	538,475	43,574	58,001	77,805	95,394	112,538	151,163
2018	635,129	550,912	44,747	59,545	80,386	97,852	113,841	154,542
2019	648,880	565,999	45,214	61,173	83,858	100,941	115,421	159,392
2020	670,672	588,049	46,481	63,040	88,834	105,516	117,883	166,294
2021	687,552	603,817	46,647	63,991	91,494	109,331	119,938	172,416
2022	709,378	624,425	46,814	65,358	95,992	114,602	123,441	178,217
2023	730,896	648,016	48,235	68,392	100,665	119,647	127,396	183,682
2024	751,063	666,439	48,435	70,019	104,247	124,979	131,946	186,812
2025	775,411	690,461	48,324	71,804	109,876	131,102	137,413	191,942
2026	801,328	714,112	50,136	73,760	112,482	135,155	143,475	199,105
2027	820,975	735,283	48,879	74,250	116,610	140,630	149,035	205,879
2028	848,334	761,526	50,119	76,927	122,370	146,754	153,664	211,693
2029	880,760	795,885	49,160	76,873	126,686	154,871	163,735	224,559
2030	900,667	816,873	48,001	78,757	129,532	158,648	170,801	231,134
2031	923,763	838,714	47,332	78,617	130,681	162,326	179,856	239,901
2032	960,370	877,189	47,585	79,922	136,002	169,777	186,388	257,515
2033	984,285	902,024	44,463	80,326	139,063	175,470	197,074	265,629
2034	1,013,905	932,953	45,785	82,164	140,565	178,713	206,246	279,480
2035	1,042,113	961,230	45,515	82,224	142,192	181,841	214,495	294,964
2036	1,069,774	988,572	45,965	83,876	147,871	189,167	221,591	300,102
2037	1,095,164	1,014,896	44,356	82,798	146,532	190,477	230,884	319,848
2038	1,125,184	1,042,301	44,503	83,781	147,700	193,576	239,316	333,425

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 59 All-Cause Dementia Prevalence: 95% Lower Bound (Males & Females by Age Group: 2008-2038)

Year	Prevalence: Lower Bound (Males & Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	353,062	321,721	16,055	33,892	54,398	70,644	79,593	67,139
2009	362,292	330,448	16,212	33,581	55,386	71,103	82,860	71,305
2010	380,011	343,237	19,888	36,417	54,209	70,741	85,864	76,119
2011	391,554	354,969	20,809	37,533	54,655	70,895	89,351	81,727
2012	396,377	360,410	19,828	37,295	55,132	72,300	90,982	84,874
2013	410,747	372,309	22,139	39,710	55,462	72,167	90,663	92,167
2014	421,732	382,989	21,787	39,323	57,931	74,551	92,991	96,406
2015	428,818	391,271	21,573	39,171	58,787	77,195	93,904	100,640
2016	444,743	406,384	23,160	42,175	59,546	76,782	95,355	109,366
2017	456,711	414,608	26,141	43,603	61,523	78,789	96,284	108,269
2018	466,771	424,895	24,718	45,132	63,537	80,788	98,383	112,338
2019	483,710	440,972	27,224	47,160	66,002	84,739	100,044	115,803
2020	502,876	458,555	27,860	49,265	71,859	89,839	100,880	118,851
2021	523,545	477,231	28,059	50,346	75,053	92,309	104,051	127,413
2022	538,624	492,467	29,052	52,198	78,397	96,289	106,263	130,269
2023	551,429	506,373	26,539	52,971	81,432	100,607	110,811	134,013
2024	555,651	510,746	26,147	52,337	83,831	103,835	111,595	133,001
2025	588,331	542,089	28,517	56,906	89,812	111,048	116,382	139,423
2026	602,721	557,807	25,513	55,645	92,374	114,693	122,949	146,634
2027	624,481	577,173	28,313	58,465	94,370	118,166	125,794	152,065
2028	635,193	587,711	28,427	61,005	99,721	122,773	131,704	144,082
2029	655,043	608,727	26,877	61,299	99,569	126,597	142,663	151,722
2030	663,744	620,518	23,494	59,707	101,885	132,766	145,834	156,832
2031	707,273	661,616	26,489	62,381	107,785	140,572	154,439	169,951
2032	721,649	681,915	20,401	62,939	110,244	142,603	159,437	186,291
2033	736,488	696,472	21,793	62,973	110,457	147,973	166,670	186,606
2034	761,184	722,326	21,559	62,736	114,409	152,348	175,749	195,525
2035	779,716	740,545	21,215	63,904	113,964	154,201	182,937	204,322
2036	808,874	768,192	22,585	65,087	122,330	162,846	190,654	204,689
2037	831,964	792,642	21,312	66,396	116,863	159,061	194,423	234,588
2038	846,601	806,915	19,710	64,842	115,993	161,991	204,127	240,251

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 60 All-Cause Dementia Prevalence: 95% Upper Bound (Males & Females By Age Group: 2008-2038)

Year	Prevalence: Upper Bound (Males & Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	598,290	488,259	41,927	53,464	80,104	95,729	105,593	111,443
2009	616,452	503,604	44,459	55,258	80,015	95,369	108,104	120,400
2010	638,043	523,056	46,899	56,440	81,231	98,202	112,284	127,999
2011	653,163	539,165	46,489	57,172	82,060	97,522	115,484	140,437
2012	683,906	565,189	50,799	60,353	82,872	98,797	119,234	153,135
2013	697,327	576,872	51,558	61,842	83,841	101,916	119,190	158,524
2014	726,938	602,236	55,053	65,197	86,635	103,620	123,601	168,131
2015	745,127	619,248	58,189	67,388	87,442	103,982	122,600	179,646
2016	760,972	637,153	58,998	69,169	90,869	106,838	126,422	184,859
2017	779,068	650,967	59,676	70,463	94,169	109,663	126,724	190,272
2018	805,251	675,425	62,606	72,081	95,585	114,357	130,100	200,695
2019	824,586	693,967	64,248	75,171	99,463	116,877	131,154	207,054
2020	854,638	721,665	66,648	77,978	106,380	123,120	133,640	213,901
2021	881,007	742,153	67,179	79,592	109,202	127,848	136,736	221,595
2022	901,593	766,159	68,079	82,487	114,668	132,985	141,469	226,471
2023	931,278	797,468	70,829	84,433	120,599	140,460	144,512	236,634
2024	952,695	816,487	70,250	86,355	122,441	144,249	149,969	243,222
2025	973,216	839,352	68,841	88,094	130,939	153,025	156,150	242,303
2026	1,008,193	872,223	69,791	90,090	134,781	157,141	159,742	260,680
2027	1,028,680	892,365	68,806	91,110	138,632	162,435	166,537	264,844
2028	1,065,056	930,774	70,639	93,173	144,853	171,241	176,851	274,017
2029	1,102,503	964,338	70,874	94,476	151,934	178,017	185,243	283,794
2030	1,124,957	992,169	69,730	94,873	154,638	183,489	192,184	297,255
2031	1,150,809	1,018,033	68,599	94,601	156,856	189,593	205,863	302,522
2032	1,189,101	1,054,993	69,919	95,931	161,917	196,079	213,771	317,376
2033	1,225,799	1,095,485	66,411	97,049	165,770	201,858	228,033	336,365
2034	1,260,737	1,130,241	67,473	97,276	167,955	205,478	234,268	357,790
2035	1,292,706	1,160,453	66,039	98,536	166,871	209,979	244,420	374,608
2036	1,318,342	1,187,943	66,333	99,006	173,602	213,604	251,070	384,328
2037	1,383,497	1,248,782	67,820	99,564	175,512	218,857	262,949	424,079
2038	1,400,591	1,267,244	65,046	99,601	174,248	221,184	276,462	430,704

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 61 All-Cause Dementia Prevalence: Expected Value (Males, By Age Group: 2008-2038)

Year	Prevalence: Expected Value (Males)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	180,653	144,372	14,718	19,625	28,233	31,288	26,352	24,156
2009	184,730	148,038	15,022	19,906	28,347	31,369	27,503	25,890
2010	191,776	154,228	15,835	21,000	28,906	31,978	29,549	26,959
2011	195,429	159,548	16,646	21,584	28,770	32,153	30,371	30,023
2012	202,729	164,145	17,251	21,618	29,018	32,394	31,919	31,944
2013	211,908	172,459	18,285	22,791	30,593	33,841	32,549	34,400
2014	220,738	181,364	19,033	23,586	31,378	34,625	33,061	39,681
2015	222,597	183,320	18,742	23,433	32,061	35,702	33,760	39,623
2016	226,567	187,469	19,990	25,122	31,829	35,979	35,237	39,311
2017	240,417	198,357	20,700	25,979	33,967	38,087	36,024	43,600
2018	245,418	203,035	21,364	26,763	35,154	39,224	36,565	43,966
2019	251,746	209,676	22,287	27,731	36,511	39,930	37,490	45,727
2020	259,657	218,557	22,424	28,592	38,775	42,012	37,985	48,770
2021	266,993	225,060	22,720	29,422	39,798	43,788	38,915	50,417
2022	274,290	232,674	22,504	29,229	41,547	45,826	39,969	53,598
2023	286,472	245,212	23,651	31,304	44,450	47,995	41,565	56,248
2024	290,924	249,066	22,937	31,530	45,352	50,490	43,888	54,869
2025	305,096	260,946	24,594	32,930	47,604	52,460	44,943	58,413
2026	312,036	268,778	24,413	33,483	48,979	54,869	47,680	59,355
2027	318,830	276,303	23,325	32,765	50,787	57,084	50,009	62,333
2028	331,899	287,879	24,467	35,112	54,197	59,955	50,473	63,676
2029	347,577	304,731	24,180	35,055	55,105	63,105	54,992	72,294
2030	351,044	307,681	23,922	35,207	55,972	63,540	57,225	71,814
2031	362,456	318,705	23,434	35,698	57,512	65,860	61,086	75,115
2032	377,189	335,338	23,241	36,124	60,019	69,582	62,475	83,898
2033	386,806	344,334	22,593	36,468	60,466	71,102	67,301	86,404
2034	394,152	353,413	22,767	37,251	61,685	72,947	69,356	89,407
2035	411,602	369,897	23,017	37,642	63,315	74,138	73,193	98,591
2036	420,712	378,760	22,830	37,935	66,336	79,213	75,942	96,503
2037	428,229	387,109	22,501	37,739	65,405	78,526	78,783	104,156
2038	439,621	396,944	22,584	38,240	65,627	80,004	82,077	108,411

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 62 All-Cause Dementia Prevalence: 95% Lower Bound (Males, By Age Group: 2008-2038)

Year	Prevalence: Lower Bound (Males)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	115,904	101,993	7,375	14,143	22,989	25,976	20,710	10,801
2009	116,458	100,844	6,894	14,039	22,768	25,580	22,064	9,499
2010	126,140	107,841	9,304	15,736	22,259	25,847	23,656	11,039
2011	131,568	113,311	10,293	16,154	22,695	26,079	24,485	13,605
2012	129,095	112,563	9,263	15,604	22,531	26,242	25,482	13,441
2013	135,180	116,638	10,140	16,989	23,032	26,699	25,639	14,139
2014	140,984	122,733	10,036	16,444	24,257	28,112	26,796	17,088
2015	137,191	120,826	8,789	16,066	24,404	28,872	26,933	15,762
2016	141,032	124,504	9,540	17,564	24,346	28,207	27,341	17,506
2017	149,494	129,644	11,535	18,448	25,778	29,162	28,273	16,448
2018	149,590	130,947	10,273	18,863	26,118	29,978	28,844	16,872
2019	161,276	140,565	12,781	20,639	26,614	31,767	31,043	17,721
2020	169,078	148,414	12,735	21,330	29,705	34,043	30,262	20,338
2021	179,716	156,530	14,166	22,405	30,731	34,460	31,191	23,578
2022	182,351	160,609	12,928	22,577	33,218	36,933	31,668	23,285
2023	187,581	166,263	12,205	22,979	34,591	38,926	33,979	23,585
2024	182,622	162,621	10,759	21,819	35,754	40,077	33,875	20,336
2025	202,638	179,266	13,849	24,923	37,885	42,859	34,836	24,912
2026	204,633	184,016	11,542	23,461	38,167	43,524	37,845	29,477
2027	210,344	188,784	11,816	24,536	39,255	45,941	38,409	28,827
2028	207,170	185,883	11,897	25,599	41,604	46,938	39,686	20,159
2029	219,445	197,702	11,717	26,076	43,073	49,821	44,904	22,110
2030	213,314	194,466	9,074	24,273	41,892	50,963	44,750	23,514
2031	243,353	220,996	12,507	27,400	45,962	55,291	48,495	31,342
2032	251,004	231,844	9,700	26,814	47,254	56,541	49,193	42,342
2033	243,384	224,131	9,903	27,274	45,530	56,779	51,552	33,094
2034	253,783	234,110	10,884	27,971	48,642	59,933	55,298	31,382
2035	258,658	240,983	9,242	26,932	48,643	60,102	56,447	39,617
2036	266,830	247,801	10,241	28,538	53,945	63,916	60,655	30,506
2037	277,972	258,733	9,903	28,709	50,710	62,390	61,341	45,680
2038	284,675	265,948	8,394	28,782	52,011	64,380	65,371	47,010

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 63 All-Cause Dementia Prevalence: 95% Upper Bound (Males, By Age Group: 2008-2038)

Year	Prevalence: Upper Bound (Males)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	239,690	184,394	21,175	24,237	33,917	37,081	31,375	36,609
2009	250,492	192,247	22,470	25,643	34,372	37,152	32,575	40,034
2010	260,500	201,087	23,713	25,992	35,557	39,699	34,930	41,196
2011	264,741	208,292	23,715	26,653	35,793	38,465	35,865	47,801
2012	282,708	223,684	25,556	28,234	36,496	39,714	38,057	55,627
2013	290,707	229,042	26,342	29,346	37,797	41,724	38,279	55,553
2014	302,601	239,606	27,473	30,194	38,605	41,934	41,162	60,239
2015	312,511	247,329	28,938	31,678	39,311	42,964	40,510	63,929
2016	319,280	256,345	29,609	32,222	41,025	43,942	43,141	66,407
2017	324,719	260,544	29,897	32,894	42,753	45,783	42,003	67,214
2018	332,958	269,129	29,828	33,095	42,442	46,893	44,057	72,816
2019	348,936	281,755	32,448	35,753	44,747	48,476	44,593	75,739
2020	363,724	296,126	33,750	36,930	47,649	51,128	45,657	81,013
2021	373,607	302,846	33,609	37,199	48,888	53,804	46,787	82,558
2022	380,805	310,764	34,077	38,565	50,510	55,047	49,266	83,299
2023	397,498	329,316	36,482	39,541	54,407	58,011	50,408	90,467
2024	405,518	336,434	35,569	40,454	53,682	60,164	53,122	93,445
2025	411,564	343,202	34,082	40,985	57,851	63,597	55,131	91,556
2026	424,226	355,826	34,623	41,083	60,072	66,051	55,622	98,376
2027	435,671	367,768	33,774	41,937	63,333	69,194	59,154	100,376
2028	454,843	384,434	37,201	44,261	65,216	72,490	61,286	103,981
2029	465,105	394,990	35,089	43,923	69,726	75,812	64,912	105,528
2030	473,809	406,778	34,820	43,821	69,826	77,195	67,799	113,317
2031	486,781	417,854	34,881	44,231	69,154	79,355	73,897	116,336
2032	502,789	434,155	35,196	44,055	73,431	82,726	75,796	122,950
2033	519,362	451,806	33,260	45,208	74,657	85,906	81,923	130,852
2034	529,670	463,898	33,781	44,961	75,184	86,170	83,530	140,272
2035	546,905	478,494	33,357	45,987	74,689	88,196	86,839	149,426
2036	561,591	493,504	34,471	46,562	78,825	90,647	91,733	151,267
2037	590,177	520,647	35,268	46,005	79,843	92,082	93,521	173,928
2038	596,121	527,473	33,140	46,261	78,492	93,483	101,736	174,359

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 64 All-Cause Dementia Prevalence: Expected Value (Females, By Age Group: 2008-2038)

Year	Prevalence: Expected Value (Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	299,961	263,159	14,972	24,399	39,357	51,330	66,212	66,889
2009	303,735	269,421	14,527	24,455	38,290	51,533	69,299	71,316
2010	313,575	278,072	16,386	25,605	38,168	51,746	69,847	76,321
2011	325,851	288,313	17,555	26,507	39,261	52,469	71,512	81,008
2012	337,264	297,132	18,832	27,587	39,107	52,696	73,100	85,811
2013	340,654	301,414	18,676	27,516	38,925	52,560	73,383	90,353
2014	351,175	310,869	19,641	28,462	40,072	53,809	74,923	93,962
2015	358,654	319,445	20,432	29,645	41,076	54,560	75,352	98,380
2016	373,282	332,787	21,524	30,457	43,282	56,446	75,601	105,476
2017	382,018	340,119	22,874	32,023	43,838	57,307	76,514	107,563
2018	389,711	347,877	23,383	32,782	45,232	58,628	77,276	110,576
2019	397,133	356,323	22,927	33,442	47,347	61,011	77,931	113,666
2020	411,015	369,492	24,058	34,449	50,059	63,505	79,898	117,523
2021	420,559	378,758	23,927	34,569	51,695	65,543	81,024	122,000
2022	435,088	391,751	24,310	36,129	54,445	68,777	83,472	124,619
2023	444,424	402,804	24,584	37,088	56,215	71,652	85,830	127,434
2024	460,139	417,373	25,498	38,490	58,895	74,489	88,058	131,943
2025	470,314	429,515	23,730	38,873	62,272	78,641	92,470	133,529
2026	489,292	445,334	25,722	40,277	63,503	80,286	95,796	139,750
2027	502,145	458,980	25,554	41,485	65,823	83,546	99,025	143,546
2028	516,435	473,647	25,652	41,815	68,173	86,798	103,191	148,017
2029	533,183	491,154	24,980	41,818	71,581	91,766	108,743	152,266
2030	549,623	509,192	24,079	43,550	73,560	95,107	113,576	159,320
2031	561,307	520,009	23,898	42,919	73,170	96,466	118,770	164,786
2032	583,181	541,851	24,344	43,798	75,983	100,195	123,914	173,617
2033	597,480	557,691	21,870	43,858	78,597	104,368	129,773	179,225
2034	619,753	579,539	23,018	44,913	78,880	105,766	136,891	190,073
2035	630,512	591,334	22,497	44,583	78,877	107,703	141,302	196,373
2036	649,063	609,813	23,135	45,941	81,535	109,954	145,649	203,599
2037	666,934	627,787	21,855	45,059	81,128	111,951	152,101	215,692
2038	685,563	645,357	21,919	45,541	82,073	113,572	157,239	225,013

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 65 All-Cause Dementia Prevalence: 95% Lower Bound (Females, By Age Group: 2008-2038)

Year	Prevalence: Lower Bound (Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	237,157	219,728	8,680	19,749	31,409	44,668	58,883	56,338
2009	245,834	229,603	9,318	19,542	32,618	45,523	60,796	61,805
2010	253,870	235,397	10,584	20,681	31,950	44,894	62,208	65,079
2011	259,986	241,659	10,516	21,379	31,960	44,816	64,866	68,122
2012	267,282	247,846	10,565	21,691	32,601	46,058	65,500	71,433
2013	275,567	255,672	11,999	22,720	32,430	45,469	65,025	78,028
2014	280,748	260,255	11,751	22,879	33,673	46,439	66,195	79,318
2015	291,627	270,445	12,785	23,106	34,383	48,323	66,971	84,877
2016	303,711	281,880	13,620	24,611	35,200	48,575	68,014	91,860
2017	307,217	284,964	14,606	25,154	35,745	49,627	68,011	91,821
2018	317,182	293,948	14,446	26,268	37,419	50,810	69,539	95,466
2019	322,434	300,407	14,444	26,521	39,387	52,972	69,001	98,082
2020	333,798	310,141	15,125	27,935	42,154	55,797	70,618	98,513
2021	343,828	320,701	13,893	27,942	44,322	57,849	72,860	103,836
2022	356,272	331,858	16,123	29,621	45,179	59,356	74,595	106,985
2023	363,848	340,110	14,334	29,992	46,841	61,681	76,832	110,428
2024	373,029	348,125	15,388	30,517	48,076	63,758	77,720	112,665
2025	385,694	362,823	14,668	31,983	51,927	68,189	81,546	114,511
2026	398,088	373,791	13,970	32,184	54,207	71,169	85,103	117,157
2027	414,137	388,389	16,496	33,929	55,114	72,225	87,385	123,239
2028	428,023	401,829	16,530	35,405	58,117	75,835	92,018	123,923
2029	435,598	411,025	15,160	35,223	56,496	76,775	97,759	129,612
2030	450,431	426,052	14,420	35,434	59,993	81,803	101,083	133,318
2031	463,920	440,620	13,982	34,981	61,823	85,281	105,944	138,608
2032	470,645	450,070	10,701	36,125	62,990	86,062	110,244	143,949
2033	493,104	472,341	11,890	35,699	64,928	91,194	115,117	153,512
2034	507,402	488,216	10,675	34,765	65,767	92,415	120,451	164,143
2035	521,057	499,562	11,973	36,972	65,322	94,099	126,491	164,705
2036	542,044	520,391	12,344	36,550	68,384	98,931	129,999	174,183
2037	553,991	533,909	11,409	37,686	66,153	96,671	133,082	188,908
2038	561,926	540,967	11,316	36,060	63,982	97,611	138,756	193,241

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 66 All-Cause Dementia Prevalence: 95% Upper Bound (Females, By Age Group: 2008-2038)

Year	Prevalence: Upper Bound (Females)							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	358,600	303,865	20,752	29,226	46,187	58,217	74,218	74,835
2009	365,960	311,357	21,989	29,615	45,643	58,503	75,529	80,365
2010	377,543	321,969	23,185	30,449	45,675	59,057	77,354	86,803
2011	388,422	330,872	22,775	30,518	46,267	59,083	79,619	92,636
2012	401,198	341,505	25,243	32,119	46,376	60,192	81,177	97,508
2013	406,621	347,830	25,216	32,496	46,044	61,686	80,911	102,971
2014	424,337	362,630	27,580	35,003	48,030	61,019	82,439	107,893
2015	432,617	371,919	29,251	35,710	48,131	62,895	82,091	115,717
2016	441,693	380,808	29,389	36,946	49,844	63,880	83,281	118,452
2017	454,349	390,423	29,779	37,569	51,415	67,464	84,721	123,058
2018	472,293	406,296	32,778	38,986	53,144	68,401	86,043	127,880
2019	475,649	412,212	31,801	39,418	54,717	71,992	86,561	131,315
2020	490,913	425,539	32,898	41,048	58,731	74,043	87,983	132,887
2021	507,400	439,306	33,570	42,393	60,314	77,938	89,949	139,038
2022	520,788	455,395	34,002	43,923	64,158	82,449	92,203	143,172
2023	533,780	468,152	34,347	44,893	66,192	84,086	94,104	146,167
2024	547,177	480,053	34,681	45,901	68,760	89,428	96,848	149,777
2025	561,652	496,150	34,759	47,108	73,088	91,090	101,019	150,748
2026	583,966	516,397	35,168	49,007	74,710	93,241	104,120	162,303
2027	593,009	524,597	35,032	49,173	75,300	98,751	107,384	164,467
2028	610,213	546,340	33,438	48,912	79,638	102,204	115,566	170,036
2029	637,397	569,348	35,785	50,553	82,208	106,294	120,331	178,266
2030	651,147	585,390	34,910	51,052	84,812	110,238	124,385	183,937
2031	664,028	600,179	33,718	50,370	87,703	113,353	131,966	186,185
2032	686,312	620,837	34,723	51,875	88,486	115,952	137,975	194,425
2033	706,436	643,679	33,151	51,841	91,113	119,308	146,109	205,513
2034	731,067	666,342	33,692	52,314	92,771	121,783	150,739	217,518
2035	745,801	681,959	32,682	52,549	92,182	122,957	157,581	225,182
2036	756,750	694,439	31,862	52,444	94,778	126,776	159,337	233,061
2037	793,320	728,135	32,552	53,559	95,669	127,700	169,428	250,151
2038	804,470	739,771	31,905	53,339	95,756	130,056	174,726	256,345

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

INCIDENCE

Exhibit 67 All-Cause Dementia Incidence: Expected Value (Males & Females, By Age Group: 2008-2038)

Year	Incidence: Expected Value(Males & Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	103,728	7,115	11,516	18,463	23,287	43,347
2009	107,615	7,837	11,667	18,076	23,585	46,450
2010	110,108	7,963	12,060	18,349	23,619	48,118
2011	113,313	8,405	12,389	18,618	23,716	50,185
2012	116,326	8,449	12,798	18,747	24,118	52,214
2013	119,962	9,355	13,485	19,347	24,287	53,488
2014	123,664	9,841	14,334	19,799	24,569	55,120
2015	127,025	10,106	14,958	20,529	24,835	56,595
2016	131,089	10,338	15,513	21,184	25,221	58,833
2017	133,920	10,128	16,453	21,698	26,269	59,371
2018	137,659	10,815	17,245	23,003	26,032	60,563
2019	141,975	11,267	17,617	23,899	26,953	62,239
2020	146,346	11,507	18,418	24,914	27,829	63,677
2021	152,047	12,202	19,004	26,495	29,257	65,088
2022	156,665	12,142	19,702	27,802	30,559	66,460
2023	162,269	12,212	20,259	29,275	31,707	68,817
2024	167,656	12,415	20,837	29,794	33,797	70,813
2025	173,129	12,525	21,555	31,228	35,313	72,508
2026	179,219	12,993	22,122	32,568	36,304	75,232
2027	184,668	12,710	22,272	33,852	37,977	77,857
2028	193,663	13,058	23,359	34,441	41,219	81,586
2029	199,935	12,828	23,462	36,105	41,974	85,565
2030	205,349	12,859	23,506	36,015	43,560	89,408
2031	213,250	12,769	24,773	37,783	45,376	92,549
2032	219,005	12,651	24,660	38,723	46,610	96,360
2033	227,129	12,629	24,361	39,333	48,761	102,045
2034	230,444	12,548	24,259	39,489	49,507	104,641
2035	239,876	11,878	24,073	40,803	51,261	111,860
2036	245,758	12,445	23,581	41,349	52,528	115,854
2037	251,996	12,251	23,740	41,668	53,691	120,648
2038	257,811	11,677	23,821	41,389	55,159	125,765

Exhibit 68 All-Cause Dementia Incidence: 95% Lower Bound (Males & Females, By Age Group: 2008-2038)

Year	Incidence: Lower Bound (Males & Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	77,708	2,771	7,738	13,875	18,587	34,738
2009	80,329	3,175	7,837	13,653	18,746	36,917
2010	83,233	3,150	8,426	13,750	19,190	38,718
2011	85,996	3,555	8,727	14,096	19,138	40,480
2012	87,892	3,231	8,737	14,140	19,115	42,670
2013	90,663	3,893	8,901	14,708	19,440	43,720
2014	93,261	3,746	9,720	14,583	19,481	45,732
2015	96,595	4,434	10,088	15,373	20,419	46,281
2016	98,375	4,018	9,956	16,147	19,847	48,407
2017	100,739	4,775	11,328	15,856	20,478	48,301
2018	104,354	4,458	11,321	17,661	21,068	49,845
2019	106,740	3,860	11,790	18,514	21,346	51,229
2020	109,823	3,868	12,363	18,616	22,270	52,706
2021	112,664	5,487	12,987	19,277	22,046	52,866
2022	119,371	4,489	13,936	20,661	24,161	56,124
2023	121,878	4,329	14,108	21,997	24,865	56,579
2024	124,543	5,097	14,014	22,741	25,683	57,010
2025	129,195	4,900	14,084	23,363	28,412	58,435
2026	135,021	5,004	14,542	24,312	29,241	61,922
2027	139,497	5,304	14,773	25,946	29,710	63,764
2028	144,086	5,054	15,211	25,561	31,600	66,661
2029	149,208	4,955	16,109	27,177	32,472	68,494
2030	153,328	4,854	16,382	26,859	33,376	71,856
2031	161,142	5,164	15,554	27,909	34,658	77,857
2032	166,439	5,788	16,569	28,948	36,718	78,415
2033	176,031	4,872	16,835	30,785	38,652	84,887
2034	178,044	5,198	16,816	28,841	40,070	87,119
2035	182,667	4,732	16,497	30,757	41,381	89,300
2036	185,928	5,299	16,261	30,664	41,557	92,148
2037	193,963	4,644	16,065	31,340	42,527	99,387
2038	200,534	4,811	16,547	31,453	45,542	102,181

Exhibit 69 All-Cause Dementia Incidence: 95% Upper Bound (Males & Females, By Age Group: 2008-2038)

Year	Incidence: Upper Bound (Males & Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	129,602	2,771	7,738	13,875	18,587	34,738
2009	133,237	3,175	7,837	13,653	18,746	36,917
2010	137,428	3,150	8,426	13,750	19,190	38,718
2011	141,635	3,555	8,727	14,096	19,138	40,480
2012	145,065	3,231	8,737	14,140	19,115	42,670
2013	149,074	3,893	8,901	14,708	19,440	43,720
2014	153,738	3,746	9,720	14,583	19,481	45,732
2015	158,801	4,434	10,088	15,373	20,419	46,281
2016	161,117	4,018	9,956	16,147	19,847	48,407
2017	167,128	4,775	11,328	15,856	20,478	48,301
2018	170,758	4,458	11,321	17,661	21,068	49,845
2019	177,694	3,860	11,790	18,514	21,346	51,229
2020	183,055	3,868	12,363	18,616	22,270	52,706
2021	189,087	5,487	12,987	19,277	22,046	52,866
2022	196,101	4,489	13,936	20,661	24,161	56,124
2023	202,845	4,329	14,108	21,997	24,865	56,579
2024	209,728	5,097	14,014	22,741	25,683	57,010
2025	216,069	4,900	14,084	23,363	28,412	58,435
2026	224,022	5,004	14,542	24,312	29,241	61,922
2027	231,167	5,304	14,773	25,946	29,710	63,764
2028	241,471	5,054	15,211	25,561	31,600	66,661
2029	247,564	4,955	16,109	27,177	32,472	68,494
2030	257,934	4,854	16,382	26,859	33,376	71,856
2031	262,825	5,164	15,554	27,909	34,658	77,857
2032	272,731	5,788	16,569	28,948	36,718	78,415
2033	279,623	4,872	16,835	30,785	38,652	84,887
2034	289,222	5,198	16,816	28,841	40,070	87,119
2035	295,855	4,732	16,497	30,757	41,381	89,300
2036	302,879	5,299	16,261	30,664	41,557	92,148
2037	311,675	4,644	16,065	31,340	42,527	99,387
2038	318,604	4,811	16,547	31,453	45,542	102,181

Exhibit 70 All-Cause Dementia Incidence: Expected Value (Males, By Age Group: 2008-2038)

Year	Incidence: Expected Value (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	42,660	2,416	7,140	9,825	8,831	14,448
2009	44,281	2,533	7,380	9,515	9,014	15,840
2010	45,240	2,749	7,572	9,680	8,961	16,279
2011	47,650	2,884	7,761	9,946	9,438	17,621
2012	49,032	2,959	8,075	9,882	9,578	18,538
2013	50,497	3,201	8,413	10,305	9,559	19,018
2014	53,026	3,394	9,126	10,600	9,780	20,126
2015	54,264	3,400	9,467	10,971	10,034	20,392
2016	55,620	3,350	9,640	11,245	10,088	21,297
2017	57,685	3,418	10,292	11,555	10,548	21,872
2018	59,597	3,577	10,711	12,331	10,501	22,478
2019	62,135	3,978	10,965	12,885	10,860	23,446
2020	64,007	4,054	11,506	13,480	11,275	23,691
2021	66,553	4,121	11,847	14,257	11,882	24,447
2022	68,937	4,149	12,300	15,071	12,522	24,896
2023	71,663	4,053	12,793	16,080	12,808	25,929
2024	73,989	4,126	13,133	15,928	13,969	26,833
2025	76,432	4,284	13,424	16,996	14,403	27,324
2026	80,062	4,492	13,970	17,518	15,019	29,063
2027	81,764	4,134	13,907	18,225	15,678	29,818
2028	86,295	4,393	14,790	18,622	16,934	31,555
2029	89,767	4,398	14,651	19,878	17,529	33,310
2030	91,350	4,506	14,824	19,274	17,932	34,814
2031	94,969	4,275	15,564	20,240	18,625	36,266
2032	97,724	4,222	15,662	20,981	19,191	37,667
2033	102,695	4,517	15,582	21,631	20,442	40,523
2034	103,205	4,376	15,354	21,705	20,683	41,087
2035	107,439	4,052	15,326	22,501	20,999	44,561
2036	110,201	4,234	14,884	22,852	21,961	46,270
2037	112,311	4,248	14,995	23,013	22,124	47,931
2038	115,461	3,951	15,142	22,986	23,138	50,244

Exhibit 71 All-Cause Dementia Incidence: 95% Lower Bound (Males, By Age Group: 2008-2038)

Year	Incidence: Lower Bound (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	31,206	739	4,930	7,114	6,873	11,550
2009	32,063	913	5,009	7,212	6,972	11,956
2010	34,099	1,112	5,429	7,383	7,078	13,097
2011	35,402	904	5,567	7,530	7,522	13,880
2012	35,691	664	5,837	7,634	7,042	14,513
2013	37,634	814	5,940	7,897	7,614	15,369
2014	38,236	641	6,176	7,582	7,688	16,149
2015	39,510	854	6,687	8,139	8,048	15,782
2016	40,626	1,022	6,254	8,728	7,850	16,772
2017	43,242	1,434	7,260	8,592	8,090	17,866
2018	44,455	1,252	7,348	9,557	8,379	17,919
2019	44,930	696	7,548	9,957	8,458	18,270
2020	46,435	773	7,841	9,791	8,866	19,163
2021	48,394	1,401	8,633	10,087	8,774	19,498
2022	52,149	1,240	8,851	11,219	9,779	21,060
2023	53,595	1,020	8,985	12,227	9,871	21,492
2024	54,540	1,214	9,185	12,408	10,480	21,254
2025	56,787	1,394	8,943	12,897	11,334	22,219
2026	58,392	931	9,423	12,879	11,630	23,528
2027	59,340	1,105	9,419	13,566	11,724	23,527
2028	62,951	1,147	10,000	13,747	12,926	25,131
2029	64,413	753	10,633	14,345	12,645	26,037
2030	66,438	824	10,546	14,348	13,979	26,741
2031	71,044	1,030	10,382	15,303	14,061	30,268
2032	73,983	1,839	11,029	16,454	14,242	30,420
2033	78,037	1,135	11,202	16,718	15,501	33,481
2034	77,707	1,215	11,026	15,501	16,009	33,956
2035	80,538	995	10,884	16,599	16,765	35,295
2036	82,105	1,351	10,793	16,564	16,915	36,482
2037	86,503	1,433	10,427	17,538	17,383	39,722
2038	87,087	1,214	10,741	17,125	18,245	39,762

Exhibit 72 All-Cause Dementia Incidence: 95% Upper Bound (Males, By Age Group: 2008-2038)

Year	Incidence: Upper Bound (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	54,303	4,218	9,363	12,108	11,137	17,477
2009	55,378	4,292	9,237	12,160	11,433	18,255
2010	57,594	4,377	10,027	12,137	11,058	19,995
2011	59,525	4,674	10,124	12,013	11,599	21,114
2012	60,345	5,005	10,288	12,205	11,636	21,211
2013	63,666	5,151	10,999	12,926	11,608	22,982
2014	66,394	5,552	11,541	13,533	11,957	23,811
2015	67,719	5,578	11,965	13,355	12,284	24,537
2016	69,394	5,899	12,740	13,567	12,271	24,917
2017	73,273	6,100	13,470	14,653	13,062	25,989
2018	74,261	5,697	13,909	15,191	12,988	26,476
2019	78,596	6,740	14,170	16,432	13,631	27,622
2020	81,182	6,900	14,979	16,953	13,781	28,570
2021	83,915	6,741	15,600	17,536	14,557	29,482
2022	86,884	6,955	16,048	18,454	15,505	29,923
2023	89,969	6,665	16,448	19,365	16,164	31,328
2024	93,978	7,548	16,802	20,898	16,842	31,889
2025	97,692	7,367	17,779	20,874	17,898	33,774
2026	100,548	7,615	17,723	21,956	18,573	34,680
2027	104,183	6,756	18,321	22,653	19,428	37,024
2028	108,086	7,115	19,225	22,966	20,478	38,301
2029	111,730	6,963	18,949	24,496	21,124	40,198
2030	117,203	7,536	19,604	24,311	21,957	43,795
2031	119,705	7,546	19,867	25,834	22,705	43,753
2032	124,052	7,227	20,064	26,385	23,919	46,458
2033	126,418	7,608	19,581	26,928	24,397	47,903
2034	130,065	7,432	19,880	27,307	25,426	50,020
2035	133,815	7,028	19,841	26,519	26,564	53,862
2036	135,899	6,852	19,347	27,944	27,185	54,571
2037	141,035	7,840	19,243	29,200	26,510	58,242
2038	144,818	7,004	20,011	28,302	28,237	61,264

Exhibit 73 All-Cause Dementia Incidence : Expected Value (Females, By Age Group: 2008-2038)

Year	Incidence: Expected Value (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	61,068	4,699	4,377	8,637	14,456	28,899
2009	63,334	5,304	4,287	8,562	14,571	30,610
2010	64,868	5,214	4,488	8,669	14,658	31,839
2011	65,663	5,521	4,628	8,672	14,278	32,564
2012	67,293	5,490	4,722	8,865	14,540	33,676
2013	69,465	6,154	5,071	9,042	14,728	34,469
2014	70,638	6,447	5,208	9,199	14,789	34,994
2015	72,761	6,707	5,491	9,558	14,801	36,203
2016	75,469	6,988	5,873	9,939	15,133	37,536
2017	76,235	6,710	6,161	10,143	15,722	37,500
2018	78,061	7,239	6,534	10,672	15,531	38,085
2019	79,840	7,289	6,652	11,014	16,093	38,793
2020	82,339	7,453	6,912	11,434	16,554	39,985
2021	85,494	8,081	7,158	12,237	17,376	40,641
2022	87,728	7,993	7,402	12,731	18,037	41,564
2023	90,606	8,159	7,466	13,195	18,899	42,888
2024	93,668	8,289	7,704	13,867	19,828	43,980
2025	96,698	8,241	8,131	14,232	20,911	45,183
2026	99,157	8,501	8,152	15,051	21,285	46,168
2027	102,904	8,576	8,365	15,627	22,298	48,039
2028	107,369	8,665	8,569	15,819	24,285	50,031
2029	110,168	8,430	8,811	16,228	24,445	52,254
2030	113,998	8,352	8,682	16,741	25,628	54,594
2031	118,280	8,494	9,209	17,543	26,751	56,282
2032	121,281	8,429	8,998	17,742	27,419	58,693
2033	124,435	8,112	8,779	17,703	28,318	61,522
2034	127,239	8,172	8,905	17,784	28,824	63,554
2035	132,437	7,826	8,747	18,302	30,262	67,299
2036	135,557	8,211	8,697	18,498	30,567	69,584
2037	139,686	8,003	8,745	18,655	31,566	72,717
2038	142,350	7,726	8,680	18,404	32,020	75,521

Exhibit 74 All-Cause Dementia Incidence: 95% Lower Bound (Females, By Age Group 2008-2038)

Year	Incidence: Lower Bound (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	46,502	2,032	2,807	6,761	11,713	23,188
2009	48,266	2,262	2,827	6,441	11,774	24,962
2010	49,134	2,038	2,997	6,367	12,112	25,621
2011	50,594	2,651	3,160	6,566	11,616	26,601
2012	52,201	2,566	2,901	6,506	12,072	28,157
2013	53,029	3,079	2,962	6,811	11,826	28,351
2014	55,026	3,105	3,544	7,001	11,793	29,583
2015	57,084	3,581	3,401	7,234	12,370	30,498
2016	57,749	2,996	3,702	7,420	11,997	31,635
2017	57,496	3,342	4,068	7,264	12,388	30,435
2018	59,899	3,206	3,973	8,104	12,689	31,926
2019	61,810	3,164	4,242	8,557	12,888	32,958
2020	63,388	3,095	4,522	8,825	13,404	33,542
2021	64,269	4,086	4,354	9,189	13,273	33,368
2022	67,222	3,248	5,085	9,442	14,382	35,064
2023	68,283	3,309	5,123	9,770	14,994	35,087
2024	70,003	3,883	4,829	10,333	15,203	35,756
2025	72,407	3,507	5,141	10,466	17,078	36,216
2026	76,629	4,073	5,118	11,434	17,611	38,393
2027	80,157	4,199	5,354	12,381	17,986	40,237
2028	81,135	3,907	5,210	11,814	18,674	41,530
2029	84,794	4,202	5,477	12,832	19,827	42,457
2030	86,889	4,031	5,835	12,511	19,397	45,115
2031	90,098	4,134	5,171	12,606	20,597	47,589
2032	92,455	3,949	5,540	12,494	22,476	47,995
2033	97,995	3,737	5,633	14,067	23,151	51,406
2034	100,337	3,983	5,791	13,340	24,060	53,163
2035	102,129	3,737	5,613	14,157	24,617	54,005
2036	103,822	3,947	5,468	14,100	24,642	55,666
2037	107,461	3,212	5,638	13,802	25,143	59,665
2038	113,447	3,597	5,806	14,328	27,297	62,419

Exhibit 75 All-Cause Dementia Incidence: 95% Upper Bound (Females, By Age Group: 2008-2038)

Year	Incidence: Upper Bound (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	75,299	7,088	5,611	10,730	17,427	34,442
2009	77,859	7,909	5,919	10,851	17,533	35,648
2010	79,834	8,244	6,156	10,526	17,265	37,643
2011	82,111	8,370	6,294	10,784	17,428	39,234
2012	84,720	8,443	6,734	10,958	17,620	40,964
2013	85,407	9,050	6,922	11,327	17,730	40,377
2014	87,343	10,014	7,039	11,725	17,652	40,913
2015	91,083	10,601	7,386	11,446	17,998	43,651
2016	91,723	10,392	7,641	12,438	17,815	43,438
2017	93,854	10,795	7,948	12,600	18,024	44,487
2018	96,497	11,138	8,597	13,126	18,574	45,063
2019	99,099	11,208	8,729	13,652	18,858	46,651
2020	101,873	11,779	9,618	14,589	19,630	46,257
2021	105,172	11,915	9,559	15,286	20,779	47,632
2022	109,217	12,832	9,896	16,256	21,639	48,594
2023	112,876	12,767	10,863	17,066	22,545	49,636
2024	115,749	12,359	10,913	17,717	23,406	51,354
2025	118,377	12,866	11,017	17,753	24,905	51,836
2026	123,474	13,220	11,360	18,642	26,379	53,874
2027	126,984	13,321	10,748	19,480	27,577	55,858
2028	133,386	13,979	11,813	19,869	28,384	59,341
2029	135,834	12,780	11,949	20,126	28,958	62,022
2030	140,730	13,121	12,078	20,669	30,126	64,736
2031	143,120	11,815	11,992	21,722	32,126	65,465
2032	148,680	12,334	11,764	22,255	33,054	69,272
2033	153,206	12,575	12,200	22,480	34,573	71,377
2034	159,156	12,673	11,857	23,068	34,968	76,590
2035	162,040	12,809	12,431	23,154	35,176	78,470
2036	166,980	12,077	11,649	23,788	36,184	83,283
2037	170,639	12,068	12,290	23,255	38,199	84,827
2038	173,786	11,662	11,437	23,161	38,242	89,284

MORTALITY

Exhibit 76 All-Cause Dementia Mortality: Expected Value (Males & Females, By Age Group: 2008-2038)

Year	Mortality, Males & Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	22,662	479	662	2,470	3,130	15,921
2009	23,160	485	652	2,449	3,093	16,480
2010	23,867	510	647	2,418	3,096	17,195
2011	24,124	517	651	2,361	3,081	17,513
2012	24,974	526	664	2,367	3,063	18,355
2013	25,416	545	678	2,302	3,028	18,863
2014	26,162	567	696	2,238	3,061	19,600
2015	26,403	589	701	2,228	3,046	19,840
2016	27,324	591	733	2,244	3,120	20,637
2017	27,906	592	750	2,209	3,194	21,161
2018	27,977	597	761	2,187	3,301	21,131
2019	28,389	609	781	2,180	3,324	21,494
2020	28,215	636	792	2,104	3,443	21,240
2021	29,132	608	825	2,219	3,627	21,851
2022	29,490	633	831	2,206	3,727	22,092
2023	30,176	639	857	2,254	3,835	22,590
2024	30,651	630	873	2,318	3,919	22,911
2025	30,953	639	875	2,296	4,016	23,128
2026	31,943	617	866	2,342	4,138	23,980
2027	32,936	617	875	2,446	4,238	24,760
2028	33,969	591	903	2,455	4,319	25,701
2029	34,223	620	890	2,535	4,397	25,781
2030	36,123	592	891	2,581	4,461	27,597
2031	36,716	574	848	2,601	4,522	28,171
2032	37,891	561	869	2,721	4,609	29,132
2033	38,073	553	842	2,707	4,612	29,359
2034	39,613	533	858	2,763	4,576	30,883
2035	40,071	509	816	2,762	4,568	31,416
2036	41,545	475	808	2,851	4,617	32,794
2037	43,302	487	805	2,853	4,605	34,552
2038	44,360	481	773	2,917	4,495	35,693

Exhibit 77 All-Cause Dementia Mortality : 95% Lower Bound (Males & Females, By Age Group: 2008-2038)

Year	Mortality, Males and Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	18,185	372	571	1,992	2,642	12,608
2009	18,812	387	552	1,938	2,642	13,294
2010	19,636	397	547	1,918	2,656	14,118
2011	19,812	404	543	1,902	2,612	14,351
2012	20,003	420	549	1,953	2,641	14,439
2013	20,587	427	565	1,855	2,523	15,217
2014	20,531	421	584	1,810	2,607	15,108
2015	20,904	435	587	1,789	2,613	15,480
2016	21,375	454	581	1,698	2,607	16,035
2017	22,024	452	630	1,750	2,775	16,416
2018	21,557	457	607	1,703	2,778	16,013
2019	21,515	453	646	1,656	2,846	15,914
2020	21,446	460	653	1,607	2,818	15,906
2021	22,031	461	663	1,702	2,995	16,211
2022	22,548	466	666	1,622	3,102	16,692
2023	22,360	454	667	1,639	3,128	16,472
2024	23,081	466	692	1,701	3,214	17,009
2025	23,313	465	656	1,681	3,372	17,138
2026	23,761	466	660	1,689	3,378	17,567
2027	24,522	452	644	1,788	3,405	18,233
2028	25,241	443	686	1,788	3,563	18,760
2029	25,400	456	708	1,879	3,571	18,787
2030	26,202	435	671	1,823	3,671	19,602
2031	26,601	427	637	1,805	3,555	20,176
2032	28,325	416	630	1,917	3,716	21,646
2033	28,278	394	630	1,896	3,803	21,554
2034	27,926	383	635	1,722	3,573	21,612
2035	29,032	365	590	1,859	3,650	22,569
2036	31,179	336	566	1,885	3,509	24,883
2037	31,596	353	544	1,841	3,551	25,307
2038	31,966	340	549	1,839	3,433	25,806

Exhibit 78 All-Cause Dementia Mortality: 95% Upper Bound (Males & Females, By Age Group: 2008-2038)

Year	Mortality, Males and Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	27,223	577	748	3,000	3,518	19,381
2009	27,078	600	736	3,003	3,500	19,239
2010	28,501	601	744	2,995	3,491	20,669
2011	29,202	627	760	2,923	3,433	21,459
2012	30,422	676	765	2,925	3,499	22,557
2013	31,920	686	794	2,880	3,505	24,055
2014	31,654	727	822	2,918	3,433	23,753
2015	32,878	735	844	2,909	3,589	24,802
2016	32,886	747	854	2,867	3,624	24,793
2017	33,523	761	902	2,823	3,713	25,325
2018	34,281	761	903	2,801	3,850	25,966
2019	35,724	780	943	2,884	3,918	27,199
2020	35,480	820	966	3,002	4,059	26,633
2021	36,646	798	982	2,913	4,206	27,747
2022	35,754	793	1,008	2,994	4,227	26,732
2023	37,382	813	1,050	3,032	4,494	27,994
2024	37,547	809	1,064	3,124	4,655	27,895
2025	39,037	852	1,107	3,246	4,842	28,991
2026	40,581	808	1,055	3,245	4,988	30,486
2027	41,743	827	1,073	3,438	4,896	31,509
2028	41,914	815	1,103	3,676	5,176	31,144
2029	44,256	846	1,132	3,837	5,254	33,187
2030	45,914	798	1,103	3,881	5,234	34,899
2031	47,016	784	1,092	3,855	5,411	35,874
2032	49,197	785	1,118	3,976	5,603	37,714
2033	49,057	746	1,080	4,040	5,708	37,484
2034	50,932	734	1,111	4,253	5,610	39,225
2035	52,453	698	1,059	4,305	5,510	40,881
2036	55,727	691	1,042	4,370	5,796	43,828
2037	56,905	670	1,027	4,640	5,516	45,051
2038	58,684	638	1,008	4,447	5,479	47,111

Exhibit 79 All-Cause Dementia Mortality: Expected Value (Males, By Age Group: 2008-2038)

Year	Mortality: Expected Value (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	8,688	292	336	1,317	1,575	5,168
2009	9,018	299	329	1,316	1,538	5,536
2010	9,237	311	330	1,336	1,527	5,732
2011	9,632	319	326	1,341	1,519	6,128
2012	9,955	327	332	1,312	1,541	6,442
2013	10,128	342	343	1,314	1,516	6,614
2014	10,621	344	350	1,291	1,529	7,106
2015	10,813	358	352	1,277	1,524	7,303
2016	11,288	363	366	1,295	1,537	7,727
2017	11,482	364	379	1,291	1,610	7,838
2018	11,678	369	385	1,304	1,650	7,969
2019	11,980	372	390	1,303	1,673	8,243
2020	11,848	377	384	1,238	1,740	8,109
2021	12,275	373	402	1,334	1,851	8,315
2022	12,676	389	414	1,300	1,896	8,678
2023	12,859	389	423	1,342	1,897	8,807
2024	13,117	389	429	1,356	1,974	8,969
2025	13,723	390	427	1,375	1,999	9,532
2026	14,106	387	423	1,472	2,078	9,746
2027	14,245	384	420	1,484	2,117	9,842
2028	14,889	375	442	1,516	2,109	10,447
2029	15,120	371	430	1,527	2,189	10,602
2030	15,673	365	434	1,604	2,218	11,052
2031	16,166	358	402	1,615	2,244	11,548
2032	16,735	348	411	1,696	2,320	11,959
2033	16,803	338	402	1,576	2,274	12,213
2034	17,799	338	414	1,625	2,255	13,166
2035	17,587	321	381	1,686	2,200	12,999
2036	18,875	302	394	1,705	2,284	14,190
2037	19,486	297	380	1,679	2,293	14,836
2038	20,344	287	362	1,644	2,213	15,839

Exhibit 80 All-Cause Dementia Mortality: 95% Lower Bound (Males, By Age Group: 2008-2038)

Year	Mortality: Lower Bound (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	7,422	247	289	1,149	1,333	4,404
2009	7,461	265	270	1,134	1,242	4,549
2010	7,790	271	273	1,094	1,285	4,867
2011	7,969	273	265	1,109	1,261	5,062
2012	8,278	287	269	1,143	1,306	5,274
2013	8,510	288	275	1,086	1,245	5,617
2014	8,809	279	293	1,058	1,300	5,878
2015	8,572	293	285	1,037	1,293	5,664
2016	8,888	295	276	993	1,248	6,077
2017	9,364	311	318	1,035	1,390	6,310
2018	9,268	311	292	1,025	1,401	6,239
2019	8,982	304	319	990	1,406	5,964
2020	9,254	306	315	946	1,408	6,279
2021	9,629	311	317	1,019	1,496	6,486
2022	9,796	316	310	947	1,541	6,681
2023	9,481	308	304	974	1,475	6,421
2024	10,081	306	326	1,029	1,569	6,851
2025	10,379	304	304	1,011	1,640	7,120
2026	10,498	318	303	1,030	1,683	7,165
2027	10,821	302	297	1,103	1,632	7,487
2028	11,234	295	317	1,113	1,724	7,784
2029	11,395	292	328	1,167	1,727	7,883
2030	11,628	285	317	1,099	1,758	8,169
2031	11,878	290	282	1,067	1,719	8,519
2032	12,887	272	279	1,170	1,804	9,361
2033	13,528	256	290	1,125	1,904	9,953
2034	12,618	249	288	951	1,718	9,411
2035	13,137	233	253	1,057	1,720	9,873
2036	13,865	213	266	1,103	1,650	10,633
2037	14,072	232	234	1,032	1,691	10,882
2038	14,611	220	221	1,013	1,613	11,544

Exhibit 81 All-Cause Dementia Mortality: 95% Upper Bound (Males, By Age Group: 2008-2038)

Year	Mortality: Upper Bound (Males)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	9,907	329	388	1,508	1,773	5,910
2009	10,466	341	378	1,499	1,758	6,490
2010	11,028	349	383	1,559	1,739	7,000
2011	11,382	368	387	1,568	1,695	7,363
2012	11,925	377	392	1,534	1,773	7,849
2013	12,197	392	403	1,559	1,755	8,088
2014	12,728	409	421	1,560	1,771	8,568
2015	12,982	417	427	1,561	1,830	8,746
2016	13,217	424	432	1,537	1,828	8,996
2017	13,436	431	466	1,511	1,891	9,137
2018	14,150	441	458	1,550	2,008	9,693
2019	14,550	458	477	1,588	1,983	10,044
2020	14,757	441	486	1,542	2,079	10,209
2021	15,319	458	493	1,671	2,146	10,552
2022	15,306	466	517	1,633	2,152	10,539
2023	16,025	465	533	1,722	2,236	11,069
2024	15,685	464	531	1,675	2,388	10,627
2025	16,833	478	561	1,805	2,468	11,522
2026	17,119	471	516	1,854	2,541	11,736
2027	17,975	472	532	1,960	2,456	12,555
2028	18,084	457	552	2,046	2,592	12,437
2029	19,153	463	556	2,054	2,638	13,442
2030	20,063	453	559	2,263	2,634	14,154
2031	20,222	453	527	2,285	2,729	14,228
2032	21,127	445	567	2,269	2,838	15,009
2033	21,593	413	521	2,204	2,815	15,641
2034	22,603	428	529	2,208	2,873	16,565
2035	23,579	401	524	2,394	2,732	17,529
2036	23,384	392	517	2,316	2,861	17,298
2037	24,638	367	515	2,321	2,747	18,688
2038	26,152	364	504	2,371	2,796	20,117

Exhibit 82 All-Cause Dementia Mortality: Expected Value (Females, By Age Group: 2008-2038)

Year	Mortality: Expected Value (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	13,975	187	326	1,153	1,555	10,753
2009	14,142	187	323	1,133	1,555	10,944
2010	14,630	199	317	1,082	1,569	11,463
2011	14,491	198	325	1,020	1,563	11,386
2012	15,020	198	332	1,055	1,522	11,913
2013	15,288	203	335	988	1,513	12,249
2014	15,541	222	346	947	1,532	12,494
2015	15,590	231	349	951	1,523	12,537
2016	16,036	228	367	949	1,583	12,910
2017	16,424	228	371	918	1,584	13,323
2018	16,300	228	376	883	1,651	13,163
2019	16,409	238	391	877	1,652	13,252
2020	16,366	259	408	866	1,703	13,131
2021	16,857	235	424	885	1,776	13,536
2022	16,813	244	417	906	1,831	13,414
2023	17,317	250	434	912	1,938	13,783
2024	17,534	241	444	962	1,945	13,942
2025	17,229	249	447	920	2,017	13,596
2026	17,837	230	443	870	2,059	14,234
2027	18,691	234	455	962	2,121	14,919
2028	19,080	216	460	939	2,210	15,254
2029	19,103	249	460	1,008	2,208	15,179
2030	20,450	227	457	977	2,244	16,545
2031	20,550	216	446	986	2,278	16,623
2032	21,157	213	458	1,024	2,289	17,173
2033	21,271	215	440	1,131	2,338	17,146
2034	21,815	195	444	1,139	2,321	17,717
2035	22,485	188	436	1,076	2,368	18,417
2036	22,670	173	414	1,146	2,333	18,605
2037	23,816	189	424	1,174	2,312	19,716
2038	24,016	194	412	1,273	2,282	19,855

Exhibit 83 All-Cause Dementia Mortality:95% Lower Bound (Females, By Age Group: 2008-2038)

Year	Mortality: Lower Bound (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	10,763	125	282	843	1,309	8,204
2009	11,352	122	283	804	1,399	8,744
2010	11,846	126	274	824	1,372	9,251
2011	11,843	132	278	793	1,351	9,289
2012	11,725	133	280	811	1,335	9,165
2013	12,077	139	290	769	1,278	9,600
2014	11,722	142	291	752	1,307	9,231
2015	12,332	143	302	752	1,320	9,816
2016	12,486	159	305	705	1,359	9,958
2017	12,661	142	312	714	1,386	10,107
2018	12,289	145	315	678	1,377	9,773
2019	12,532	149	327	665	1,441	9,950
2020	12,192	154	339	661	1,410	9,627
2021	12,402	150	346	683	1,499	9,724
2022	12,752	149	356	675	1,561	10,011
2023	12,879	146	363	665	1,654	10,051
2024	13,000	160	367	671	1,645	10,158
2025	12,933	161	352	670	1,732	10,018
2026	13,263	148	357	659	1,695	10,403
2027	13,701	150	347	686	1,772	10,746
2028	14,007	148	369	675	1,839	10,976
2029	14,005	165	380	712	1,844	10,904
2030	14,574	150	354	724	1,913	11,433
2031	14,723	137	355	738	1,836	11,657
2032	15,438	144	351	747	1,912	12,284
2033	14,749	138	340	771	1,900	11,601
2034	15,308	135	347	770	1,855	12,201
2035	15,895	131	337	802	1,929	12,696
2036	17,314	124	300	782	1,859	14,250
2037	17,525	121	310	809	1,860	14,425
2038	17,355	120	328	826	1,820	14,262

Exhibit 84 All-Cause Dementia Mortality: 95% Upper Bound (Females, By Age Group: 2008-2038)

Year	Mortality: Upper Bound (Females)					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	17,315	247	360	1,492	1,745	13,471
2009	16,611	259	358	1,504	1,742	12,749
2010	17,473	253	361	1,437	1,752	13,670
2011	17,820	259	373	1,355	1,738	14,096
2012	18,496	299	373	1,391	1,726	14,707
2013	19,724	294	391	1,322	1,750	15,967
2014	18,926	318	401	1,359	1,662	15,186
2015	19,896	318	417	1,348	1,759	16,055
2016	19,669	324	422	1,329	1,796	15,798
2017	20,087	330	436	1,312	1,822	16,188
2018	20,131	320	444	1,251	1,842	16,273
2019	21,175	322	466	1,296	1,935	17,156
2020	20,723	379	479	1,461	1,980	16,424
2021	21,327	340	490	1,241	2,060	17,196
2022	20,447	326	491	1,361	2,075	16,194
2023	21,357	348	516	1,310	2,258	16,925
2024	21,862	345	533	1,449	2,268	17,267
2025	22,204	374	546	1,441	2,374	17,469
2026	23,463	337	539	1,391	2,446	18,750
2027	23,767	355	540	1,479	2,439	18,953
2028	23,830	359	551	1,630	2,584	18,707
2029	25,103	382	576	1,784	2,616	19,745
2030	25,851	345	544	1,617	2,600	20,745
2031	26,794	332	565	1,570	2,682	21,646
2032	28,071	341	551	1,707	2,765	22,706
2033	27,464	332	559	1,836	2,893	21,843
2034	28,329	305	582	2,045	2,737	22,660
2035	28,874	297	535	1,911	2,778	23,352
2036	32,343	299	525	2,054	2,935	26,530
2037	32,267	303	512	2,319	2,769	26,363
2038	32,531	274	504	2,075	2,683	26,994

Exhibit 85 All-Cause Dementia Mortality in Population with Dementia Removing Excess Risk of Death due to Dementia: Expected Value (Males & Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males and Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	6,497	189	264	1,000	1,136	3,909
2009	6,955	192	260	977	1,159	4,368
2010	7,440	199	254	942	1,181	4,864
2011	7,738	198	251	895	1,187	5,207
2012	8,208	199	253	874	1,180	5,702
2013	8,528	205	257	827	1,160	6,078
2014	8,920	214	265	786	1,157	6,498
2015	9,131	225	269	768	1,131	6,738
2016	9,554	229	286	763	1,134	7,142
2017	9,844	233	297	745	1,135	7,434
2018	9,915	239	306	736	1,149	7,484
2019	10,076	247	319	737	1,137	7,637
2020	10,010	261	327	717	1,161	7,543
2021	10,299	252	345	765	1,212	7,725
2022	10,369	266	350	770	1,241	7,741
2023	10,558	271	365	797	1,280	7,845
2024	10,666	270	377	830	1,313	7,876
2025	10,706	277	382	832	1,357	7,859
2026	11,008	271	384	857	1,412	8,084
2027	11,336	276	394	907	1,463	8,297
2028	11,676	268	413	920	1,511	8,564
2029	11,785	287	414	963	1,556	8,565
2030	12,464	278	422	993	1,599	9,173
2031	12,709	274	408	1,015	1,641	9,371
2032	13,191	272	424	1,078	1,694	9,724
2033	13,344	272	416	1,092	1,719	9,846
2034	13,971	264	429	1,132	1,729	10,417
2035	14,256	255	412	1,148	1,752	10,690
2036	14,893	239	409	1,204	1,796	11,246
2037	15,667	246	409	1,221	1,819	11,973
2038	16,201	243	393	1,265	1,804	12,495

Exhibit 86 All-Cause Dementia, Mortality in Population with Dementia Removing Excess Risk of Death due to Dementia: 95% Lower Bound (Males & Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males and Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	5,237	147	227	713	1,072	3,078
2009	5,666	152	220	716	1,059	3,519
2010	6,117	154	215	724	1,040	3,984
2011	6,349	154	210	724	996	4,265
2012	6,566	158	209	746	979	4,473
2013	6,878	160	215	704	911	4,887
2014	6,966	159	222	678	920	4,987
2015	7,214	166	226	659	905	5,259
2016	7,451	176	227	612	891	5,545
2017	7,740	177	250	617	940	5,756
2018	7,615	182	244	588	940	5,662
2019	7,635	183	263	561	967	5,660
2020	7,602	188	270	538	965	5,640
2021	7,788	191	277	564	1,037	5,718
2022	7,945	195	281	537	1,088	5,844
2023	7,852	192	285	543	1,112	5,720
2024	8,060	199	299	566	1,156	5,841
2025	8,102	201	287	564	1,228	5,822
2026	8,234	204	293	572	1,244	5,921
2027	8,476	201	290	613	1,270	6,102
2028	8,726	201	314	620	1,345	6,247
2029	8,801	210	330	659	1,365	6,237
2030	9,099	204	318	649	1,422	6,507
2031	9,264	203	307	651	1,397	6,706
2032	9,904	201	308	699	1,482	7,213
2033	9,951	193	312	702	1,540	7,204
2034	9,912	190	318	648	1,472	7,285
2035	10,383	182	298	709	1,527	7,667
2036	11,211	169	287	729	1,490	8,536
2037	11,476	178	277	724	1,528	8,769
2038	11,713	171	280	735	1,495	9,032

Exhibit 87 All-Cause Dementia Mortality in Population with Dementia Removing Excess Risk of Death due to Dementia: 95% Upper Bound (Males & Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males and Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	7,822	228	298	1,089	1,427	4,780
2009	8,153	238	293	1,124	1,400	5,098
2010	8,870	235	291	1,138	1,366	5,841
2011	9,350	240	293	1,119	1,308	6,389
2012	9,979	257	291	1,124	1,296	7,011
2013	10,695	259	301	1,098	1,266	7,771
2014	10,775	276	313	1,099	1,210	7,877
2015	11,367	282	324	1,076	1,241	8,444
2016	11,494	290	333	1,038	1,237	8,595
2017	11,824	300	357	1,000	1,258	8,908
2018	12,141	305	363	971	1,301	9,201
2019	12,694	317	384	982	1,331	9,681
2020	12,594	338	399	1,012	1,389	9,456
2021	12,975	332	410	968	1,456	9,810
2022	12,599	333	425	994	1,481	9,366
2023	13,110	345	447	1,006	1,596	9,716
2024	13,122	347	459	1,044	1,673	9,599
2025	13,572	370	483	1,092	1,761	9,864
2026	14,058	356	467	1,102	1,836	10,297
2027	14,415	370	482	1,181	1,824	10,557
2028	14,491	371	504	1,280	1,951	10,384
2029	15,310	392	526	1,355	2,006	11,031
2030	15,900	376	521	1,382	2,025	11,595
2031	16,360	375	525	1,390	2,124	11,946
2032	17,214	382	545	1,454	2,233	12,600
2033	17,282	367	534	1,500	2,312	12,569
2034	18,065	365	555	1,604	2,307	13,235
2035	18,725	350	533	1,643	2,303	13,896
2036	20,099	348	527	1,696	2,459	15,068
2037	20,690	339	521	1,832	2,371	15,626
2038	21,507	322	512	1,780	2,382	16,511

Exhibit 88 All-Cause Dementia Mortality in Population with Dementia Removing Excess Risk of Death due to Dementia: Expected Value (Males, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	2,343	112	129	512	521	1,070
2009	2,536	115	127	507	530	1,257
2010	2,690	118	125	505	541	1,401
2011	2,873	119	121	494	548	1,591
2012	3,034	121	122	471	560	1,760
2013	3,147	126	126	459	550	1,887
2014	3,351	127	130	441	549	2,104
2015	3,464	134	132	428	538	2,233
2016	3,663	138	139	429	532	2,426
2017	3,770	141	146	425	546	2,512
2018	3,866	145	151	429	548	2,592
2019	3,987	148	155	431	547	2,706
2020	3,953	152	155	414	562	2,672
2021	4,097	152	163	451	593	2,738
2022	4,225	160	170	445	606	2,845
2023	4,279	162	175	466	608	2,868
2024	4,355	163	180	477	637	2,899
2025	4,545	166	181	489	651	3,058
2026	4,670	166	182	530	684	3,107
2027	4,720	168	183	540	706	3,123
2028	4,939	167	196	558	712	3,306
2029	5,033	168	194	569	748	3,353
2030	5,241	168	200	606	768	3,500
2031	5,429	167	188	619	786	3,669
2032	5,661	165	195	660	823	3,818
2033	5,720	162	193	623	818	3,923
2034	6,103	164	201	653	822	4,262
2035	6,090	157	187	688	814	4,244
2036	6,586	149	194	706	858	4,678
2037	6,859	147	188	705	875	4,944
2038	7,217	142	179	699	858	5,340

Exhibit 89 All-Cause Dementia Mortality in Pop. with Dementia Removing Excess Risk of Death due to Dementia: 95% Lower Bound (Males, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	2,015	95	111	380	518	911
2009	2,108	102	104	391	479	1,033
2010	2,269	103	104	388	486	1,189
2011	2,379	102	99	400	465	1,314
2012	2,529	106	99	415	468	1,441
2013	2,638	106	101	394	435	1,602
2014	2,776	103	108	380	444	1,741
2015	2,748	110	107	366	433	1,732
2016	2,881	112	105	344	413	1,908
2017	3,073	120	123	351	457	2,022
2018	3,068	122	114	341	461	2,030
2019	2,994	121	127	324	465	1,958
2020	3,095	123	127	305	470	2,069
2021	3,223	126	129	326	506	2,135
2022	3,278	130	127	303	528	2,190
2023	3,169	128	126	312	512	2,091
2024	3,363	128	136	332	552	2,214
2025	3,455	129	129	329	583	2,285
2026	3,496	137	130	339	606	2,284
2027	3,599	132	130	368	594	2,376
2028	3,746	131	141	376	635	2,463
2029	3,815	132	148	399	644	2,493
2030	3,908	131	146	380	664	2,587
2031	4,007	136	132	374	659	2,707
2032	4,367	129	132	415	702	2,988
2033	4,617	123	139	405	753	3,197
2034	4,344	121	140	347	690	3,046
2035	4,555	114	124	391	702	3,224
2036	4,840	105	131	414	684	3,506
2037	4,961	115	116	394	710	3,626
2038	5,188	109	109	392	686	3,892

Exhibit 90 All-Cause Dementia Mortality in Pop. with Dementia Removing Excess Risk of Death due to Dementia: 95% Upper Bound (Males, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Males, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	2,686	126	149	499	689	1,223
2009	2,945	131	145	517	678	1,473
2010	3,197	132	145	552	657	1,710
2011	3,384	137	144	565	625	1,912
2012	3,621	139	145	557	636	2,144
2013	3,778	144	148	565	613	2,307
2014	4,009	151	156	560	605	2,537
2015	4,155	156	160	551	613	2,674
2016	4,287	161	164	532	605	2,824
2017	4,409	166	180	512	622	2,929
2018	4,682	173	180	515	661	3,153
2019	4,844	182	190	519	656	3,297
2020	4,929	177	196	498	694	3,364
2021	5,121	186	200	535	726	3,474
2022	5,117	192	212	522	737	3,455
2023	5,347	193	221	552	776	3,605
2024	5,232	195	222	540	839	3,435
2025	5,603	203	238	588	878	3,697
2026	5,692	203	222	611	914	3,742
2027	5,970	206	233	653	894	3,984
2028	6,029	203	245	691	954	3,936
2029	6,397	209	251	702	983	4,251
2030	6,726	208	257	783	995	4,482
2031	6,825	212	247	801	1,046	4,520
2032	7,181	211	269	805	1,104	4,791
2033	7,379	199	250	793	1,113	5,025
2034	7,786	208	257	805	1,154	5,362
2035	8,177	197	257	885	1,115	5,723
2036	8,206	193	255	870	1,186	5,703
2037	8,703	182	255	885	1,154	6,228
2038	9,319	180	249	919	1,189	6,782

Exhibit 91 All-Cause Dementia Mortality in Pop. with Dementia Removing Excess Risk of Death due to Dementia: Expected Value (Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	4,154	77	135	488	615	2,839
2009	4,419	77	133	470	628	3,112
2010	4,750	81	129	437	640	3,463
2011	4,865	79	130	401	639	3,616
2012	5,174	78	131	404	620	3,942
2013	5,380	79	131	368	610	4,191
2014	5,569	87	136	345	608	4,394
2015	5,666	91	138	340	592	4,505
2016	5,890	91	147	334	602	4,716
2017	6,074	93	151	320	589	4,921
2018	6,049	94	155	307	601	4,892
2019	6,090	99	163	306	590	4,931
2020	6,056	110	173	304	600	4,871
2021	6,203	101	181	314	619	4,988
2022	6,143	106	181	325	635	4,897
2023	6,279	109	190	331	671	4,977
2024	6,310	107	197	354	676	4,977
2025	6,161	112	201	343	706	4,800
2026	6,338	105	202	328	728	4,976
2027	6,616	108	210	367	758	5,173
2028	6,737	101	216	362	799	5,258
2029	6,753	119	220	394	808	5,212
2030	7,223	110	222	387	831	5,673
2031	7,281	107	220	396	855	5,703
2032	7,530	107	229	418	870	5,906
2033	7,624	109	223	469	901	5,922
2034	7,868	100	227	479	907	6,155
2035	8,166	97	225	460	939	6,445
2036	8,308	90	215	497	939	6,568
2037	8,808	99	221	516	945	7,029
2038	8,984	101	214	566	947	7,156

Exhibit 92 All-Cause Dementia Mortality in Pop. with Dementia Removing Excess Risk of Death due to Dementia: 95% Lower Bound (Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	3,221	52	116	333	554	2,166
2009	3,557	50	116	324	580	2,486
2010	3,848	51	111	336	554	2,795
2011	3,969	52	111	324	532	2,950
2012	4,037	52	110	330	511	3,033
2013	4,240	54	114	310	476	3,285
2014	4,190	56	114	299	476	3,246
2015	4,467	56	119	292	471	3,528
2016	4,570	64	122	268	478	3,638
2017	4,667	58	127	266	483	3,733
2018	4,548	60	130	247	479	3,632
2019	4,641	62	137	238	502	3,702
2020	4,508	65	143	233	495	3,571
2021	4,565	64	148	238	531	3,583
2022	4,667	65	154	234	560	3,654
2023	4,683	64	159	230	600	3,629
2024	4,697	71	162	233	605	3,626
2025	4,646	72	158	234	645	3,537
2026	4,738	67	163	233	639	3,637
2027	4,877	69	160	245	675	3,726
2028	4,980	69	173	244	710	3,783
2029	4,986	79	182	260	721	3,744
2030	5,191	73	172	268	758	3,920
2031	5,257	68	175	277	738	3,999
2032	5,537	72	176	284	780	4,225
2033	5,334	70	172	297	787	4,007
2034	5,568	69	178	301	781	4,239
2035	5,828	68	174	318	825	4,443
2036	6,371	64	156	315	806	5,030
2037	6,514	63	161	330	818	5,142
2038	6,525	63	170	343	809	5,140

Exhibit 93 All-Cause Dementia Mortality in Pop. with Dementia Removing Excess Risk of Death due to Dementia: 95% Upper Bound (Females, By Age Group: 2008-2038)

Year	Mortality Without Dementia, Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	5,136	102	149	590	738	3,557
2009	5,208	107	148	607	722	3,625
2010	5,673	103	146	586	708	4,130
2011	5,967	103	149	554	683	4,477
2012	6,358	117	147	567	661	4,867
2013	6,917	115	153	533	652	5,464
2014	6,766	125	157	539	605	5,340
2015	7,212	126	165	524	628	5,770
2016	7,207	129	169	506	632	5,771
2017	7,414	134	177	488	635	5,980
2018	7,459	132	183	455	641	6,048
2019	7,850	135	195	463	675	6,383
2020	7,665	160	203	514	695	6,092
2021	7,854	146	210	433	730	6,336
2022	7,481	141	212	472	744	5,911
2023	7,763	152	226	454	820	6,111
2024	7,890	153	236	504	834	6,164
2025	7,968	168	245	505	883	6,167
2026	8,366	153	245	491	921	6,555
2027	8,444	164	250	528	930	6,573
2028	8,462	169	259	589	997	6,448
2029	8,913	183	275	653	1,022	6,780
2030	9,174	168	264	599	1,030	7,113
2031	9,535	164	279	589	1,078	7,426
2032	10,033	171	276	649	1,129	7,809
2033	9,903	168	284	707	1,199	7,544
2034	10,278	156	298	799	1,153	7,873
2035	10,548	153	276	758	1,188	8,173
2036	11,892	155	272	826	1,273	9,365
2037	11,987	158	267	947	1,217	9,398
2038	12,188	143	262	861	1,193	9,729

DISABILITY

Exhibit 94 All-Cause Dementia Disability by Severity Level (Males & Females, All Age Groups: 2008-2038)

Year	Disability by Severity Level			
	Good Functioning	Mild	Moderate	Severe
2008	14,764	6,559	23,154	359,144
2009	15,752	6,995	24,691	379,751
2010	16,590	7,365	25,993	396,590
2011	17,386	7,715	27,228	412,321
2012	18,176	8,063	28,452	427,810
2013	18,972	8,414	29,686	443,361
2014	19,779	8,769	30,938	459,110
2015	20,603	9,132	32,215	475,151
2016	21,448	9,504	33,524	491,581
2017	22,317	9,887	34,873	508,502
2018	23,217	10,283	36,268	526,023
2019	24,152	10,695	37,717	544,251
2020	25,127	11,124	39,229	563,277
2021	26,146	11,573	40,808	583,173
2022	27,210	12,042	42,459	603,989
2023	28,322	12,532	44,183	625,753
2024	29,483	13,043	45,984	648,475
2025	30,693	13,576	47,859	672,145
2026	31,950	14,129	49,809	696,737
2027	33,254	14,704	51,830	722,208
2028	34,601	15,297	53,918	748,494
2029	35,988	15,908	56,069	775,512
2030	37,410	16,534	58,273	803,159
2031	38,862	17,173	60,524	831,316
2032	40,338	17,823	62,812	859,849
2033	41,831	18,480	65,125	888,614
2034	43,333	19,141	67,453	917,461
2035	44,839	19,804	69,784	946,240
2036	46,339	20,464	72,108	974,804
2037	47,828	21,119	74,413	1,003,012
2038	49,299	21,766	76,690	1,030,733

Exhibit 95 All-Cause Dementia Prevalence of “Good Functioning” by Type of Care (Males & Females, All Age Groups: 2008-2038)

Year	Dementia, Number of “Good Functioning” Cases, Long-Term Care (LTC), Community Care (CC), No Care					
	Disabled in LTC Due to Dementia	Disabled in LTC Due to Comorbid Dementia	Disabled in CC Due to Dementia	Disabled in CC Due to Comorbid Dementia	Disabled , No Care, Due to Dementia	Disabled , No Care, Due to Comorbid Dementia
2008	-	-	1,621	7,385	1,036	4,721
2009	-	-	1,745	7,950	1,090	4,967
2010	-	-	1,854	8,446	1,132	5,158
2011	-	-	1,957	8,917	1,172	5,340
2012	-	-	2,059	9,379	1,213	5,526
2013	-	-	2,159	9,837	1,256	5,720
2014	-	-	2,260	10,296	1,300	5,923
2015	-	-	2,361	10,758	1,347	6,137
2016	-	-	2,464	11,226	1,396	6,361
2017	-	-	2,569	11,704	1,448	6,596
2018	-	-	2,677	12,195	1,502	6,843
2019	-	-	2,788	12,703	1,559	7,102
2020	-	-	2,905	13,232	1,618	7,372
2021	-	-	3,026	13,786	1,680	7,654
2022	-	-	3,154	14,367	1,744	7,945
2023	-	-	3,288	14,979	1,810	8,245
2024	-	-	3,430	15,624	1,877	8,552
2025	-	-	3,579	16,303	1,946	8,865
2026	-	-	3,736	17,018	2,015	9,181
2027	-	-	3,900	17,768	2,085	9,500
2028	-	-	4,072	18,552	2,156	9,820
2029	-	-	4,252	19,370	2,226	10,140
2030	-	-	4,438	20,219	2,295	10,457
2031	-	-	4,631	21,096	2,364	10,771
2032	-	-	4,829	21,998	2,432	11,079
2033	-	-	5,031	22,920	2,498	11,381
2034	-	-	5,237	23,858	2,563	11,675
2035	-	-	5,445	24,807	2,625	11,961
2036	-	-	5,655	25,762	2,686	12,236
2037	-	-	5,865	26,719	2,744	12,501
2038	-	-	6,074	27,671	2,800	12,754

Exhibit 96 All-Cause Dementia Prevalence of Mild disability, by Type of Care (Males & Females, All Age Groups: 2008-2038

Year	Dementia, Number of Mild Cases, Long-Term Care (LTC), Community Care (CC), No Care					
	Disabled in LTC Due to Dementia	Disabled in LTC Due to Comorbid Dementia	Disabled in CC Due to Dementia	Disabled in CC Due to Comorbid Dementia	Disabled , No Care, Due to Dementia	Disabled , No Care, Due to Comorbid Dementia
2008	26	120	704	3,207	450	2,051
2009	28	126	758	3,453	474	2,157
2010	29	130	805	3,668	492	2,240
2011	30	135	850	3,873	509	2,319
2012	30	139	894	4,073	527	2,400
2013	31	143	938	4,272	545	2,484
2014	32	147	982	4,472	565	2,573
2015	33	151	1,026	4,672	585	2,665
2016	34	155	1,070	4,876	606	2,763
2017	35	159	1,116	5,083	629	2,865
2018	36	164	1,163	5,297	652	2,972
2019	37	168	1,211	5,517	677	3,084
2020	38	173	1,262	5,747	703	3,202
2021	39	178	1,314	5,988	730	3,324
2022	40	183	1,370	6,240	757	3,451
2023	41	189	1,428	6,506	786	3,581
2024	43	195	1,490	6,786	815	3,714
2025	44	201	1,554	7,081	845	3,850
2026	45	207	1,622	7,391	875	3,988
2027	47	214	1,694	7,717	906	4,126
2028	48	220	1,769	8,058	936	4,265
2029	50	227	1,847	8,413	967	4,404
2030	51	234	1,928	8,782	997	4,542
2031	53	241	2,011	9,163	1,027	4,678
2032	55	248	2,097	9,554	1,056	4,812
2033	56	256	2,185	9,955	1,085	4,943
2034	58	263	2,275	10,362	1,113	5,071
2035	59	270	2,365	10,774	1,140	5,195
2036	61	277	2,456	11,189	1,167	5,314
2037	62	284	2,547	11,605	1,192	5,429
2038	64	290	2,638	12,018	1,216	5,539

Exhibit 97 All-Cause Dementia Prevalence of Moderate Disability: Mode of Care (Males & Females, All Age Groups: 2008-2038)

Year	Dementia, Number of Moderate Cases, Long-Term Care (LTC), Community Care (CC), No Care					
	Disabled in LTC Due to Dementia	Disabled in LTC Due to Comorbid Dementia	Disabled in CC Due to Dementia	Disabled in CC Due to Comorbid Dementia	Disabled , No Care, Due to Dementia	Disabled , No Care, Due to Comorbid Dementia
2008	122	556	2,468	11,243	1,578	7,188
2009	128	583	2,657	12,103	1,660	7,561
2010	132	604	2,822	12,858	1,724	7,852
2011	137	622	2,980	13,575	1,784	8,129
2012	141	641	3,134	14,278	1,847	8,412
2013	145	659	3,287	14,976	1,911	8,708
2014	149	678	3,441	15,674	1,979	9,017
2015	153	697	3,595	16,378	2,051	9,342
2016	157	716	3,752	17,091	2,126	9,684
2017	161	736	3,911	17,818	2,204	10,042
2018	166	756	4,075	18,566	2,287	10,418
2019	171	778	4,245	19,339	2,373	10,812
2020	176	800	4,422	20,145	2,464	11,223
2021	181	824	4,607	20,987	2,558	11,652
2022	186	848	4,801	21,873	2,655	12,095
2023	192	874	5,006	22,805	2,755	12,552
2024	198	901	5,221	23,786	2,858	13,019
2025	204	929	5,448	24,820	2,962	13,495
2026	210	958	5,687	25,908	3,068	13,977
2027	217	988	5,938	27,049	3,175	14,463
2028	224	1,019	6,200	28,244	3,282	14,950
2029	231	1,051	6,473	29,489	3,389	15,437
2030	238	1,083	6,757	30,781	3,495	15,920
2031	245	1,116	7,050	32,117	3,599	16,397
2032	252	1,149	7,351	33,490	3,702	16,867
2033	260	1,182	7,660	34,893	3,803	17,326
2034	267	1,215	7,973	36,321	3,902	17,774
2035	274	1,248	8,290	37,766	3,997	18,209
2036	281	1,281	8,609	39,220	4,089	18,628
2037	288	1,312	8,929	40,676	4,177	19,031
2038	295	1,343	9,247	42,126	4,262	19,417

Exhibit 98 All-Cause Dementia, Prevalence of Severe Disability: Mode of Care (Males & Females, All Age Groups: 2008-2038)

Year	Dementia, Number of Severe Cases, Long-Term Care (LTC), Community Care (CC), No Care					
	Disabled in LTC Due to Dementia	Disabled in LTC Due to Comorbid Dementia	Disabled in CC Due to Dementia	Disabled in CC Due to Comorbid Dementia	Disabled , No Care, Due to Dementia	Disabled , No Care, Due to Comorbid Dementia
2008	32,840	149,603	19,402	88,386	12,404	56,509
2009	34,420	156,801	20,886	95,149	13,049	59,446
2010	35,645	162,383	22,190	101,086	13,551	61,734
2011	36,762	167,470	23,427	106,725	14,029	63,908
2012	37,849	172,422	24,640	112,249	14,517	66,133
2013	38,934	177,364	25,844	117,735	15,027	68,457
2014	40,028	182,351	27,050	123,226	15,562	70,893
2015	41,141	187,419	28,264	128,757	16,123	73,448
2016	42,279	192,604	29,494	134,363	16,711	76,130
2017	43,451	197,944	30,750	140,082	17,329	78,945
2018	44,666	203,480	32,040	145,958	17,978	81,901
2019	45,933	209,249	33,374	152,039	18,658	84,998
2020	47,257	215,281	34,764	158,371	19,369	88,234
2021	48,644	221,601	36,219	164,998	20,108	91,603
2022	50,098	228,223	37,747	171,958	20,873	95,090
2023	51,619	235,154	39,355	179,284	21,661	98,680
2024	53,208	242,392	41,049	187,002	22,468	102,355
2025	54,863	249,931	42,834	195,131	23,290	106,097
2026	56,581	257,756	44,711	203,681	24,122	109,887
2027	58,357	265,849	46,680	212,655	24,960	113,706
2028	60,187	274,184	48,742	222,045	25,801	117,536
2029	62,062	282,726	50,891	231,835	26,640	121,359
2030	63,974	291,438	53,121	241,997	27,473	125,156
2031	65,914	300,275	55,426	252,495	28,297	128,909
2032	67,870	309,187	57,795	263,288	29,108	132,602
2033	69,832	318,123	60,217	274,324	29,901	136,217
2034	71,787	327,030	62,682	285,550	30,674	139,738
2035	73,725	335,857	65,175	296,908	31,424	143,152
2036	75,633	344,553	67,684	308,340	32,147	146,447
2037	77,503	353,070	70,197	319,785	32,842	149,615
2038	79,324	361,366	72,699	331,186	33,508	152,650

ALL CAUSE DEMENTIA AND HEALTHCARE UTILIZATION

Exhibit 99 All-Cause Dementia Prevalence: Mode of Care (Males and Females, All Age Groups: 2008-2038)

Year	Prevalence of All-Cause Dementia by Care Type in Canada					
	Prevalence of Dementia in LTC	Percent of Prevalence: People with Dementia in LTC	Prevalence of Dementia in CC	Percent of Prevalence: People with Dementia in CC	Prevalence of Dementia for No Formal Care	Percent of Prevalence: People with Dementia in No Formal Care
2008	183,268	45.4%	134,416	33.3%	85,938	21.3%
2009	192,086	45.0%	144,700	33.9%	90,404	21.2%
2010	198,924	44.5%	153,729	34.4%	93,884	21.0%
2011	205,155	44.2%	162,305	34.9%	97,191	20.9%
2012	211,221	43.8%	170,706	35.4%	100,574	20.8%
2013	217,275	43.4%	179,049	35.8%	104,108	20.8%
2014	223,384	43.1%	187,400	36.1%	107,813	20.8%
2015	229,592	42.7%	195,811	36.5%	111,698	20.8%
2016	235,944	42.4%	204,336	36.7%	115,777	20.8%
2017	242,487	42.1%	213,033	37.0%	120,058	20.9%
2018	249,268	41.8%	221,970	37.3%	124,553	20.9%
2019	256,335	41.6%	231,218	37.5%	129,263	21.0%
2020	263,725	41.3%	240,848	37.7%	134,185	21.0%
2021	271,467	41.0%	250,925	37.9%	139,307	21.1%
2022	279,579	40.8%	261,510	38.1%	144,610	21.1%
2023	288,069	40.5%	272,651	38.4%	150,070	21.1%
2024	296,936	40.3%	284,389	38.6%	155,660	21.1%
2025	306,171	40.1%	296,751	38.8%	161,350	21.1%
2026	315,758	39.8%	309,754	39.1%	167,114	21.1%
2027	325,672	39.6%	323,402	39.3%	172,922	21.0%
2028	335,882	39.4%	337,682	39.6%	178,747	21.0%
2029	346,347	39.2%	352,569	39.9%	184,560	20.9%
2030	357,019	39.0%	368,023	40.2%	190,334	20.8%
2031	367,844	38.8%	383,989	40.5%	196,043	20.7%
2032	378,761	38.6%	400,402	40.8%	201,658	20.6%
2033	389,708	38.4%	417,186	41.1%	207,155	20.4%
2034	400,620	38.2%	434,258	41.5%	212,510	20.3%
2035	411,433	38.1%	451,531	41.8%	217,702	20.1%
2036	422,085	37.9%	468,916	42.1%	222,713	20.0%
2037	432,519	37.7%	486,323	42.4%	227,531	19.8%
2038	442,682	37.6%	503,661	42.7%	232,146	19.7%

Exhibit 100 Supply of Long-term Care Beds and Number of Beds Occupied by All-Cause Dementia Patients: 2008-2038

Year	Supply and Demand of LTC Beds			
	Number of LTC Beds	Number of LTC Beds Occupied by Dementia Patients	Prevalence of Dementia That Would Have Been in LTC	Excess Demand for LTC
2008	285,178	183,268	198,659	15,392
2009	298,900	192,086	210,941	18,855
2010	309,540	198,924	221,270	22,346
2011	319,236	205,155	230,898	25,743
2012	328,675	211,221	240,248	29,027
2013	338,096	217,275	249,482	32,207
2014	347,602	223,384	258,685	35,301
2015	357,263	229,592	267,918	38,326
2016	367,147	235,944	277,246	41,301
2017	377,328	242,487	286,737	44,250
2018	387,880	249,268	296,473	47,204
2019	398,876	256,335	306,536	50,202
2020	410,375	263,725	317,011	53,286
2021	422,422	271,467	327,972	56,506
2022	435,046	279,579	339,488	59,909
2023	448,257	288,069	351,613	63,544
2024	462,055	296,936	364,389	67,453
2025	476,425	306,171	377,845	71,674
2026	491,343	315,758	391,995	76,237
2027	506,770	325,672	406,836	81,164
2028	522,657	335,882	422,351	86,469
2029	538,941	346,347	438,502	92,156
2030	555,548	357,019	455,238	98,219
2031	572,392	367,844	472,490	104,647
2032	589,381	378,761	490,179	111,418
2033	606,415	389,708	508,216	118,507
2034	623,395	400,620	526,502	125,882
2035	640,221	411,433	544,940	133,506
2036	656,796	422,085	563,426	141,340
2037	673,032	432,519	581,860	149,340
2038	688,846	442,682	600,142	157,461

ECONOMIC SIMULATION RESULTS: ALL-CAUSE DEMENTIA

DIRECT HEALTH COSTS FOR PATIENTS WITH ALL-CAUSE DEMENTIA

Exhibit 101 All-Cause Dementia, Total & Incremental Direct Health Costs, Long-term care (LTC), Community Care (CC), No Care, and Caregivers, Future Values: 2008-2038

Year	Direct Health Costs, Long-Term Care (LTC) , Community Care (CC), No Care, and Caregivers, Future Values							
	Direct Cost, LTC Due to Dementia	Incremental Direct Cost, LTC Due to Comorbid Dementia	Direct Cost, CC Due to Dementia	Incremental Direct Cost, CC Due to Comorbid Dementia	Direct Cost, No Care Due to Dementia	Incremental Direct Cost, No Care Due to Comorbid Dementia	Excess Health Costs Associated with Caregivers	Total Direct Cost – All Methods of Care and Caregivers
2008	\$3,488,976,859	\$899,673,278	\$899,663,518	\$2,171,161,676	\$148,158,636	\$357,551,846	\$98,548,155	\$8,063,733,967
2009	\$3,842,053,652	\$990,718,237	\$1,017,542,426	\$2,455,639,330	\$163,152,103	\$393,735,642	\$109,183,717	\$8,972,025,107
2010	\$4,182,241,590	\$1,078,439,655	\$1,136,305,803	\$2,742,251,477	\$177,405,233	\$428,132,780	\$119,498,453	\$9,864,274,990
2011	\$4,533,869,459	\$1,169,110,993	\$1,261,057,309	\$3,043,314,801	\$192,325,049	\$464,138,834	\$130,217,119	\$10,794,033,564
2012	\$4,907,101,846	\$1,265,353,306	\$1,394,287,273	\$3,364,839,223	\$208,438,624	\$503,025,789	\$141,618,350	\$11,784,664,412
2013	\$5,305,133,337	\$1,367,990,357	\$1,536,999,771	\$3,709,247,882	\$225,960,122	\$545,310,494	\$153,823,645	\$12,844,465,607
2014	\$5,733,746,168	\$1,478,513,163	\$1,691,111,113	\$4,081,165,419	\$245,232,030	\$591,819,469	\$167,058,306	\$13,988,645,669
2015	\$6,196,373,693	\$1,597,807,053	\$1,857,950,116	\$4,483,798,673	\$266,244,494	\$642,528,934	\$181,309,776	\$15,226,012,739
2016	\$6,696,802,044	\$1,726,848,326	\$2,039,006,934	\$4,920,743,839	\$289,155,129	\$697,819,265	\$196,679,974	\$16,567,055,510
2017	\$7,237,193,426	\$1,866,194,531	\$2,235,350,685	\$5,394,581,020	\$313,875,135	\$757,476,156	\$213,108,053	\$18,017,779,006
2018	\$7,814,993,328	\$2,015,186,959	\$2,446,654,228	\$5,904,520,732	\$340,327,241	\$821,313,134	\$230,551,918	\$19,573,547,540
2019	\$8,433,238,217	\$2,174,608,597	\$2,674,392,427	\$6,454,122,268	\$368,779,000	\$889,975,880	\$249,217,515	\$21,244,333,904
2020	\$9,102,775,940	\$2,347,256,689	\$2,922,684,813	\$7,053,327,305	\$399,604,541	\$964,367,285	\$269,397,056	\$23,059,413,629
2021	\$9,826,964,972	\$2,533,997,257	\$3,193,475,642	\$7,706,827,929	\$432,613,744	\$1,044,028,532	\$291,016,788	\$25,028,924,864
2022	\$10,608,266,795	\$2,735,465,023	\$3,488,546,027	\$8,418,922,505	\$467,934,180	\$1,129,267,485	\$314,231,642	\$27,162,633,658
2023	\$11,444,925,668	\$2,951,207,248	\$3,808,377,975	\$9,190,774,265	\$505,452,381	\$1,219,810,315	\$339,045,717	\$29,459,593,571
2024	\$12,342,646,153	\$3,182,694,920	\$4,155,983,915	\$10,029,653,113	\$544,988,010	\$1,315,221,810	\$365,426,412	\$31,936,614,333
2025	\$13,300,406,535	\$3,429,664,578	\$4,532,198,156	\$10,937,572,490	\$586,325,252	\$1,414,981,148	\$393,321,146	\$34,594,469,306
2026	\$14,320,089,182	\$3,692,601,613	\$4,938,839,552	\$11,918,921,846	\$629,685,157	\$1,519,621,786	\$422,969,962	\$37,442,729,097
2027	\$15,413,335,814	\$3,974,507,977	\$5,381,142,073	\$12,986,332,344	\$675,617,155	\$1,630,469,665	\$454,831,430	\$40,516,236,458
2028	\$16,589,338,377	\$4,277,753,921	\$5,863,632,470	\$14,150,728,409	\$724,283,584	\$1,747,916,558	\$489,101,815	\$43,842,755,134
2029	\$17,842,976,213	\$4,601,019,023	\$6,385,825,581	\$15,410,939,194	\$775,615,663	\$1,871,796,476	\$525,817,026	\$47,413,989,177
2030	\$19,180,391,309	\$4,945,887,067	\$6,951,165,518	\$16,775,276,396	\$829,658,485	\$2,002,218,241	\$565,083,445	\$51,249,680,461
2031	\$20,600,253,668	\$5,312,015,097	\$7,560,395,967	\$18,245,534,748	\$886,429,431	\$2,139,223,800	\$606,981,773	\$55,350,834,484
2032	\$22,110,810,081	\$5,701,529,643	\$8,217,721,390	\$19,831,860,900	\$945,963,162	\$2,282,896,798	\$651,597,043	\$59,742,379,017
2033	\$23,714,528,735	\$6,115,067,158	\$8,925,248,331	\$21,539,338,584	\$1,007,998,516	\$2,432,606,974	\$698,801,444	\$64,433,589,743
2034	\$25,409,940,755	\$6,552,248,874	\$9,683,549,185	\$23,369,349,160	\$1,072,540,212	\$2,588,365,714	\$748,638,716	\$69,424,632,616
2035	\$27,207,334,124	\$7,015,727,667	\$10,497,617,959	\$25,333,944,687	\$1,139,825,113	\$2,750,744,643	\$801,305,261	\$74,746,499,454
2036	\$29,106,972,231	\$7,505,571,456	\$11,368,632,845	\$27,435,968,503	\$1,210,288,785	\$2,920,794,913	\$857,131,024	\$80,405,359,757
2037	\$31,116,522,901	\$8,023,757,478	\$12,300,597,220	\$29,685,081,970	\$1,284,151,141	\$3,099,047,241	\$916,287,610	\$86,425,445,561
2038	\$33,243,745,344	\$8,572,286,535	\$13,297,576,167	\$32,091,095,371	\$1,361,996,359	\$3,286,911,426	\$979,197,580	\$92,832,808,780

Exhibit 102 All-Cause Dementia, Total & Incremental Direct Health Costs, Long-Term Care (LTC), Community Care (CC), No Care, and Caregivers, 2008 Present Values: 2008-2038

Year	Direct Health Costs, Long-Term Care (LTC), Community Care (CC), No Care, and Caregivers, 2008 Present Values							
	Direct Cost LTC Due to Dementia	Incremental Direct Cost LTC Due to Comorbid Dementia	Direct Cost CC Due to Dementia	Incremental Direct Cost CC Due to Comorbid Dementia	Direct Cost No Care Due to Dementia	Incremental Direct Cost No Care Due to Comorbid Dementia	Excess Health Costs Associated with Caregivers	Total Direct Cost – All Methods of Care and Caregivers
2008	\$3,488,976,859	\$899,673,278	\$899,663,518	\$2,171,161,676	\$148,158,636	\$357,551,846	\$98,548,155	\$8,063,733,967
2009	\$3,770,230,658	\$972,197,843	\$998,520,582	\$2,409,733,836	\$160,102,152	\$386,375,184	\$107,142,646	\$8,804,302,901
2010	\$4,010,517,223	\$1,034,158,529	\$1,089,648,671	\$2,629,653,630	\$170,120,909	\$410,553,492	\$114,591,803	\$9,459,244,257
2011	\$4,219,930,738	\$1,088,158,241	\$1,173,737,918	\$2,832,586,555	\$179,007,886	\$432,000,469	\$121,200,495	\$10,046,622,302
2012	\$4,404,300,651	\$1,135,700,168	\$1,251,423,047	\$3,020,064,398	\$187,081,172	\$451,483,764	\$127,107,570	\$10,577,160,769
2013	\$4,570,039,878	\$1,178,437,956	\$1,324,028,973	\$3,195,284,578	\$194,650,483	\$469,750,814	\$132,509,429	\$11,064,702,112
2014	\$4,725,739,661	\$1,218,586,957	\$1,393,809,670	\$3,363,686,622	\$202,119,644	\$487,776,169	\$137,689,050	\$11,529,407,773
2015	\$4,874,224,056	\$1,256,875,385	\$1,461,510,490	\$3,527,069,288	\$209,434,644	\$505,429,489	\$142,622,849	\$11,977,166,201
2016	\$5,015,140,884	\$1,293,212,429	\$1,526,983,622	\$3,685,075,868	\$216,544,210	\$522,587,035	\$147,290,867	\$12,406,834,915
2017	\$5,145,374,465	\$1,326,794,673	\$1,589,250,923	\$3,835,345,803	\$223,153,508	\$538,537,281	\$151,511,873	\$12,809,968,527
2018	\$5,259,315,158	\$1,356,175,607	\$1,646,543,397	\$3,973,609,967	\$229,032,597	\$552,725,311	\$155,156,268	\$13,172,558,305
2019	\$5,357,681,376	\$1,381,540,481	\$1,699,055,823	\$4,100,338,421	\$234,287,272	\$565,406,440	\$158,329,221	\$13,496,639,034
2020	\$5,448,284,952	\$1,404,903,667	\$1,749,314,691	\$4,221,628,355	\$239,175,326	\$577,202,801	\$161,242,234	\$13,801,752,025
2021	\$5,535,775,296	\$1,427,464,070	\$1,798,964,748	\$4,341,449,042	\$243,702,149	\$588,127,400	\$163,937,040	\$14,099,419,744
2022	\$5,625,809,391	\$1,450,680,409	\$1,850,056,694	\$4,464,749,446	\$248,156,325	\$598,876,682	\$166,644,312	\$14,404,973,260
2023	\$5,722,650,995	\$1,475,652,143	\$1,904,251,600	\$4,595,538,234	\$252,734,501	\$609,925,212	\$169,528,433	\$14,730,281,117
2024	\$5,834,369,427	\$1,504,460,041	\$1,964,533,796	\$4,741,017,506	\$257,615,858	\$621,705,412	\$172,737,083	\$15,096,439,123
2025	\$5,964,686,361	\$1,538,063,779	\$2,032,504,830	\$4,905,052,284	\$262,942,807	\$634,560,961	\$176,388,389	\$15,514,199,412
2026	\$6,117,362,853	\$1,577,433,189	\$2,109,810,437	\$5,091,614,223	\$268,993,617	\$649,163,406	\$180,687,473	\$15,995,065,197
2027	\$6,298,334,634	\$1,624,098,868	\$2,198,890,227	\$5,306,590,848	\$276,076,703	\$666,257,044	\$185,857,272	\$16,556,105,596
2028	\$6,510,048,346	\$1,678,691,712	\$2,301,027,925	\$5,553,080,176	\$284,225,991	\$685,923,756	\$191,935,108	\$17,204,933,014
2029	\$6,747,448,492	\$1,739,908,102	\$2,414,845,409	\$5,827,756,378	\$293,304,585	\$707,833,164	\$198,841,452	\$17,929,937,583
2030	\$7,008,551,057	\$1,807,236,436	\$2,539,968,954	\$6,129,717,545	\$303,158,771	\$731,614,311	\$206,482,554	\$18,726,729,627
2031	\$7,287,349,216	\$1,879,127,785	\$2,674,493,553	\$6,454,366,315	\$313,574,819	\$756,751,404	\$214,720,081	\$19,580,383,173
2032	\$7,580,439,904	\$1,954,704,629	\$2,817,352,368	\$6,799,128,083	\$324,312,717	\$782,665,218	\$223,392,639	\$20,481,995,559
2033	\$7,881,744,693	\$2,032,399,575	\$2,966,389,484	\$7,158,799,969	\$335,017,704	\$808,499,605	\$232,253,174	\$21,415,104,204
2034	\$8,183,747,422	\$2,110,274,492	\$3,118,768,416	\$7,526,536,673	\$345,431,667	\$833,631,666	\$241,113,123	\$22,359,503,459
2035	\$8,482,874,275	\$2,187,407,832	\$3,273,013,553	\$7,898,777,097	\$355,381,864	\$857,644,518	\$249,836,009	\$23,304,935,149
2036	\$8,772,562,816	\$2,262,107,393	\$3,426,397,118	\$8,268,938,288	\$364,769,455	\$880,299,629	\$258,331,086	\$24,233,405,785
2037	\$9,049,033,542	\$2,333,398,586	\$3,577,151,508	\$8,632,754,479	\$373,445,542	\$901,237,665	\$266,466,705	\$25,133,488,027
2038	\$9,308,981,245	\$2,400,429,126	\$3,723,614,348	\$8,986,213,853	\$381,388,993	\$920,407,629	\$274,196,900	\$25,995,232,094

Exhibit 103 All-Cause Dementia, Direct Health Costs, Patients Residing in Long Term Care Facilities Due to Dementia, By Cost Component, Future Values: 2008-2038

Year	Direct Health Costs, LTC Patients Admitted With an Initial Diagnosis of Dementia, Future Values						
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Support Staff Costs	Annual Administrative Costs	Annual Physician & Hospital Costs	Annual Facility User Fees	Out-of-Pocket Expenses
2008	\$4,886,626	\$1,160,036,531	\$558,869,996	\$935,849,214	\$31,251,105	\$714,883,903	\$83,199,484
2009	\$5,381,142	\$1,277,429,680	\$615,426,412	\$1,030,555,099	\$34,413,648	\$787,228,584	\$91,619,089
2010	\$5,857,606	\$1,390,537,462	\$669,918,270	\$1,121,803,802	\$37,460,744	\$856,932,365	\$99,731,341
2011	\$6,350,092	\$1,507,448,863	\$726,242,595	\$1,216,121,041	\$40,610,309	\$928,980,164	\$108,116,394
2012	\$6,872,838	\$1,631,543,468	\$786,027,567	\$1,316,233,266	\$43,953,388	\$1,005,454,683	\$117,016,637
2013	\$7,430,317	\$1,763,883,431	\$849,784,899	\$1,422,997,361	\$47,518,595	\$1,087,010,484	\$126,508,249
2014	\$8,030,627	\$1,906,391,267	\$918,440,801	\$1,537,964,298	\$51,357,721	\$1,174,832,338	\$136,729,116
2015	\$8,678,579	\$2,060,208,518	\$992,545,231	\$1,662,055,005	\$55,501,521	\$1,269,623,729	\$147,761,110
2016	\$9,379,474	\$2,226,594,021	\$1,072,704,660	\$1,796,285,038	\$59,983,906	\$1,372,160,429	\$159,694,516
2017	\$10,136,341	\$2,406,266,678	\$1,159,265,431	\$1,941,234,366	\$64,824,245	\$1,482,885,468	\$172,580,897
2018	\$10,945,601	\$2,598,377,151	\$1,251,818,361	\$2,096,217,791	\$69,999,654	\$1,601,275,434	\$186,359,336
2019	\$11,811,509	\$2,803,935,023	\$1,350,849,834	\$2,262,049,786	\$75,537,334	\$1,727,952,490	\$201,102,241
2020	\$12,749,257	\$3,026,547,051	\$1,458,097,477	\$2,441,640,072	\$81,534,448	\$1,865,139,339	\$217,068,295
2021	\$13,763,549	\$3,267,329,885	\$1,574,099,256	\$2,635,889,494	\$88,021,080	\$2,013,524,124	\$234,337,585
2022	\$14,857,832	\$3,527,101,930	\$1,699,249,455	\$2,845,458,295	\$95,019,276	\$2,173,611,198	\$252,968,809
2023	\$16,029,648	\$3,805,279,429	\$1,833,266,836	\$3,069,875,532	\$102,513,311	\$2,345,040,814	\$272,920,098
2024	\$17,286,987	\$4,103,759,070	\$1,977,065,165	\$3,310,671,343	\$110,554,281	\$2,528,981,823	\$294,327,486
2025	\$18,628,416	\$4,422,201,145	\$2,130,480,783	\$3,567,571,671	\$119,133,033	\$2,725,224,878	\$317,166,608
2026	\$20,056,573	\$4,761,231,516	\$2,293,815,210	\$3,841,081,425	\$128,266,430	\$2,934,155,674	\$341,482,353
2027	\$21,587,764	\$5,124,720,895	\$2,468,933,237	\$4,134,323,268	\$138,058,746	\$3,158,159,573	\$367,552,332
2028	\$23,234,861	\$5,515,725,476	\$2,657,307,243	\$4,449,762,756	\$148,592,315	\$3,399,119,985	\$395,595,742
2029	\$24,990,694	\$5,932,542,710	\$2,858,116,993	\$4,786,026,374	\$159,821,271	\$3,655,987,698	\$425,490,471
2030	\$26,863,864	\$6,377,214,725	\$3,072,346,322	\$5,144,761,590	\$171,800,628	\$3,930,021,194	\$457,382,986
2031	\$28,852,509	\$6,849,299,314	\$3,299,782,187	\$5,525,611,658	\$184,518,473	\$4,220,947,957	\$491,241,570
2032	\$30,968,179	\$7,351,538,420	\$3,541,745,574	\$5,930,788,616	\$198,048,674	\$4,530,457,738	\$527,262,879
2033	\$33,214,331	\$7,884,752,683	\$3,798,631,840	\$6,360,954,508	\$212,413,338	\$4,859,056,264	\$565,505,770
2034	\$35,588,908	\$8,448,453,722	\$4,070,205,699	\$6,815,715,336	\$227,599,308	\$5,206,442,564	\$605,935,217
2035	\$38,106,320	\$9,046,062,148	\$4,358,115,097	\$7,297,830,650	\$243,698,735	\$5,574,724,624	\$648,796,551
2036	\$40,766,934	\$9,677,665,535	\$4,662,402,223	\$7,807,371,097	\$260,713,978	\$5,963,956,413	\$694,096,051
2037	\$43,581,490	\$10,345,813,328	\$4,984,295,323	\$8,346,393,422	\$278,713,718	\$6,375,709,052	\$742,016,569
2038	\$46,560,857	\$11,053,085,357	\$5,325,037,278	\$8,916,978,877	\$297,767,456	\$6,811,572,385	\$792,743,134

Exhibit 104 All-Cause Dementia, Direct Health Cost, Patients Residing in Long Term Care Facilities Due to Dementia, by Cost Component, 2008 Present Values: 2008-2038

Year	Direct Health Costs, Long-Term Care Patients Admitted With an Initial Diagnosis of Dementia, 2008 Present Values						
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Support Staff Costs	Annual Administrative Costs	Annual Physician & Hospital Costs	Annual Facility User Fees	Out-of-Pocket Expenses
2008	\$4,886,626	\$1,160,036,531	\$558,869,996	\$935,849,214	\$31,251,105	\$714,883,903	\$83,199,484
2009	\$5,280,547	\$1,253,549,528	\$603,921,688	\$1,011,289,997	\$33,770,322	\$772,512,205	\$89,906,370
2010	\$5,617,090	\$1,333,441,486	\$642,411,181	\$1,075,742,128	\$35,922,592	\$821,746,409	\$95,636,336
2011	\$5,910,393	\$1,403,068,582	\$675,955,379	\$1,131,913,172	\$37,798,330	\$864,654,791	\$100,630,091
2012	\$6,168,619	\$1,464,369,027	\$705,488,052	\$1,181,366,764	\$39,449,749	\$902,431,792	\$105,026,647
2013	\$6,400,752	\$1,519,475,027	\$732,036,432	\$1,225,823,042	\$40,934,291	\$936,391,406	\$108,978,928
2014	\$6,618,824	\$1,571,243,051	\$756,976,676	\$1,267,586,438	\$42,328,909	\$968,293,958	\$112,691,805
2015	\$6,826,789	\$1,620,612,057	\$780,761,149	\$1,307,414,447	\$43,658,898	\$998,718,094	\$116,232,621
2016	\$7,024,156	\$1,667,464,953	\$803,333,436	\$1,345,212,607	\$44,921,104	\$1,027,591,651	\$119,592,978
2017	\$7,206,560	\$1,710,765,817	\$824,194,463	\$1,380,145,196	\$46,087,619	\$1,054,276,233	\$122,698,578
2018	\$7,366,144	\$1,748,649,521	\$842,445,669	\$1,410,707,539	\$47,108,197	\$1,077,622,438	\$125,415,651
2019	\$7,503,915	\$1,781,354,927	\$858,202,130	\$1,437,092,336	\$47,989,273	\$1,097,777,465	\$127,761,330
2020	\$7,630,813	\$1,811,479,362	\$872,715,158	\$1,461,394,958	\$48,800,818	\$1,116,341,944	\$129,921,898
2021	\$7,753,351	\$1,840,568,691	\$886,729,504	\$1,484,862,517	\$49,584,477	\$1,134,268,529	\$132,008,226
2022	\$7,879,452	\$1,870,503,782	\$901,151,312	\$1,509,012,387	\$50,390,921	\$1,152,716,323	\$134,155,214
2023	\$8,015,088	\$1,902,702,276	\$916,663,558	\$1,534,988,237	\$51,258,341	\$1,172,558,961	\$136,464,536
2024	\$8,171,559	\$1,939,847,108	\$934,558,798	\$1,564,954,502	\$52,259,014	\$1,195,449,829	\$139,128,617
2025	\$8,354,080	\$1,983,175,686	\$955,433,177	\$1,599,909,449	\$53,426,275	\$1,222,151,490	\$142,236,204
2026	\$8,567,917	\$2,033,938,507	\$979,889,146	\$1,640,861,906	\$54,793,813	\$1,253,434,577	\$145,876,987
2027	\$8,821,384	\$2,094,109,120	\$1,008,877,501	\$1,689,404,016	\$56,414,795	\$1,290,515,308	\$150,192,509
2028	\$9,117,908	\$2,164,501,000	\$1,042,790,148	\$1,746,192,043	\$58,311,135	\$1,333,894,995	\$155,241,116
2029	\$9,450,409	\$2,243,433,264	\$1,080,817,290	\$1,809,869,949	\$60,437,552	\$1,382,537,778	\$160,902,251
2030	\$9,816,106	\$2,330,246,254	\$1,122,641,124	\$1,879,905,561	\$62,776,273	\$1,436,037,136	\$167,128,603
2031	\$10,206,588	\$2,422,942,784	\$1,167,299,467	\$1,954,687,667	\$65,273,495	\$1,493,162,282	\$173,776,931
2032	\$10,617,088	\$2,520,391,383	\$1,214,247,211	\$2,033,303,462	\$67,898,737	\$1,553,215,938	\$180,766,085
2033	\$11,039,093	\$2,620,571,056	\$1,262,510,703	\$2,114,122,528	\$70,597,553	\$1,614,952,646	\$187,951,114
2034	\$11,462,075	\$2,720,982,785	\$1,310,885,992	\$2,195,128,802	\$73,302,621	\$1,676,832,359	\$195,152,788
2035	\$11,881,029	\$2,820,438,325	\$1,358,800,619	\$2,275,363,680	\$75,981,929	\$1,738,122,812	\$202,285,882
2036	\$12,286,764	\$2,916,755,757	\$1,405,203,401	\$2,353,066,916	\$78,576,697	\$1,797,479,376	\$209,193,906
2037	\$12,673,986	\$3,008,678,448	\$1,449,488,932	\$2,427,224,734	\$81,053,072	\$1,854,127,637	\$215,786,733
2038	\$13,038,066	\$3,095,107,462	\$1,491,127,779	\$2,496,950,577	\$83,381,449	\$1,907,390,365	\$221,985,546

Exhibit 105 All-Cause Dementia, Incremental Direct Health Cost, Comorbidity Adjusted Patients Residing in Long Term Care Facilities, by Cost Component, Future Values: 2008-2038

Year	Incremental Direct Health Costs, Comorbidity Adjusted Long-Term Care Patients, Future Values						
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Support Staff Costs	Annual Administrative Costs	Annual Physician & Hospital Costs	Annual Facility User Fees	Out-of-Pocket Expenses
2008	\$1,260,073	\$299,128,917	\$144,111,131	\$241,319,609	\$8,058,461	\$184,341,132	\$21,453,955
2009	\$1,387,590	\$329,400,106	\$158,694,861	\$265,740,623	\$8,873,959	\$202,996,050	\$23,625,048
2010	\$1,510,452	\$358,566,264	\$172,746,221	\$289,270,163	\$9,659,689	\$220,969,981	\$25,716,887
2011	\$1,637,445	\$388,713,229	\$187,270,103	\$313,590,960	\$10,471,841	\$239,548,344	\$27,879,070
2012	\$1,772,241	\$420,712,467	\$202,686,354	\$339,406,062	\$11,333,892	\$259,268,189	\$30,174,101
2013	\$1,915,994	\$454,837,866	\$219,126,924	\$366,936,427	\$12,253,223	\$280,298,301	\$32,621,624
2014	\$2,070,791	\$491,585,170	\$236,830,647	\$396,581,989	\$13,243,186	\$302,944,188	\$35,257,193
2015	\$2,237,873	\$531,248,737	\$255,939,336	\$428,580,221	\$14,311,713	\$327,387,251	\$38,101,921
2016	\$2,418,606	\$574,153,175	\$276,609,378	\$463,192,997	\$15,467,548	\$353,827,532	\$41,179,089
2017	\$2,613,773	\$620,483,860	\$298,930,080	\$500,569,868	\$16,715,686	\$382,379,272	\$44,501,992
2018	\$2,822,451	\$670,021,781	\$322,795,930	\$540,534,147	\$18,050,225	\$412,907,502	\$48,054,923
2019	\$3,045,735	\$723,027,270	\$348,332,347	\$583,295,857	\$19,478,180	\$445,572,655	\$51,856,553
2020	\$3,287,544	\$780,430,372	\$375,987,400	\$629,605,302	\$21,024,606	\$480,947,880	\$55,973,586
2021	\$3,549,091	\$842,519,027	\$405,899,808	\$679,694,775	\$22,697,260	\$519,210,623	\$60,426,673
2022	\$3,831,265	\$909,504,271	\$438,171,243	\$733,734,529	\$24,501,826	\$560,490,938	\$65,230,951
2023	\$4,133,431	\$981,235,576	\$472,729,184	\$791,603,125	\$26,434,250	\$604,696,059	\$70,375,623
2024	\$4,457,651	\$1,058,202,024	\$509,809,256	\$853,695,126	\$28,507,708	\$652,127,388	\$75,895,767
2025	\$4,803,554	\$1,140,316,018	\$549,369,259	\$919,939,865	\$30,719,839	\$702,730,943	\$81,785,100
2026	\$5,171,821	\$1,227,738,944	\$591,486,941	\$990,467,537	\$33,074,991	\$756,606,180	\$88,055,198
2027	\$5,566,656	\$1,321,468,910	\$636,643,162	\$1,066,083,358	\$35,600,054	\$814,368,192	\$94,777,645
2028	\$5,991,379	\$1,422,293,991	\$685,217,591	\$1,147,423,101	\$38,316,257	\$876,502,638	\$102,008,965
2029	\$6,444,141	\$1,529,775,164	\$736,998,722	\$1,234,132,587	\$41,211,774	\$942,738,966	\$109,717,669
2030	\$6,927,160	\$1,644,439,017	\$792,240,247	\$1,326,636,636	\$44,300,791	\$1,013,401,691	\$117,941,525
2031	\$7,439,955	\$1,766,171,521	\$850,887,231	\$1,424,843,258	\$47,580,235	\$1,088,420,542	\$126,672,354
2032	\$7,985,505	\$1,895,679,718	\$913,280,305	\$1,529,322,851	\$51,069,155	\$1,168,231,241	\$135,960,868
2033	\$8,564,702	\$2,033,175,220	\$979,521,418	\$1,640,246,131	\$54,773,251	\$1,252,964,194	\$145,822,243
2034	\$9,177,014	\$2,178,532,092	\$1,049,549,897	\$1,757,511,502	\$58,689,130	\$1,342,541,793	\$156,247,446
2035	\$9,826,158	\$2,332,632,378	\$1,123,790,685	\$1,881,830,545	\$62,840,554	\$1,437,507,608	\$167,299,740
2036	\$10,512,228	\$2,495,498,660	\$1,202,254,661	\$2,013,221,478	\$67,228,133	\$1,537,875,553	\$178,980,743
2037	\$11,237,994	\$2,667,788,342	\$1,285,258,542	\$2,152,214,656	\$71,869,575	\$1,644,050,762	\$191,337,606
2038	\$12,006,259	\$2,850,166,664	\$1,373,122,820	\$2,299,346,754	\$76,782,803	\$1,756,443,193	\$204,418,041

Exhibit 106 All-Cause Dementia, Incremental Direct Health Costs, Comorbidity Adjusted Patients Residing in Long Term Care Facilities, by Cost Component, 2008 Present Values: 2008-2038

Year	Incremental Direct Health Costs, Comorbidity Adjusted Long-Term Care Patients, 2008 Present Values						
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Support Staff Costs	Annual Administrative Costs	Annual Physician & Hospital Costs	Annual Facility User Fees	Out-of-Pocket Expenses
2008	\$1,260,073	\$299,128,917	\$144,111,131	\$241,319,609	\$8,058,461	\$184,341,132	\$21,453,955
2009	\$1,361,651	\$323,242,331	\$155,728,234	\$260,772,892	\$8,708,071	\$199,201,261	\$23,183,404
2010	\$1,448,432	\$343,843,402	\$165,653,198	\$277,392,624	\$9,263,058	\$211,896,873	\$24,660,942
2011	\$1,524,064	\$361,797,559	\$174,302,959	\$291,876,982	\$9,746,739	\$222,961,298	\$25,948,640
2012	\$1,590,650	\$377,604,592	\$181,918,303	\$304,629,166	\$10,172,577	\$232,702,538	\$27,082,343
2013	\$1,650,508	\$391,814,315	\$188,764,111	\$316,092,734	\$10,555,383	\$241,459,419	\$28,101,485
2014	\$1,706,741	\$405,163,302	\$195,195,244	\$326,861,912	\$10,915,002	\$249,685,863	\$29,058,893
2015	\$1,760,367	\$417,893,675	\$201,328,347	\$337,132,027	\$11,257,955	\$257,531,081	\$29,971,934
2016	\$1,811,260	\$429,975,239	\$207,148,873	\$346,878,723	\$11,583,429	\$264,976,463	\$30,838,441
2017	\$1,858,295	\$441,140,871	\$212,528,132	\$355,886,497	\$11,884,229	\$271,857,393	\$31,639,256
2018	\$1,899,446	\$450,909,625	\$217,234,418	\$363,767,353	\$12,147,397	\$277,877,484	\$32,339,885
2019	\$1,934,972	\$459,343,094	\$221,297,405	\$370,570,980	\$12,374,592	\$283,074,692	\$32,944,746
2020	\$1,967,694	\$467,111,031	\$225,039,758	\$376,837,694	\$12,583,859	\$287,861,759	\$33,501,873
2021	\$1,999,292	\$474,612,053	\$228,653,520	\$382,889,077	\$12,785,934	\$292,484,338	\$34,039,857
2022	\$2,031,808	\$482,331,164	\$232,372,351	\$389,116,402	\$12,993,885	\$297,241,316	\$34,593,483
2023	\$2,066,784	\$490,633,920	\$236,372,364	\$395,814,577	\$13,217,560	\$302,357,971	\$35,188,968
2024	\$2,107,132	\$500,212,147	\$240,986,860	\$403,541,727	\$13,475,595	\$308,260,648	\$35,875,933
2025	\$2,154,197	\$511,384,925	\$246,369,561	\$412,555,267	\$13,776,587	\$315,145,982	\$36,677,260
2026	\$2,209,337	\$524,474,709	\$252,675,818	\$423,115,334	\$14,129,222	\$323,212,690	\$37,616,078
2027	\$2,274,697	\$539,990,402	\$260,150,802	\$435,632,482	\$14,547,211	\$332,774,388	\$38,728,886
2028	\$2,351,159	\$558,141,767	\$268,895,573	\$450,275,936	\$15,036,205	\$343,960,345	\$40,030,728
2029	\$2,436,898	\$578,495,370	\$278,701,314	\$466,696,025	\$15,584,526	\$356,503,452	\$41,490,518
2030	\$2,531,197	\$600,881,110	\$289,486,076	\$484,755,522	\$16,187,592	\$370,298,884	\$43,096,055
2031	\$2,631,888	\$624,783,988	\$301,001,749	\$504,038,958	\$16,831,530	\$385,029,268	\$44,810,404
2032	\$2,737,740	\$649,912,243	\$313,107,771	\$524,310,956	\$17,508,479	\$400,514,802	\$46,612,638
2033	\$2,846,558	\$675,744,738	\$325,553,074	\$545,151,092	\$18,204,400	\$416,434,330	\$48,465,382
2034	\$2,955,629	\$701,637,070	\$338,027,206	\$566,039,502	\$18,901,934	\$432,390,734	\$50,322,417
2035	\$3,063,661	\$727,282,839	\$350,382,549	\$586,728,999	\$19,592,824	\$448,195,191	\$52,161,768
2036	\$3,168,285	\$752,119,409	\$362,348,047	\$606,765,683	\$20,261,916	\$463,500,971	\$53,943,083
2037	\$3,268,135	\$775,822,744	\$373,767,586	\$625,888,139	\$20,900,478	\$478,108,384	\$55,643,120
2038	\$3,362,017	\$798,109,471	\$384,504,647	\$643,867,759	\$21,500,877	\$491,842,799	\$57,241,556

Exhibit 107 All-Cause Dementia, Direct Health Care Cost, Patients in Community Care Due to Dementia, by Cost Component, Future Values: 2008-2038

Year	Direct Health Costs, Community Care Patients Admitted With an Initial Diagnosis of Dementia, Future Values				
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Physician & Hospital Costs	Annual Services Purchased	Out-of- Pocket Expenses
2008	\$1,447,591	\$674,745,712	\$67,837,621	\$39,547,104	\$116,085,490
2009	\$1,637,262	\$763,154,641	\$76,726,083	\$44,728,785	\$131,295,655
2010	\$1,828,357	\$852,226,919	\$85,681,236	\$49,949,345	\$146,619,945
2011	\$2,029,086	\$945,790,282	\$95,087,915	\$55,433,130	\$162,716,896
2012	\$2,243,458	\$1,045,712,470	\$105,133,897	\$61,289,608	\$179,907,841
2013	\$2,473,088	\$1,152,746,538	\$115,894,894	\$67,562,915	\$198,322,337
2014	\$2,721,058	\$1,268,329,714	\$127,515,401	\$74,337,289	\$218,207,650
2015	\$2,989,508	\$1,393,458,609	\$140,095,617	\$81,671,142	\$239,735,240
2016	\$3,280,835	\$1,529,250,835	\$153,747,903	\$89,629,976	\$263,097,385
2017	\$3,596,759	\$1,676,508,228	\$168,552,875	\$98,260,788	\$288,432,035
2018	\$3,936,754	\$1,834,985,433	\$184,485,865	\$107,549,198	\$315,696,978
2019	\$4,303,193	\$2,005,788,595	\$201,658,082	\$117,560,036	\$345,082,521
2020	\$4,702,704	\$2,192,007,353	\$220,380,154	\$128,474,389	\$377,120,213
2021	\$5,138,416	\$2,395,099,894	\$240,798,683	\$140,377,720	\$412,060,928
2022	\$5,613,195	\$2,616,402,052	\$263,047,971	\$153,348,324	\$450,134,485
2023	\$6,127,816	\$2,856,275,328	\$287,164,364	\$167,407,389	\$491,403,079
2024	\$6,687,127	\$3,116,979,039	\$313,375,007	\$182,687,333	\$536,255,410
2025	\$7,292,469	\$3,399,138,914	\$341,742,812	\$199,224,831	\$584,799,130
2026	\$7,946,769	\$3,704,119,090	\$372,404,926	\$217,099,836	\$637,268,931
2027	\$8,658,450	\$4,035,845,034	\$405,756,007	\$236,542,420	\$694,340,162
2028	\$9,434,794	\$4,397,711,799	\$442,137,387	\$257,751,569	\$756,596,920
2029	\$10,275,021	\$4,789,355,514	\$481,512,484	\$280,705,957	\$823,976,604
2030	\$11,184,674	\$5,213,359,257	\$524,140,995	\$305,556,979	\$896,923,614
2031	\$12,164,947	\$5,670,280,789	\$570,078,997	\$332,337,324	\$975,533,909
2032	\$13,222,607	\$6,163,273,449	\$619,643,520	\$361,231,813	\$1,060,350,001
2033	\$14,361,043	\$6,693,917,140	\$672,993,404	\$392,333,042	\$1,151,643,701
2034	\$15,581,177	\$7,262,641,157	\$730,171,810	\$425,666,174	\$1,249,488,867
2035	\$16,891,042	\$7,873,190,995	\$791,555,303	\$461,450,734	\$1,354,529,886
2036	\$18,292,536	\$8,526,450,295	\$857,232,722	\$499,738,511	\$1,466,918,782
2037	\$19,792,100	\$9,225,421,581	\$927,505,935	\$540,705,485	\$1,587,172,119
2038	\$21,396,275	\$9,973,153,656	\$1,002,681,462	\$584,530,348	\$1,715,814,425

Exhibit 108 All-Cause Dementia, Direct Health Costs Patients in Community Care Due to Dementia, by Cost Component, 2008 Present Values: 2008-2038

Year	Direct Health Costs, Community Care Patients Admitted With an Initial Diagnosis of Dementia, 2008 Present Values				
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Physician & Hospital Costs	Annual Services Purchased	Out-of- Pocket Expenses
2008	\$1,447,591	\$674,745,712	\$67,837,621	\$39,547,104	\$116,085,490
2009	\$1,606,655	\$748,888,299	\$75,291,772	\$43,892,629	\$128,841,226
2010	\$1,753,284	\$817,234,171	\$82,163,133	\$47,898,407	\$140,599,677
2011	\$1,888,586	\$880,300,926	\$88,503,742	\$51,594,774	\$151,449,890
2012	\$2,013,584	\$938,564,606	\$94,361,459	\$55,009,630	\$161,473,767
2013	\$2,130,410	\$993,018,895	\$99,836,187	\$58,201,217	\$170,842,264
2014	\$2,242,690	\$1,045,354,269	\$105,097,884	\$61,268,613	\$179,846,215
2015	\$2,351,623	\$1,096,129,738	\$110,202,751	\$64,244,583	\$188,581,795
2016	\$2,456,971	\$1,145,234,447	\$115,139,643	\$67,122,629	\$197,029,932
2017	\$2,557,162	\$1,191,934,790	\$119,834,804	\$69,859,754	\$205,064,414
2018	\$2,649,347	\$1,234,904,023	\$124,154,848	\$72,378,197	\$212,456,983
2019	\$2,733,842	\$1,274,288,230	\$128,114,459	\$74,686,520	\$219,232,772
2020	\$2,814,710	\$1,311,982,273	\$131,904,145	\$76,895,783	\$225,717,781
2021	\$2,894,599	\$1,349,219,710	\$135,647,924	\$79,078,283	\$232,124,233
2022	\$2,976,807	\$1,387,538,560	\$139,500,427	\$81,324,165	\$238,716,735
2023	\$3,064,009	\$1,428,184,623	\$143,586,903	\$83,706,447	\$245,709,618
2024	\$3,161,005	\$1,473,396,141	\$148,132,381	\$86,356,311	\$253,487,958
2025	\$3,270,373	\$1,524,374,271	\$153,257,623	\$89,344,159	\$262,258,404
2026	\$3,394,760	\$1,582,353,311	\$159,086,723	\$92,742,332	\$272,233,311
2027	\$3,538,093	\$1,649,162,963	\$165,803,635	\$96,658,072	\$283,727,465
2028	\$3,702,436	\$1,725,766,018	\$173,505,157	\$101,147,806	\$296,906,508
2029	\$3,885,573	\$1,811,128,887	\$182,087,374	\$106,150,956	\$311,592,619
2030	\$4,086,901	\$1,904,971,277	\$191,522,105	\$111,651,095	\$327,737,575
2031	\$4,303,356	\$2,005,864,439	\$201,665,708	\$117,564,481	\$345,095,569
2032	\$4,533,221	\$2,113,008,245	\$212,437,737	\$123,844,221	\$363,528,945
2033	\$4,773,027	\$2,224,785,763	\$223,675,631	\$130,395,544	\$382,759,520
2034	\$5,018,210	\$2,339,069,635	\$235,165,510	\$137,093,765	\$402,421,296
2035	\$5,266,396	\$2,454,753,158	\$246,796,106	\$143,874,021	\$422,323,873
2036	\$5,513,195	\$2,569,790,503	\$258,361,737	\$150,616,404	\$442,115,279
2037	\$5,755,765	\$2,682,855,973	\$269,729,119	\$157,243,214	\$461,567,438
2038	\$5,991,428	\$2,792,702,789	\$280,772,904	\$163,681,378	\$480,465,848

Exhibit 109 All-Cause Dementia, Incremental Direct Health Costs, Comorbidity Adjusted Patients in Community Care, by Cost Component, Future Values: 2008-2038

Year	Incremental Direct health Costs, Comorbidity Adjusted Community Care Patients, Future Values				
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Physician & Hospital Costs	Annual Services Purchased	Out-of- Pocket Expenses
2008	\$3,493,477	\$1,628,366,609	\$163,712,810	\$95,439,189	\$280,149,591
2009	\$3,951,211	\$1,841,724,240	\$185,163,371	\$107,944,162	\$316,856,345
2010	\$4,412,381	\$2,056,682,737	\$206,774,880	\$120,542,961	\$353,838,518
2011	\$4,896,802	\$2,282,479,585	\$229,476,056	\$133,777,001	\$392,685,356
2012	\$5,414,146	\$2,523,622,214	\$253,720,067	\$147,910,463	\$434,172,334
2013	\$5,968,312	\$2,781,927,970	\$279,689,625	\$163,049,862	\$478,612,113
2014	\$6,566,741	\$3,060,865,327	\$307,733,444	\$179,398,487	\$526,601,420
2015	\$7,214,592	\$3,362,839,405	\$338,093,330	\$197,097,303	\$578,554,042
2016	\$7,917,653	\$3,690,547,344	\$371,040,449	\$216,304,390	\$634,934,003
2017	\$8,680,074	\$4,045,924,216	\$406,769,348	\$237,133,165	\$696,074,218
2018	\$9,500,585	\$4,428,377,908	\$445,220,498	\$259,548,922	\$761,872,819
2019	\$10,384,913	\$4,840,577,883	\$486,662,281	\$283,708,120	\$832,789,070
2020	\$11,349,056	\$5,289,980,379	\$531,844,334	\$310,047,772	\$910,105,765
2021	\$12,400,561	\$5,780,104,447	\$581,120,454	\$338,774,131	\$994,428,335
2022	\$13,546,347	\$6,314,173,855	\$634,814,753	\$370,076,143	\$1,086,311,407
2023	\$14,788,284	\$6,893,061,022	\$693,014,942	\$404,004,941	\$1,185,905,075
2024	\$16,138,070	\$7,522,218,362	\$756,269,197	\$440,880,093	\$1,294,147,390
2025	\$17,598,945	\$8,203,155,952	\$824,729,337	\$480,790,106	\$1,411,298,151
2026	\$19,177,971	\$8,939,165,867	\$898,726,342	\$523,927,928	\$1,537,923,737
2027	\$20,895,473	\$9,739,721,456	\$979,212,643	\$570,848,797	\$1,675,653,975
2028	\$22,769,027	\$10,613,016,011	\$1,067,011,979	\$622,032,925	\$1,825,898,466
2029	\$24,796,752	\$11,558,171,402	\$1,162,036,062	\$677,428,844	\$1,988,506,134
2030	\$26,992,019	\$12,581,421,383	\$1,264,911,624	\$737,401,916	\$2,164,549,454
2031	\$29,357,717	\$13,684,112,000	\$1,375,773,993	\$802,031,035	\$2,354,260,004
2032	\$31,910,173	\$14,873,853,217	\$1,495,388,260	\$871,762,222	\$2,558,947,028
2033	\$34,657,565	\$16,154,457,825	\$1,624,137,756	\$946,818,948	\$2,779,266,491
2034	\$37,602,118	\$17,526,961,839	\$1,762,126,639	\$1,027,261,933	\$3,015,396,633
2035	\$40,763,222	\$19,000,404,278	\$1,910,263,674	\$1,113,620,957	\$3,268,892,556
2036	\$44,145,453	\$20,576,917,640	\$2,068,763,260	\$1,206,021,008	\$3,540,121,142
2037	\$47,764,357	\$22,263,747,924	\$2,238,353,895	\$1,304,886,776	\$3,830,329,018
2038	\$51,635,719	\$24,068,252,824	\$2,419,775,306	\$1,410,649,497	\$4,140,782,024

Exhibit 110 All-Cause Dementia, Incremental Direct Health Costs, Comorbidity Adjusted Patients in Community Care, by Cost Component, 2008 Present Values: 2008-2038

Year	Incremental Direct Health Costs, Comorbidity Adjusted Community Care Patients, 2008 Present Values				
	Annual Costs of Medication	Annual Long-Term Care Staff Costs	Annual Physician & Hospital Costs	Annual Services Purchased	Out-of- Pocket Expenses
2008	\$3,493,477	\$1,628,366,609	\$163,712,810	\$95,439,189	\$280,149,591
2009	\$3,877,348	\$1,807,295,218	\$181,701,945	\$105,926,264	\$310,933,062
2010	\$4,231,207	\$1,972,234,593	\$198,284,628	\$115,593,423	\$339,309,779
2011	\$4,557,733	\$2,124,433,852	\$213,586,446	\$124,513,880	\$365,494,644
2012	\$4,859,391	\$2,265,041,833	\$227,722,898	\$132,754,968	\$389,685,308
2013	\$5,141,327	\$2,396,456,593	\$240,935,083	\$140,457,237	\$412,294,339
2014	\$5,412,292	\$2,522,757,766	\$253,633,157	\$147,859,797	\$434,023,611
2015	\$5,675,180	\$2,645,294,415	\$265,952,753	\$155,041,717	\$455,105,223
2016	\$5,929,419	\$2,763,799,012	\$277,866,975	\$161,987,316	\$475,493,147
2017	\$6,171,208	\$2,876,501,141	\$289,197,827	\$168,592,831	\$494,882,795
2018	\$6,393,680	\$2,980,198,968	\$299,623,405	\$174,670,601	\$512,723,313
2019	\$6,597,591	\$3,075,245,037	\$309,179,152	\$180,241,287	\$529,075,353
2020	\$6,792,751	\$3,166,212,228	\$318,324,816	\$185,572,909	\$544,725,651
2021	\$6,985,547	\$3,256,077,487	\$327,359,695	\$190,839,946	\$560,186,368
2022	\$7,183,941	\$3,348,552,526	\$336,656,955	\$196,259,943	\$576,096,080
2023	\$7,394,385	\$3,446,643,837	\$346,518,865	\$202,009,113	\$592,972,034
2024	\$7,628,467	\$3,555,752,979	\$357,488,486	\$208,404,041	\$611,743,533
2025	\$7,892,404	\$3,678,778,712	\$369,857,253	\$215,614,626	\$632,909,288
2026	\$8,192,589	\$3,818,699,766	\$383,924,644	\$223,815,453	\$656,981,770
2027	\$8,538,494	\$3,979,931,775	\$400,134,596	\$233,265,323	\$684,720,660
2028	\$8,935,104	\$4,164,798,243	\$418,720,711	\$244,100,417	\$716,525,700
2029	\$9,377,068	\$4,370,804,807	\$439,432,210	\$256,174,540	\$751,967,752
2030	\$9,862,934	\$4,597,275,035	\$462,201,086	\$269,448,047	\$790,930,441
2031	\$10,385,306	\$4,840,760,918	\$486,680,683	\$283,718,848	\$832,820,560
2032	\$10,940,040	\$5,099,331,506	\$512,676,867	\$298,873,769	\$877,305,901
2033	\$11,518,765	\$5,369,084,651	\$539,797,323	\$314,684,104	\$923,715,127
2034	\$12,110,466	\$5,644,886,391	\$567,525,894	\$330,848,949	\$971,164,973
2035	\$12,709,414	\$5,924,065,913	\$595,594,060	\$347,211,767	\$1,019,195,943
2036	\$13,305,017	\$6,201,686,013	\$623,505,444	\$363,483,188	\$1,066,958,626
2037	\$13,890,410	\$6,474,547,377	\$650,938,395	\$379,475,697	\$1,113,902,600
2038	\$14,459,139	\$6,739,641,151	\$677,590,407	\$395,012,944	\$1,159,510,212

Exhibit 111 All-Cause Dementia, Direct Health Cost, Individuals Not Receiving Care, by Cost Component, Future Values: 2008-2038

Year	Direct Health Costs, Individuals Not Receiving Care with an Initial Diagnosis of Dementia, Future Values
	Out-of- Pocket Expenses
2008	\$148,158,636
2009	\$163,152,103
2010	\$177,405,233
2011	\$192,325,049
2012	\$208,438,624
2013	\$225,960,122
2014	\$245,232,030
2015	\$266,244,494
2016	\$289,155,129
2017	\$313,875,135
2018	\$340,327,241
2019	\$368,779,000
2020	\$399,604,541
2021	\$432,613,744
2022	\$467,934,180
2023	\$505,452,381
2024	\$544,988,010
2025	\$586,325,252
2026	\$629,685,157
2027	\$675,617,155
2028	\$724,283,584
2029	\$775,615,663
2030	\$829,658,485
2031	\$886,429,431
2032	\$945,963,162
2033	\$1,007,998,516
2034	\$1,072,540,212
2035	\$1,139,825,113
2036	\$1,210,288,785
2037	\$1,284,151,141
2038	\$1,361,996,359

Exhibit 112 All-Cause Dementia, Direct Health Costs, Individuals Not Receiving Care, 2008 Present Values: 2008-2038

Year	Direct Health Costs, Individuals Not Receiving Care with an Initial Diagnosis of Dementia, 2008 Present Values
	Out-of- Pocket Expenses
2008	\$148,158,636
2009	\$160,102,152
2010	\$170,120,909
2011	\$179,007,886
2012	\$187,081,172
2013	\$194,650,483
2014	\$202,119,644
2015	\$209,434,644
2016	\$216,544,210
2017	\$223,153,508
2018	\$229,032,597
2019	\$234,287,272
2020	\$239,175,326
2021	\$243,702,149
2022	\$248,156,325
2023	\$252,734,501
2024	\$257,615,858
2025	\$262,942,807
2026	\$268,993,617
2027	\$276,076,703
2028	\$284,225,991
2029	\$293,304,585
2030	\$303,158,771
2031	\$313,574,819
2032	\$324,312,717
2033	\$335,017,704
2034	\$345,431,667
2035	\$355,381,864
2036	\$364,769,455
2037	\$373,445,542
2038	\$381,388,993

Exhibit 113 All-Cause Dementia, Incremental Direct Health Cost, Comorbidity Adjusted Individuals Not Receiving Care, by Cost Component, Future Values: 2008-2038

Year	Incremental Direct Health Costs, Comorbidity Adjusted Individuals Not Receiving Care, Future Values
	Out-of- Pocket Expenses
2008	\$357,551,846
2009	\$393,735,642
2010	\$428,132,780
2011	\$464,138,834
2012	\$503,025,789
2013	\$545,310,494
2014	\$591,819,469
2015	\$642,528,934
2016	\$697,819,265
2017	\$757,476,156
2018	\$821,313,134
2019	\$889,975,880
2020	\$964,367,285
2021	\$1,044,028,532
2022	\$1,129,267,485
2023	\$1,219,810,315
2024	\$1,315,221,810
2025	\$1,414,981,148
2026	\$1,519,621,786
2027	\$1,630,469,665
2028	\$1,747,916,558
2029	\$1,871,796,476
2030	\$2,002,218,241
2031	\$2,139,223,800
2032	\$2,282,896,798
2033	\$2,432,606,974
2034	\$2,588,365,714
2035	\$2,750,744,643
2036	\$2,920,794,913
2037	\$3,099,047,241
2038	\$3,286,911,426

Exhibit 114 All-Cause Dementia, Incremental Direct Health Care Costs, Comorbidity Adjusted Individuals Not Receiving Care, by Cost Component, 2008 Present Values: 2008-2038

Year	Incremental Direct Health Costs, Comorbidity Adjusted Individuals Not Receiving Care, 2008 Present Values
	Out-of- Pocket Expenses
2008	\$357,551,846
2009	\$386,375,184
2010	\$410,553,492
2011	\$432,000,469
2012	\$451,483,764
2013	\$469,750,814
2014	\$487,776,169
2015	\$505,429,489
2016	\$522,587,035
2017	\$538,537,281
2018	\$552,725,311
2019	\$565,406,440
2020	\$577,202,801
2021	\$588,127,400
2022	\$598,876,682
2023	\$609,925,212
2024	\$621,705,412
2025	\$634,560,961
2026	\$649,163,406
2027	\$666,257,044
2028	\$685,923,756
2029	\$707,833,164
2030	\$731,614,311
2031	\$756,751,404
2032	\$782,665,218
2033	\$808,499,605
2034	\$833,631,666
2035	\$857,644,518
2036	\$880,299,629
2037	\$901,237,665
2038	\$920,407,629

OPPORTUNITY COSTS OF INFORMAL CAREGIVING FOR PATIENTS WITH DEMENTIA

Exhibit 115 All-Cause Dementia, Informal Caregiver Opportunity Costs at Average Wages, Long-Term Care (LTC), Community Care (CC), and No Care, Future Values: 2008-2038

Year	Informal Caregiver Opportunity Costs, Long-Term Care (LTC), Community Care (CC), No Care, At Average Wage, Future Values						
	Cost of Unpaid Caregiver LTC Due to Dementia	Incremental Cost of Unpaid Caregiver LTC Due to Comorbid Dementia	Costs of Unpaid Caregiver CC Due to Dementia	Incremental Cost of Unpaid Caregiver CC Due to Comorbid Dementia	Cost of Unpaid Caregiver No Care Due to Dementia	Incremental Cost of Unpaid Caregiver No Care Due to Comorbid Dementia	Total Unpaid Caregiver Opportunity Cost
2008	\$336,476,524	\$628,534,364	\$1,050,987,865	\$1,963,233,516	\$354,293,079	\$661,815,489	\$4,995,340,836
2009	\$369,170,948	\$689,607,180	\$1,184,343,086	\$2,212,339,570	\$390,147,091	\$728,790,381	\$5,574,398,256
2010	\$400,300,396	\$747,756,639	\$1,317,446,655	\$2,460,975,542	\$424,230,730	\$792,458,234	\$6,143,168,196
2011	\$432,332,949	\$807,593,088	\$1,456,615,943	\$2,720,942,206	\$459,908,620	\$859,104,133	\$6,736,496,939
2012	\$466,179,296	\$870,817,685	\$1,604,505,039	\$2,997,197,376	\$498,441,156	\$931,082,476	\$7,368,223,029
2013	\$502,207,065	\$938,117,152	\$1,762,467,953	\$3,292,270,323	\$540,340,473	\$1,009,349,929	\$8,044,752,894
2014	\$541,109,617	\$1,010,786,681	\$1,933,213,614	\$3,611,221,298	\$586,425,561	\$1,095,436,355	\$8,778,193,125
2015	\$582,796,084	\$1,088,656,534	\$2,116,771,527	\$3,954,105,417	\$636,672,854	\$1,189,297,734	\$9,568,300,150
2016	\$627,545,673	\$1,172,248,263	\$2,314,501,639	\$4,323,463,043	\$691,459,262	\$1,291,638,128	\$10,420,856,008
2017	\$675,115,788	\$1,261,108,703	\$2,525,891,328	\$4,718,336,606	\$750,572,434	\$1,402,060,869	\$11,333,085,728
2018	\$725,331,408	\$1,354,910,916	\$2,750,688,306	\$5,138,254,833	\$813,827,595	\$1,520,220,798	\$12,303,233,856
2019	\$778,798,789	\$1,454,787,382	\$2,991,692,448	\$5,588,447,860	\$881,864,540	\$1,647,313,048	\$13,342,904,067
2020	\$836,377,385	\$1,562,343,553	\$3,252,904,574	\$6,076,389,176	\$955,577,934	\$1,785,008,838	\$14,468,601,459
2021	\$897,777,442	\$1,677,038,170	\$3,534,059,043	\$6,601,582,564	\$1,034,513,139	\$1,932,458,914	\$15,677,429,272
2022	\$963,419,568	\$1,799,656,922	\$3,837,747,511	\$7,168,869,208	\$1,118,975,215	\$2,090,233,123	\$16,978,901,547
2023	\$1,033,256,279	\$1,930,111,114	\$4,164,818,057	\$7,779,833,311	\$1,208,692,828	\$2,257,824,615	\$18,374,536,203
2024	\$1,107,131,839	\$2,068,109,829	\$4,515,707,798	\$8,435,291,403	\$1,303,234,731	\$2,434,427,827	\$19,863,903,427
2025	\$1,184,835,519	\$2,213,259,429	\$4,890,609,093	\$9,135,602,807	\$1,402,084,851	\$2,619,078,740	\$21,445,470,439
2026	\$1,267,039,277	\$2,366,815,126	\$5,293,344,806	\$9,887,908,591	\$1,505,771,783	\$2,812,764,763	\$23,133,644,345
2027	\$1,355,052,641	\$2,531,223,101	\$5,730,531,406	\$10,704,568,245	\$1,615,609,382	\$3,017,940,163	\$24,954,924,939
2028	\$1,449,381,353	\$2,707,428,073	\$6,205,563,971	\$11,591,923,737	\$1,731,985,851	\$3,235,330,099	\$26,921,613,083
2029	\$1,550,049,912	\$2,895,475,810	\$6,719,800,048	\$12,552,510,948	\$1,854,736,714	\$3,464,627,331	\$29,037,200,763
2030	\$1,657,291,122	\$3,095,801,185	\$7,275,450,373	\$13,590,459,507	\$1,983,969,800	\$3,706,033,284	\$31,309,005,272
2031	\$1,771,260,177	\$3,308,694,098	\$7,874,359,603	\$14,709,215,217	\$2,119,726,675	\$3,959,625,600	\$33,742,881,371
2032	\$1,892,123,740	\$3,534,465,876	\$8,518,383,839	\$15,912,245,250	\$2,262,090,221	\$4,225,559,104	\$36,344,868,030
2033	\$2,019,432,056	\$3,772,276,379	\$9,206,529,899	\$17,197,694,354	\$2,410,435,922	\$4,502,667,205	\$39,109,035,816
2034	\$2,153,239,098	\$4,022,226,430	\$9,939,947,245	\$18,567,709,711	\$2,564,775,060	\$4,790,970,979	\$42,038,868,522
2035	\$2,294,036,411	\$4,285,234,227	\$10,721,757,791	\$20,028,123,022	\$2,725,674,049	\$5,091,528,482	\$45,146,353,982
2036	\$2,442,688,620	\$4,562,914,881	\$11,556,870,066	\$21,588,103,364	\$2,894,174,461	\$5,406,285,358	\$48,451,036,751
2037	\$2,599,597,183	\$4,856,018,314	\$12,448,072,428	\$23,252,859,357	\$3,070,802,178	\$5,736,223,948	\$51,963,573,408
2038	\$2,765,867,093	\$5,166,608,637	\$13,401,541,610	\$25,033,929,072	\$3,256,954,147	\$6,083,953,734	\$55,708,854,294

Exhibit 116 All-Cause Dementia, Informal Caregiver Opportunity Costs at Average Wages, Long-Term Care (LTC), Community Care (CC), and No Care, 2008 Present Values: 2008-2038

Year	Informal Caregiver Opportunity Costs, Long-Term Care (LTC), Community Care (CC), No Care, At Average wage, 2008 Present Values						
	Unpaid Caregiver LTC Due to Dementia	Incremental Unpaid Caregiver LTC Due to Comorbid Dementia	Unpaid Caregiver CC Due to Dementia	Incremental Unpaid Caregiver CC Due to Comorbid Dementia	Unpaid Caregiver No Care Due to Dementia	Incremental Unpaid Caregiver No Care Due to Comorbid Dementia	Total Unpaid Caregiver Opportunity Cost
2008	\$336,476,524	\$628,534,364	\$1,050,987,865	\$1,963,233,516	\$354,293,079	\$661,815,489	\$4,995,340,836
2009	\$362,269,700	\$676,715,727	\$1,162,203,086	\$2,170,982,299	\$382,853,718	\$715,166,441	\$5,470,190,971
2010	\$383,863,915	\$717,053,478	\$1,263,351,815	\$2,359,926,988	\$406,811,661	\$759,919,610	\$5,890,927,467
2011	\$402,396,919	\$751,672,920	\$1,355,755,486	\$2,532,536,006	\$428,063,168	\$799,617,186	\$6,270,041,684
2012	\$418,412,709	\$781,590,237	\$1,440,101,064	\$2,690,092,598	\$447,368,890	\$835,680,058	\$6,613,245,557
2013	\$432,619,911	\$808,129,131	\$1,518,255,682	\$2,836,084,545	\$465,469,452	\$869,491,704	\$6,930,050,425
2014	\$445,981,231	\$833,087,926	\$1,593,349,964	\$2,976,359,820	\$483,330,522	\$902,855,982	\$7,234,965,445
2015	\$458,442,120	\$856,364,727	\$1,665,105,949	\$3,110,399,194	\$500,822,948	\$935,531,637	\$7,526,666,575
2016	\$469,960,130	\$877,880,240	\$1,733,297,733	\$3,237,780,679	\$517,824,118	\$967,289,632	\$7,804,032,532
2017	\$479,982,133	\$896,601,228	\$1,795,814,479	\$3,354,561,259	\$533,628,992	\$996,812,959	\$8,057,401,050
2018	\$488,131,763	\$911,824,645	\$1,851,151,510	\$3,457,930,211	\$547,687,711	\$1,023,074,487	\$8,279,800,326
2019	\$494,775,039	\$924,234,210	\$1,900,638,224	\$3,550,370,836	\$560,253,262	\$1,046,546,796	\$8,476,818,368
2020	\$500,596,999	\$935,109,567	\$1,946,961,142	\$3,636,901,526	\$571,942,110	\$1,068,381,432	\$8,659,892,776
2021	\$505,740,501	\$944,717,570	\$1,990,823,902	\$3,718,836,668	\$582,767,141	\$1,088,602,467	\$8,831,488,248
2022	\$510,923,693	\$954,399,716	\$2,035,246,323	\$3,801,817,252	\$593,418,453	\$1,108,499,000	\$9,004,304,437
2023	\$516,645,127	\$965,087,289	\$2,082,477,500	\$3,890,044,560	\$604,366,286	\$1,128,949,427	\$9,187,570,189
2024	\$523,341,273	\$977,595,615	\$2,134,575,292	\$3,987,362,650	\$616,039,120	\$1,150,754,150	\$9,389,668,100
2025	\$531,350,094	\$992,556,002	\$2,193,237,423	\$4,096,942,850	\$628,777,501	\$1,174,549,304	\$9,617,413,174
2026	\$541,263,320	\$1,011,073,796	\$2,261,250,644	\$4,223,990,782	\$643,246,858	\$1,201,577,899	\$9,882,403,299
2027	\$553,713,686	\$1,034,330,940	\$2,341,660,810	\$4,374,196,069	\$660,184,703	\$1,233,217,603	\$10,197,303,811
2028	\$568,771,488	\$1,062,458,746	\$2,435,209,925	\$4,548,944,764	\$679,672,171	\$1,269,619,974	\$10,564,677,067
2029	\$586,162,410	\$1,094,944,793	\$2,541,140,232	\$4,746,821,386	\$701,381,894	\$1,310,173,493	\$10,980,624,206
2030	\$605,577,293	\$1,131,211,576	\$2,658,463,249	\$4,965,979,464	\$724,946,296	\$1,354,191,532	\$11,440,369,410
2031	\$626,584,103	\$1,170,452,060	\$2,785,558,334	\$5,203,391,653	\$749,854,287	\$1,400,719,378	\$11,936,559,815
2032	\$648,693,117	\$1,211,751,449	\$2,920,431,071	\$5,455,332,411	\$775,531,919	\$1,448,684,907	\$12,460,424,875
2033	\$671,177,069	\$1,253,751,220	\$3,059,876,036	\$5,715,814,036	\$801,130,849	\$1,496,503,420	\$12,998,252,630
2034	\$693,490,988	\$1,295,433,370	\$3,201,346,214	\$5,980,078,740	\$826,033,854	\$1,543,021,952	\$13,539,405,118
2035	\$715,249,145	\$1,336,077,361	\$3,342,897,284	\$6,244,494,546	\$849,827,850	\$1,587,468,871	\$14,076,015,057
2036	\$736,202,968	\$1,375,218,869	\$3,483,130,015	\$6,506,447,711	\$872,276,479	\$1,629,402,658	\$14,602,678,700
2037	\$755,991,991	\$1,412,184,541	\$3,620,038,951	\$6,762,192,066	\$893,023,684	\$1,668,158,202	\$15,111,589,436
2038	\$774,503,734	\$1,446,764,268	\$3,752,726,963	\$7,010,051,780	\$912,018,931	\$1,703,641,110	\$15,599,706,786

Exhibit 117 All-Cause Dementia, Informal Caregiver Opportunity Costs at Minimum Wages, Long-Term Care (LTC), Community Care (CC), and No Care, Future Values: 2008-2038

Year	Informal Caregiver Opportunity Costs, Long-Term Care (LTC), Community Care (CC), No Care, At Minimum Wage, Future Values						
	Unpaid Caregiver LTC Due to Dementia	Incremental Unpaid Caregiver LTC Due to Comorbid Dementia	Unpaid Caregiver CC Due to Dementia	Incremental Unpaid Caregiver CC Due to Comorbid Dementia	Unpaid Caregiver No Care Due to Dementia	Incremental Unpaid Caregiver No Care Due to Comorbid Dementia	Total Unpaid Caregiver Opportunity Cost
2008	\$77,600,921	\$144,957,649	\$212,657,296	\$397,241,438	\$80,923,649	\$151,164,467	\$1,064,545,419
2009	\$82,783,895	\$154,639,385	\$228,881,446	\$427,547,968	\$86,020,304	\$160,684,961	\$1,140,557,959
2010	\$85,687,826	\$160,063,896	\$244,033,907	\$455,852,595	\$89,552,324	\$167,282,734	\$1,202,473,282
2011	\$93,403,811	\$174,477,269	\$257,731,589	\$481,439,711	\$95,813,522	\$178,978,582	\$1,281,844,484
2012	\$100,642,531	\$187,999,116	\$281,342,286	\$525,544,228	\$102,791,495	\$192,013,358	\$1,390,333,013
2013	\$106,708,528	\$199,330,331	\$315,902,742	\$590,102,771	\$110,550,120	\$206,506,382	\$1,529,100,875
2014	\$114,079,533	\$213,099,286	\$347,983,436	\$650,029,147	\$118,770,527	\$221,862,008	\$1,665,823,938
2015	\$130,143,646	\$243,106,868	\$406,505,010	\$759,346,790	\$137,034,800	\$255,979,466	\$1,932,116,580
2016	\$142,789,318	\$266,728,840	\$458,084,641	\$855,696,959	\$150,902,549	\$281,884,265	\$2,156,086,571
2017	\$154,829,682	\$289,220,105	\$509,566,937	\$951,865,309	\$164,085,546	\$306,509,955	\$2,376,077,532
2018	\$167,219,352	\$312,363,870	\$563,395,353	\$1,052,416,186	\$177,885,173	\$332,287,504	\$2,605,567,439
2019	\$180,310,569	\$336,818,116	\$620,596,450	\$1,159,267,192	\$192,788,931	\$360,127,557	\$2,849,908,815
2020	\$194,245,524	\$362,848,455	\$681,693,936	\$1,273,396,608	\$208,994,906	\$390,400,134	\$3,111,579,562
2021	\$209,292,398	\$390,955,846	\$747,735,580	\$1,396,761,657	\$226,819,868	\$423,696,963	\$3,395,262,313
2022	\$225,416,046	\$421,074,639	\$818,732,795	\$1,529,383,657	\$246,254,704	\$460,001,018	\$3,700,862,858
2023	\$242,724,459	\$453,406,560	\$895,211,586	\$1,672,245,179	\$267,445,195	\$499,584,618	\$4,030,617,596
2024	\$261,123,805	\$487,776,333	\$976,973,679	\$1,824,975,850	\$290,309,208	\$542,294,338	\$4,383,453,213
2025	\$280,546,390	\$524,057,503	\$1,063,921,494	\$1,987,393,390	\$314,775,276	\$587,996,677	\$4,758,690,729
2026	\$301,226,703	\$562,688,096	\$1,157,137,975	\$2,161,520,730	\$341,090,860	\$637,153,891	\$5,160,818,255
2027	\$323,497,168	\$604,289,073	\$1,258,170,577	\$2,350,248,494	\$369,602,001	\$690,412,383	\$5,596,219,696
2028	\$347,245,711	\$648,651,085	\$1,366,916,552	\$2,553,384,753	\$400,132,855	\$747,443,674	\$6,063,774,630
2029	\$372,635,018	\$696,078,024	\$1,484,378,312	\$2,772,801,999	\$432,801,412	\$808,468,172	\$6,567,162,937
2030	\$399,646,722	\$746,535,583	\$1,610,883,879	\$3,009,112,976	\$467,502,725	\$873,289,835	\$7,106,971,720
2031	\$428,220,586	\$799,911,242	\$1,746,602,323	\$3,262,633,505	\$504,069,995	\$941,597,085	\$7,683,034,736
2032	\$458,275,106	\$856,052,746	\$1,891,608,046	\$3,533,502,564	\$542,303,614	\$1,013,017,054	\$8,294,759,130
2033	\$490,070,182	\$915,445,592	\$2,047,379,668	\$3,824,482,204	\$582,408,032	\$1,087,931,657	\$8,947,717,337
2034	\$524,112,320	\$979,035,922	\$2,216,476,334	\$4,140,352,875	\$624,891,429	\$1,167,290,165	\$9,652,159,045
2035	\$560,597,131	\$1,047,189,139	\$2,400,211,203	\$4,483,567,545	\$669,903,954	\$1,251,373,056	\$10,412,842,029
2036	\$599,534,093	\$1,119,922,945	\$2,599,109,353	\$4,855,107,053	\$717,381,991	\$1,340,061,495	\$11,231,116,931
2037	\$641,013,248	\$1,197,405,542	\$2,814,025,860	\$5,256,568,673	\$767,367,247	\$1,433,433,391	\$12,109,813,962
2038	\$685,094,625	\$1,279,749,057	\$3,045,674,209	\$5,689,285,183	\$819,875,798	\$1,531,518,774	\$13,051,197,647

Exhibit 118 All-Cause Dementia, Informal Caregiver Opportunity Costs at Minimum Wages, Long-Term Care (LTC), Community Care (CC), and No Care, 2008 Present Values: 2008-2038

Year	Informal Caregiver Opportunity Costs, Long-Term Care (LTC), Community Care (CC), No Care, At Minimum Wage, 2008 Present Values						
	Unpaid Caregiver LTC Due to Dementia	Incremental Unpaid Caregiver LTC Due to Comorbid Dementia	Unpaid Caregiver CC Due to Dementia	Incremental Unpaid Caregiver CC Due to Comorbid Dementia	Unpaid Caregiver No Care Due to Dementia	Incremental Unpaid Caregiver No Care Due to Comorbid Dementia	Total Unpaid Caregiver Opportunity Cost
2008	\$77,600,921	\$144,957,649	\$212,657,296	\$397,241,438	\$80,923,649	\$151,164,467	\$1,064,545,419
2009	\$81,236,340	\$151,748,570	\$224,602,757	\$419,555,426	\$84,412,248	\$157,681,131	\$1,119,236,474
2010	\$82,169,453	\$153,491,614	\$234,013,786	\$437,135,121	\$85,875,272	\$160,414,044	\$1,153,099,290
2011	\$86,936,251	\$162,395,939	\$239,885,481	\$448,103,381	\$89,179,106	\$166,585,568	\$1,193,085,727
2012	\$90,330,296	\$168,735,978	\$252,514,835	\$471,694,873	\$92,259,069	\$172,338,904	\$1,247,873,956
2013	\$91,922,709	\$171,710,587	\$272,130,414	\$508,336,554	\$95,232,000	\$177,892,306	\$1,317,224,570
2014	\$94,024,074	\$175,635,914	\$286,807,103	\$535,752,444	\$97,890,379	\$182,858,128	\$1,372,968,042
2015	\$102,374,279	\$191,234,003	\$319,767,109	\$597,321,364	\$107,795,035	\$201,359,913	\$1,519,851,704
2016	\$106,932,912	\$199,749,478	\$343,053,146	\$640,819,421	\$113,008,797	\$211,099,162	\$1,614,662,916
2017	\$110,078,126	\$205,624,702	\$362,283,077	\$676,740,715	\$116,658,700	\$217,917,140	\$1,689,302,460
2018	\$112,534,872	\$210,213,876	\$379,152,431	\$708,252,479	\$119,712,730	\$223,622,034	\$1,753,488,423
2019	\$114,552,269	\$213,982,352	\$394,268,246	\$736,488,652	\$122,479,840	\$228,790,964	\$1,810,562,323
2020	\$116,261,783	\$217,175,704	\$408,014,306	\$762,166,138	\$125,089,732	\$233,666,212	\$1,862,373,875
2021	\$117,899,645	\$220,235,212	\$421,218,165	\$786,830,797	\$127,773,308	\$238,679,103	\$1,912,636,230
2022	\$119,543,346	\$223,305,626	\$434,192,949	\$811,067,548	\$130,594,568	\$243,949,186	\$1,962,653,224
2023	\$121,366,220	\$226,710,734	\$447,620,511	\$836,150,082	\$133,726,994	\$249,800,522	\$2,015,375,064
2024	\$123,433,235	\$230,571,896	\$461,815,505	\$862,666,171	\$137,229,177	\$256,342,559	\$2,072,058,544
2025	\$125,813,540	\$235,018,278	\$477,125,117	\$891,264,355	\$141,163,790	\$263,692,373	\$2,134,077,452
2026	\$128,680,277	\$240,373,311	\$494,314,859	\$923,374,600	\$145,709,746	\$272,184,167	\$2,204,636,960
2027	\$132,190,296	\$246,929,986	\$514,124,873	\$960,379,483	\$151,030,063	\$282,122,461	\$2,286,777,162
2028	\$136,267,422	\$254,546,012	\$536,410,352	\$1,002,008,508	\$157,021,586	\$293,314,558	\$2,379,568,438
2029	\$140,914,585	\$263,226,861	\$561,328,227	\$1,048,554,818	\$163,666,935	\$305,727,995	\$2,483,419,421
2030	\$146,031,664	\$272,785,506	\$588,619,999	\$1,099,535,541	\$170,826,375	\$319,101,748	\$2,596,900,833
2031	\$151,483,230	\$282,968,970	\$617,861,376	\$1,154,158,104	\$178,314,993	\$333,090,402	\$2,717,877,074
2032	\$157,114,411	\$293,487,953	\$648,516,317	\$1,211,421,189	\$185,922,630	\$347,301,382	\$2,843,763,882
2033	\$162,879,394	\$304,256,876	\$680,465,719	\$1,271,102,313	\$193,568,739	\$361,584,228	\$2,973,857,268
2034	\$168,800,191	\$315,316,859	\$713,857,724	\$1,333,478,204	\$201,257,991	\$375,947,664	\$3,108,658,634
2035	\$174,786,510	\$326,499,236	\$748,352,991	\$1,397,914,974	\$208,866,881	\$390,160,986	\$3,246,581,579
2036	\$180,693,837	\$337,534,056	\$783,346,680	\$1,463,282,792	\$216,212,065	\$403,881,708	\$3,384,951,138
2037	\$186,413,836	\$348,218,949	\$818,350,253	\$1,528,669,074	\$223,158,994	\$416,858,493	\$3,521,669,599
2038	\$191,841,591	\$358,357,936	\$852,855,892	\$1,593,125,219	\$229,583,290	\$428,859,005	\$3,654,622,933

INDIRECT COSTS

Exhibit 119 Lost Production due to Disability Attributed to All-Cause Dementia and Labour Force Effects of Informal Care, Difference Between the “Absence of” Case and the Base Case, Future and 2008 Present Values: 2008-2038

Year	Lost Production From Dementia (Including Informal Care giving)	
	Future Values	2008 Present Values
2008	\$2,909,240,693	\$2,909,240,693
2009	\$5,932,398,817	\$5,821,499,104
2010	\$9,289,968,781	\$8,908,519,270
2011	\$8,560,259,707	\$7,967,521,647
2012	\$8,248,802,703	\$7,403,597,531
2013	\$8,111,936,176	\$6,987,924,612
2014	\$7,955,951,207	\$6,557,275,654
2015	\$7,888,834,734	\$6,205,556,659
2016	\$7,841,859,541	\$5,872,658,343
2017	\$7,828,277,882	\$5,565,613,456
2018	\$7,821,560,906	\$5,263,734,990
2019	\$7,803,769,193	\$4,957,776,336
2020	\$7,775,488,782	\$4,653,863,700
2021	\$7,749,471,692	\$4,365,471,341
2022	\$7,714,963,254	\$4,091,423,563
2023	\$7,676,694,107	\$3,838,473,263
2024	\$7,631,504,446	\$3,607,412,517
2025	\$7,548,615,496	\$3,385,244,186
2026	\$7,432,980,802	\$3,175,276,360
2027	\$7,318,462,557	\$2,990,535,387
2028	\$7,186,325,477	\$2,820,083,913
2029	\$7,050,667,640	\$2,666,260,167
2030	\$6,911,649,406	\$2,525,529,692
2031	\$6,825,221,316	\$2,414,425,182
2032	\$6,806,822,125	\$2,333,641,593
2033	\$6,794,570,856	\$2,258,238,963
2034	\$6,829,570,465	\$2,199,591,106
2035	\$6,877,908,109	\$2,144,437,580
2036	\$6,872,007,707	\$2,071,157,344
2037	\$6,842,540,769	\$1,989,887,531
2038	\$6,765,521,872	\$1,894,495,207

Exhibit 120 Wage Impact due to Disability Attributed to All-Cause Dementia and Labour Force Effects of Informal Care, Difference Between the “Absence of” Case and the Base Case, Future and 2008 Present Values: 2008-2038

Year	Wage Impact of Dementia (Including Informal Care giving)	
	Future Values	2008 Present Values
2008	\$1,487,257,049	\$1,487,257,049
2009	\$3,029,298,529	\$2,972,669,103
2010	\$4,737,699,950	\$4,543,168,260
2011	\$4,360,734,628	\$4,058,784,282
2012	\$4,195,776,476	\$3,765,860,510
2013	\$4,120,210,870	\$3,549,303,436
2014	\$4,035,277,569	\$3,325,865,968
2015	\$3,995,648,655	\$3,143,078,154
2016	\$3,966,172,550	\$2,970,210,853
2017	\$3,953,838,843	\$2,811,031,877
2018	\$3,945,147,720	\$2,654,995,895
2019	\$3,931,194,942	\$2,497,509,187
2020	\$3,912,425,716	\$2,341,704,365
2021	\$3,894,936,107	\$2,194,114,983
2022	\$3,873,431,638	\$2,054,170,441
2023	\$3,850,310,949	\$1,925,218,776
2024	\$3,823,954,522	\$1,807,583,485
2025	\$3,778,902,629	\$1,694,682,708
2026	\$3,717,659,237	\$1,588,137,492
2027	\$3,657,212,807	\$1,494,442,888
2028	\$3,588,194,528	\$1,408,092,313
2029	\$3,517,638,414	\$1,330,220,011
2030	\$3,445,689,161	\$1,259,061,300
2031	\$3,400,187,464	\$1,202,817,880
2032	\$3,389,001,427	\$1,161,880,617
2033	\$3,381,054,185	\$1,123,724,877
2034	\$3,396,820,816	\$1,094,009,776
2035	\$3,419,412,325	\$1,066,125,947
2036	\$3,415,162,938	\$1,029,297,419
2037	\$3,399,443,811	\$988,596,353
2038	\$3,360,464,928	\$941,004,230

Exhibit 121 Corporate Profits Impact due to Disability Attributed to All-Cause Dementia and Labour Force Effects of Informal Care, Difference Between the “Absence of” Case and the Base Case, Future and 2008 Present Values: 2008-2038

Year	Corporate Profits Impact of Dementia (Including Informal Care giving)	
	Future Values	2008 Present Values
2008	\$377,698,616	\$377,698,616
2009	\$756,738,083	\$742,591,691
2010	\$1,166,053,084	\$1,118,174,519
2011	\$1,058,711,914	\$985,403,526
2012	\$1,006,529,125	\$903,396,143
2013	\$977,740,202	\$842,261,906
2014	\$948,279,236	\$781,569,442
2015	\$930,782,567	\$732,177,077
2016	\$916,764,843	\$686,552,300
2017	\$907,588,354	\$645,261,452
2018	\$900,015,676	\$605,690,356
2019	\$891,901,604	\$566,629,863
2020	\$883,266,242	\$528,661,389
2021	\$875,504,412	\$493,193,546
2022	\$867,342,143	\$459,971,611
2023	\$859,266,733	\$429,647,493
2024	\$850,880,019	\$402,211,026
2025	\$838,723,867	\$376,133,225
2026	\$823,342,833	\$351,721,752
2027	\$808,464,025	\$330,361,774
2028	\$791,979,523	\$310,791,478
2029	\$775,414,158	\$293,228,385
2030	\$758,752,232	\$277,249,492
2031	\$748,096,133	\$264,639,351
2032	\$745,083,933	\$255,443,557
2033	\$742,902,286	\$246,910,500
2034	\$746,023,414	\$240,270,816
2035	\$750,719,872	\$234,064,178
2036	\$749,607,503	\$225,924,526
2037	\$746,030,368	\$216,953,991
2038	\$737,367,003	\$206,479,009

Exhibit 122 Domestic Demand Impact due to Disability Attributed to Dementia and Labour Force Effects of Informal Care, Difference Between the “Absence of” Case and the Base Case, Future and 2008 Present Values: 2008-2038

Year	Domestic Demand Impact of Dementia (Including Informal Care giving)	
	Future Values	2008 Present Values
2008	\$2,831,535,079	\$2,831,535,079
2009	\$5,766,632,691	\$5,658,831,794
2010	\$9,019,559,046	\$8,649,212,658
2011	\$8,301,638,014	\$7,726,807,697
2012	\$7,990,938,253	\$7,172,154,899
2013	\$7,850,247,271	\$6,762,496,021
2014	\$7,691,707,667	\$6,339,486,771
2015	\$7,619,621,499	\$5,993,786,729
2016	\$7,567,384,972	\$5,667,108,198
2017	\$7,547,689,887	\$5,366,125,862
2018	\$7,534,869,269	\$5,070,797,951
2019	\$7,511,615,595	\$4,772,169,591
2020	\$7,478,496,937	\$4,476,105,156
2021	\$7,447,772,467	\$4,195,516,617
2022	\$7,409,090,749	\$3,929,212,295
2023	\$7,366,992,936	\$3,683,617,585
2024	\$7,318,441,302	\$3,459,427,553
2025	\$7,233,940,031	\$3,244,125,157
2026	\$7,118,293,673	\$3,040,845,957
2027	\$7,003,958,872	\$2,862,020,089
2028	\$6,873,002,329	\$2,697,128,506
2029	\$6,738,919,877	\$2,548,370,531
2030	\$6,601,860,348	\$2,412,332,188
2031	\$6,515,229,395	\$2,304,765,397
2032	\$6,493,653,690	\$2,226,275,355
2033	\$6,478,009,740	\$2,153,026,925
2034	\$6,507,446,494	\$2,095,845,047
2035	\$6,549,585,043	\$2,042,070,944
2036	\$6,540,087,679	\$1,971,119,824
2037	\$6,508,215,826	\$1,892,662,091
2038	\$6,431,205,503	\$1,800,879,257

Exhibit 123 Total Taxation Revenue (Provincial + Federal) Impact Attributed All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, Future Values: 2008-2038

Year	Total Taxation Revenue Impact of Dementia (Including Informal Care) , Future Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$339,689,660	\$108,156,885	\$128,911,100	\$576,757,645
2009	\$697,729,091	\$224,232,489	\$255,225,448	\$1,177,187,028
2010	\$1,091,677,358	\$350,097,242	\$393,782,999	\$1,835,557,599
2011	\$1,004,535,165	\$318,822,019	\$360,513,130	\$1,683,870,313
2012	\$951,883,621	\$303,779,711	\$344,214,766	\$1,599,878,099
2013	\$923,200,368	\$293,367,032	\$335,230,348	\$1,551,797,748
2014	\$892,921,917	\$281,582,878	\$326,061,188	\$1,500,565,983
2015	\$872,651,100	\$272,793,779	\$320,753,408	\$1,466,198,287
2016	\$853,529,147	\$264,505,353	\$316,071,431	\$1,434,105,931
2017	\$838,657,162	\$257,742,510	\$313,000,551	\$1,409,400,223
2018	\$824,874,443	\$251,550,110	\$310,364,315	\$1,386,788,867
2019	\$811,178,197	\$245,612,273	\$307,717,979	\$1,364,508,449
2020	\$798,052,201	\$240,073,242	\$305,267,539	\$1,343,392,983
2021	\$785,188,961	\$234,804,405	\$302,964,197	\$1,322,957,563
2022	\$772,151,546	\$229,663,630	\$300,590,728	\$1,302,405,904
2023	\$759,536,938	\$224,805,213	\$298,373,794	\$1,282,715,946
2024	\$746,811,821	\$220,053,619	\$296,130,302	\$1,262,995,742
2025	\$730,466,100	\$214,369,151	\$292,606,026	\$1,237,441,277
2026	\$710,981,621	\$207,886,140	\$288,000,091	\$1,206,867,852
2027	\$692,043,209	\$201,659,195	\$283,647,468	\$1,177,349,872
2028	\$671,576,309	\$195,067,993	\$278,818,133	\$1,145,462,435
2029	\$651,079,336	\$188,535,616	\$274,078,470	\$1,113,693,421
2030	\$630,727,569	\$182,093,511	\$269,458,636	\$1,082,279,715
2031	\$616,710,386	\$177,520,500	\$267,241,722	\$1,061,472,608
2032	\$610,932,537	\$175,328,366	\$268,100,592	\$1,054,361,495
2033	\$606,316,039	\$173,481,290	\$269,524,339	\$1,049,321,667
2034	\$607,399,958	\$173,282,620	\$273,131,063	\$1,053,813,641
2035	\$610,640,027	\$173,698,900	\$277,632,303	\$1,061,971,230
2036	\$608,632,935	\$172,586,450	\$286,036,622	\$1,067,256,007
2037	\$604,884,338	\$170,944,754	\$295,606,805	\$1,071,435,897
2038	\$611,845,032	\$168,068,630	\$304,910,116	\$1,084,823,778

Exhibit 124 Total Taxation Revenue (Provincial + Federal) Impact Attributed All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, 2008 Present Values: 2008-2038

Year	Total Taxation Revenue Impact of Dementia (Including Informal Care), 2008 Present Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$339,689,660	\$108,156,885	\$128,911,100	\$576,757,645
2009	\$684,685,808	\$220,040,707	\$250,454,287	\$1,155,180,803
2010	\$1,046,852,687	\$335,722,121	\$377,614,125	\$1,760,188,933
2011	\$934,978,137	\$296,745,826	\$335,550,119	\$1,567,274,082
2012	\$854,349,835	\$272,653,233	\$308,945,150	\$1,435,948,218
2013	\$795,279,257	\$252,717,312	\$288,779,934	\$1,336,776,503
2014	\$735,944,074	\$232,079,924	\$268,738,839	\$1,236,762,837
2015	\$686,449,397	\$214,586,476	\$252,312,733	\$1,153,348,606
2016	\$639,195,977	\$198,084,340	\$236,701,450	\$1,073,981,766
2017	\$596,253,947	\$183,245,307	\$222,531,712	\$1,002,030,966
2018	\$555,121,992	\$169,287,579	\$208,868,220	\$933,277,791
2019	\$515,345,850	\$156,038,792	\$195,494,879	\$866,879,521
2020	\$477,658,225	\$143,691,050	\$182,711,796	\$804,061,071
2021	\$442,316,592	\$132,271,198	\$170,667,314	\$745,255,103
2022	\$409,489,835	\$121,795,938	\$159,410,220	\$690,695,993
2023	\$379,780,956	\$112,406,302	\$149,191,803	\$641,379,061
2024	\$353,017,983	\$104,019,356	\$139,980,808	\$597,018,148
2025	\$327,584,061	\$96,135,765	\$131,221,791	\$554,941,617
2026	\$303,722,449	\$88,806,357	\$123,030,034	\$515,558,840
2027	\$282,788,863	\$82,403,777	\$115,906,556	\$481,099,197
2028	\$263,542,411	\$76,549,290	\$109,414,823	\$449,506,524
2029	\$246,210,286	\$71,296,085	\$103,644,725	\$421,151,097
2030	\$230,469,040	\$66,537,311	\$98,460,692	\$395,467,043
2031	\$218,161,583	\$62,797,959	\$94,536,882	\$375,496,424
2032	\$209,451,276	\$60,109,337	\$91,915,240	\$361,475,854
2033	\$201,514,788	\$57,658,124	\$89,578,927	\$348,751,838
2034	\$195,624,535	\$55,808,914	\$87,966,975	\$339,400,424
2035	\$190,389,200	\$54,156,939	\$86,561,951	\$331,108,090
2036	\$183,436,141	\$52,015,904	\$86,208,700	\$321,660,745
2037	\$175,907,144	\$49,712,650	\$85,965,771	\$311,585,565
2038	\$171,330,091	\$47,062,920	\$85,381,551	\$303,774,563

Exhibit 125 Provincial Taxation Revenue Impact Attributed to All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, Future Values: 2008-2038

Year	Provincial Taxation Revenue Impact of Dementia (Including Informal Care) Future Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$135,801,221	\$38,096,902	\$66,561,478	\$240,459,601
2009	\$287,168,940	\$79,089,758	\$134,198,645	\$500,457,342
2010	\$453,841,266	\$123,073,432	\$208,978,320	\$785,893,018
2011	\$419,216,378	\$112,109,111	\$191,700,773	\$723,026,262
2012	\$404,432,860	\$106,986,046	\$189,929,265	\$701,348,171
2013	\$401,074,612	\$104,984,494	\$189,752,378	\$695,811,484
2014	\$397,929,775	\$103,165,156	\$189,076,917	\$690,171,849
2015	\$399,791,438	\$102,753,320	\$190,521,516	\$693,066,274
2016	\$402,951,370	\$102,769,275	\$192,513,452	\$698,234,096
2017	\$408,261,795	\$103,406,122	\$195,485,836	\$707,153,753
2018	\$414,242,036	\$104,276,264	\$198,767,011	\$717,285,311
2019	\$420,113,770	\$105,173,650	\$201,983,883	\$727,271,302
2020	\$426,280,588	\$106,192,539	\$205,360,607	\$737,833,734
2021	\$432,833,987	\$107,358,366	\$208,940,021	\$749,132,374
2022	\$439,313,091	\$108,549,972	\$212,499,537	\$760,362,599
2023	\$446,042,448	\$109,843,830	\$216,191,957	\$772,078,235
2024	\$452,832,043	\$111,190,765	\$219,931,041	\$783,953,849
2025	\$458,236,919	\$112,236,029	\$223,053,504	\$793,526,452
2026	\$462,589,280	\$113,061,027	\$225,721,878	\$801,372,185
2027	\$467,502,479	\$114,056,679	\$228,675,955	\$810,235,112
2028	\$472,197,082	\$115,030,346	\$231,559,709	\$818,787,137
2029	\$477,438,583	\$116,166,268	\$234,733,717	\$828,338,567
2030	\$483,163,520	\$117,444,685	\$238,151,538	\$838,759,743
2031	\$492,241,953	\$119,559,983	\$243,151,367	\$854,953,303
2032	\$505,515,865	\$122,707,211	\$250,103,261	\$878,326,336
2033	\$520,113,977	\$126,194,232	\$257,707,911	\$904,016,121
2034	\$537,871,060	\$130,463,261	\$266,802,508	\$935,136,829
2035	\$557,248,432	\$135,141,107	\$276,670,553	\$969,060,091
2036	\$575,434,536	\$139,550,061	\$286,036,622	\$1,001,021,219
2037	\$593,968,947	\$144,060,563	\$295,606,805	\$1,033,636,315
2038	\$611,845,032	\$148,427,125	\$304,910,116	\$1,065,182,273

Exhibit 126 Provincial Taxation Revenue Impact Attributed to All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, 2008 Present Values: 2008-2038

Year	Provincial Taxation Revenue Impact of Dementia (Including Informal Care), 2008 Present Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$135,801,221	\$38,096,902	\$66,561,478	\$240,459,601
2009	\$281,800,630	\$77,611,261	\$131,689,947	\$491,101,839
2010	\$435,206,378	\$118,019,992	\$200,397,594	\$753,623,963
2011	\$390,188,579	\$104,346,340	\$178,426,836	\$672,961,755
2012	\$362,993,059	\$96,023,829	\$170,468,357	\$629,485,245
2013	\$345,500,641	\$90,437,562	\$163,459,781	\$599,397,985
2014	\$327,972,754	\$85,028,471	\$155,836,736	\$568,837,961
2015	\$314,486,043	\$80,828,357	\$149,869,036	\$545,183,436
2016	\$301,764,615	\$76,962,465	\$144,170,617	\$522,897,697
2017	\$290,258,902	\$73,517,894	\$138,983,134	\$502,759,930
2018	\$278,775,595	\$70,175,586	\$133,765,738	\$482,716,920
2019	\$266,900,526	\$66,817,382	\$128,321,442	\$462,039,350
2020	\$255,141,742	\$63,559,426	\$122,914,495	\$441,615,663
2021	\$243,826,217	\$60,477,655	\$117,701,143	\$422,005,014
2022	\$232,977,899	\$57,566,562	\$112,693,422	\$403,237,884
2023	\$223,028,557	\$54,923,721	\$108,099,533	\$386,051,811
2024	\$214,053,728	\$52,559,880	\$103,961,414	\$370,575,022
2025	\$205,500,448	\$50,333,252	\$100,030,341	\$355,864,040
2026	\$197,612,350	\$48,298,255	\$96,425,561	\$342,336,166
2027	\$191,035,029	\$46,606,856	\$93,443,606	\$331,085,492
2028	\$185,301,292	\$45,140,626	\$90,869,501	\$321,311,419
2029	\$180,546,799	\$43,929,101	\$88,766,226	\$313,242,127
2030	\$176,548,859	\$42,914,509	\$87,021,020	\$306,484,388
2031	\$174,130,817	\$42,294,399	\$86,014,908	\$302,440,124
2032	\$173,310,368	\$42,068,772	\$85,745,060	\$301,124,201
2033	\$172,864,729	\$41,941,829	\$85,651,627	\$300,458,185
2034	\$173,231,451	\$42,018,137	\$85,928,746	\$301,178,334
2035	\$173,742,432	\$42,135,147	\$86,262,090	\$302,139,669
2036	\$173,430,461	\$42,059,053	\$86,208,700	\$301,698,214
2037	\$172,732,826	\$41,894,426	\$85,965,771	\$300,593,023
2038	\$171,330,091	\$41,562,866	\$85,381,551	\$298,274,508

Exhibit 127 Federal Taxation Revenue Impact Attributed to All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, Future Values: 2008-2038

Year	Federal Taxation Revenue Impact of Dementia (Including Informal Care) Future Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$203,888,438	\$70,059,983	\$62,349,622	\$336,298,044
2009	\$410,560,151	\$145,142,731	\$121,026,804	\$676,729,686
2010	\$637,836,092	\$227,023,810	\$184,804,679	\$1,049,664,581
2011	\$585,318,787	\$206,712,907	\$168,812,357	\$960,844,051
2012	\$547,450,761	\$196,793,666	\$154,285,501	\$898,529,928
2013	\$522,125,756	\$188,382,538	\$145,477,970	\$855,986,263
2014	\$494,992,141	\$178,417,722	\$136,984,271	\$810,394,134
2015	\$472,859,662	\$170,040,459	\$130,231,893	\$773,132,013
2016	\$450,577,778	\$161,736,078	\$123,557,979	\$735,871,835
2017	\$430,395,367	\$154,336,389	\$117,514,715	\$702,246,470
2018	\$410,632,407	\$147,273,845	\$111,597,304	\$669,503,556
2019	\$391,064,427	\$140,438,624	\$105,734,096	\$637,237,147
2020	\$371,771,614	\$133,880,703	\$99,906,932	\$605,559,249
2021	\$352,354,974	\$127,446,039	\$94,024,176	\$573,825,189
2022	\$332,838,455	\$121,113,658	\$88,091,191	\$542,043,305
2023	\$313,494,490	\$114,961,383	\$82,181,837	\$510,637,711
2024	\$293,979,778	\$108,862,855	\$76,199,260	\$479,041,893
2025	\$272,229,181	\$102,133,123	\$69,552,521	\$443,914,825
2026	\$248,392,342	\$94,825,113	\$62,278,212	\$405,495,667
2027	\$224,540,730	\$87,602,517	\$54,971,513	\$367,114,760
2028	\$199,379,227	\$80,037,647	\$47,258,423	\$326,675,298
2029	\$173,640,753	\$72,369,348	\$39,344,753	\$285,354,854
2030	\$147,564,049	\$64,648,825	\$31,307,098	\$243,519,972
2031	\$124,468,433	\$57,960,517	\$24,090,355	\$206,519,305
2032	\$105,416,672	\$52,621,155	\$17,997,331	\$176,035,158
2033	\$86,202,061	\$47,287,058	\$11,816,428	\$145,305,547
2034	\$69,528,898	\$42,819,358	\$6,328,555	\$118,676,811
2035	\$53,391,596	\$38,557,793	\$961,750	\$92,911,139
2036	\$33,198,399	\$33,036,389	\$0	\$66,234,788
2037	\$10,915,391	\$26,884,191	\$0	\$37,799,582
2038	\$0	\$19,641,505	\$0	\$19,641,505

Exhibit 128 Federal Taxation Revenue Impact Attributed to All-Cause Dementia and Informal Care, Difference Between the “Absence of” Case and the Base Case, 2008 Present Values: 2008-2038

Year	Federal Taxation Revenue Impact of Dementia (Including Informal Care), 2008 Present Values			
	Personal Income Tax Revenue Impact	Corporate Income Tax Revenue Impact	GST Revenue Impact	Total Tax Revenue Impact
2008	\$203,888,438	\$70,059,983	\$62,349,622	\$336,298,044
2009	\$402,885,178	\$142,429,446	\$118,764,340	\$664,078,964
2010	\$611,646,309	\$217,702,130	\$177,216,531	\$1,006,564,970
2011	\$544,789,559	\$192,399,485	\$157,123,283	\$894,312,327
2012	\$491,356,776	\$176,629,403	\$138,476,794	\$806,462,973
2013	\$449,778,615	\$162,279,750	\$125,320,153	\$737,378,518
2014	\$407,971,320	\$147,051,453	\$112,902,103	\$667,924,876
2015	\$371,963,353	\$133,758,120	\$102,443,696	\$608,165,169
2016	\$337,431,362	\$121,121,875	\$92,530,833	\$551,084,070
2017	\$305,995,045	\$109,727,413	\$83,548,577	\$499,271,036
2018	\$276,346,396	\$99,111,993	\$75,102,482	\$450,560,871
2019	\$248,445,324	\$89,221,409	\$67,173,437	\$404,840,170
2020	\$222,516,483	\$80,131,624	\$59,797,301	\$362,445,408
2021	\$198,490,375	\$71,793,543	\$52,966,171	\$323,250,090
2022	\$176,511,936	\$64,229,376	\$46,716,797	\$287,458,109
2023	\$156,752,399	\$57,482,582	\$41,092,270	\$255,327,250
2024	\$138,964,255	\$51,459,477	\$36,019,394	\$226,443,126
2025	\$122,083,613	\$45,802,513	\$31,191,451	\$199,077,577
2026	\$106,110,099	\$40,508,101	\$26,604,473	\$173,222,673
2027	\$91,753,834	\$35,796,921	\$22,462,950	\$150,013,705
2028	\$78,241,119	\$31,408,664	\$18,545,322	\$128,195,105
2029	\$65,663,487	\$27,366,984	\$14,878,499	\$107,908,970
2030	\$53,920,181	\$23,622,802	\$11,439,672	\$88,982,656
2031	\$44,030,765	\$20,503,560	\$8,521,974	\$73,056,299
2032	\$36,140,908	\$18,040,565	\$6,170,180	\$60,351,653
2033	\$28,650,059	\$15,716,294	\$3,927,300	\$48,293,653
2034	\$22,393,084	\$13,790,777	\$2,038,230	\$38,222,090
2035	\$16,646,768	\$12,021,792	\$299,861	\$28,968,421
2036	\$10,005,680	\$9,956,851	\$0	\$19,962,531
2037	\$3,174,318	\$7,818,224	\$0	\$10,992,542
2038	\$0	\$5,500,054	\$0	\$5,500,054

TOTAL ECONOMIC BURDEN OF DEMENTIA

Exhibit 129 Total Economic Burden Attributed to All-Cause Dementia and Informal Care, Future Values: 2008-2038

Year	Total Economic Burden of Dementia (Including Informal Care) , Future Values				
	Total Direct Costs	Total Unpaid Caregiver Opportunity Cost	Total Indirect Costs	Monetary Economic Burden	Total Economic Burden
2008	\$8,063,733,967	\$4,995,340,836	\$1,864,955,665	\$9,928,689,632	\$14,924,030,467
2009	\$8,972,025,107	\$5,574,398,256	\$3,786,036,612	\$12,758,061,719	\$18,332,459,975
2010	\$9,864,274,990	\$6,143,168,196	\$5,903,753,034	\$15,768,028,025	\$21,911,196,220
2011	\$10,794,033,564	\$6,736,496,939	\$5,419,446,542	\$16,213,480,106	\$22,949,977,045
2012	\$11,784,664,412	\$7,368,223,029	\$5,202,305,601	\$16,986,970,013	\$24,355,193,042
2013	\$12,844,465,607	\$8,044,752,894	\$5,097,951,072	\$17,942,416,679	\$25,987,169,573
2014	\$13,988,645,669	\$8,778,193,125	\$4,983,556,805	\$18,972,202,474	\$27,750,395,599
2015	\$15,226,012,739	\$9,568,300,150	\$4,926,431,222	\$20,152,443,961	\$29,720,744,111
2016	\$16,567,055,510	\$10,420,856,008	\$4,882,937,394	\$21,449,992,904	\$31,870,848,912
2017	\$18,017,779,006	\$11,333,085,728	\$4,861,427,197	\$22,879,206,203	\$34,212,291,931
2018	\$19,573,547,540	\$12,303,233,856	\$4,845,163,396	\$24,418,710,937	\$36,721,944,792
2019	\$21,244,333,904	\$13,342,904,067	\$4,823,096,546	\$26,067,430,450	\$39,410,334,517
2020	\$23,059,413,629	\$14,468,601,459	\$4,795,691,957	\$27,855,105,586	\$42,323,707,045
2021	\$25,028,924,864	\$15,677,429,272	\$4,770,440,519	\$29,799,365,383	\$45,476,794,655
2022	\$27,162,633,658	\$16,978,901,547	\$4,740,773,781	\$31,903,407,438	\$48,882,308,986
2023	\$29,459,593,571	\$18,374,536,203	\$4,709,577,682	\$34,169,171,253	\$52,543,707,456
2024	\$31,936,614,333	\$19,863,903,427	\$4,674,834,541	\$36,611,448,874	\$56,475,352,301
2025	\$34,594,469,306	\$21,445,470,439	\$4,617,626,496	\$39,212,095,802	\$60,657,566,241
2026	\$37,442,729,097	\$23,133,644,345	\$4,541,002,069	\$41,983,731,166	\$65,117,375,511
2027	\$40,516,236,458	\$24,954,924,939	\$4,465,676,832	\$44,981,913,290	\$69,936,838,229
2028	\$43,842,755,134	\$26,921,613,083	\$4,380,174,051	\$48,222,929,184	\$75,144,542,267
2029	\$47,413,989,177	\$29,037,200,763	\$4,293,052,571	\$51,707,041,748	\$80,744,242,511
2030	\$51,249,680,461	\$31,309,005,272	\$4,204,441,393	\$55,454,121,854	\$86,763,127,126
2031	\$55,350,834,484	\$33,742,881,371	\$4,148,283,597	\$59,499,118,081	\$93,241,999,453
2032	\$59,742,379,017	\$36,344,868,030	\$4,134,085,361	\$63,876,464,378	\$100,221,332,408
2033	\$64,433,589,743	\$39,109,035,816	\$4,123,956,470	\$68,557,546,213	\$107,666,582,029
2034	\$69,424,632,616	\$42,038,868,522	\$4,142,844,230	\$73,567,476,847	\$115,606,345,369
2035	\$74,746,499,454	\$45,146,353,982	\$4,170,132,198	\$78,916,631,651	\$124,062,985,633
2036	\$80,405,359,757	\$48,451,036,751	\$4,164,770,441	\$84,570,130,198	\$133,021,166,949
2037	\$86,425,445,561	\$51,963,573,408	\$4,145,474,179	\$90,570,919,740	\$142,534,493,148
2038	\$92,832,808,780	\$55,708,854,294	\$4,097,831,931	\$96,930,640,711	\$152,639,495,005

Exhibit 130 Total Economic Burden Attributed to All-Cause Dementia and Informal Care, 2008 Present
Values: 2008-2038

Year	Total Economic Burden of Dementia (Including Informal Care), 2008 Present Values				
	Total Direct Costs	Total Unpaid Caregiver Opportunity Cost	Total Indirect Costs	Monetary Economic Burden	Total Economic Burden
2008	\$8,063,733,967	\$4,995,340,836	\$1,864,955,665	\$9,928,689,632	\$14,924,030,467
2009	\$8,804,302,901	\$5,470,190,971	\$3,715,260,795	\$12,519,563,696	\$17,989,754,667
2010	\$9,459,244,257	\$5,890,927,467	\$5,661,342,779	\$15,120,587,036	\$21,011,514,503
2011	\$10,046,622,302	\$6,270,041,684	\$5,044,187,807	\$15,090,810,109	\$21,360,851,794
2012	\$10,577,160,769	\$6,613,245,557	\$4,669,256,653	\$15,246,417,422	\$21,859,662,979
2013	\$11,064,702,112	\$6,930,050,425	\$4,391,565,342	\$15,456,267,454	\$22,386,317,879
2014	\$11,529,407,773	\$7,234,965,445	\$4,107,435,411	\$15,636,843,183	\$22,871,808,628
2015	\$11,977,166,201	\$7,526,666,575	\$3,875,255,231	\$15,852,421,432	\$23,379,088,008
2016	\$12,406,834,915	\$7,804,032,532	\$3,656,763,153	\$16,063,598,069	\$23,867,630,601
2017	\$12,809,968,527	\$8,057,401,050	\$3,456,293,329	\$16,266,261,856	\$24,323,662,906
2018	\$13,172,558,305	\$8,279,800,326	\$3,260,686,250	\$16,433,244,556	\$24,713,044,882
2019	\$13,496,639,034	\$8,476,818,368	\$3,064,139,050	\$16,560,778,084	\$25,037,596,452
2020	\$13,801,752,025	\$8,659,892,776	\$2,870,365,754	\$16,672,117,779	\$25,332,010,555
2021	\$14,099,419,744	\$8,831,488,248	\$2,687,308,528	\$16,786,728,272	\$25,618,216,521
2022	\$14,404,973,260	\$9,004,304,437	\$2,514,142,053	\$16,919,115,313	\$25,923,419,750
2023	\$14,730,281,117	\$9,187,570,189	\$2,354,866,269	\$17,085,147,386	\$26,272,717,575
2024	\$15,096,439,123	\$9,389,668,100	\$2,209,794,511	\$17,306,233,634	\$26,695,901,734
2025	\$15,514,199,412	\$9,617,413,174	\$2,070,815,934	\$17,585,015,346	\$27,202,428,520
2026	\$15,995,065,197	\$9,882,403,299	\$1,939,859,244	\$17,934,924,441	\$27,817,327,740
2027	\$16,556,105,596	\$10,197,303,811	\$1,824,804,662	\$18,380,910,258	\$28,578,214,069
2028	\$17,204,933,014	\$10,564,677,067	\$1,718,883,791	\$18,923,816,805	\$29,488,493,872
2029	\$17,929,937,583	\$10,980,624,206	\$1,623,448,395	\$19,553,385,979	\$30,534,010,185
2030	\$18,726,729,627	\$11,440,369,410	\$1,536,310,792	\$20,263,040,420	\$31,703,409,830
2031	\$19,580,383,173	\$11,936,559,815	\$1,467,457,232	\$21,047,840,405	\$32,984,400,220
2032	\$20,481,995,559	\$12,460,424,875	\$1,417,324,174	\$21,899,319,733	\$34,359,744,608
2033	\$21,415,104,204	\$12,998,252,630	\$1,370,635,377	\$22,785,739,581	\$35,783,992,210
2034	\$22,359,503,459	\$13,539,405,118	\$1,334,280,592	\$23,693,784,051	\$37,233,189,168
2035	\$23,304,935,149	\$14,076,015,057	\$1,300,190,124	\$24,605,125,274	\$38,681,140,331
2036	\$24,233,405,785	\$14,602,678,700	\$1,255,221,945	\$25,488,627,730	\$40,091,306,430
2037	\$25,133,488,027	\$15,111,589,436	\$1,205,550,344	\$26,339,038,372	\$41,450,627,807
2038	\$25,995,232,094	\$15,599,706,786	\$1,147,483,239	\$27,142,715,333	\$42,742,422,119

SCENARIO 1 IMPACT OF PHYSICAL ACTIVITY ON DEMENTIA INCIDENCE: SIMULATION RESULTS

LIFE TERMS

Exhibit 131 All-Cause Dementia, Incidence, Prevalence, Mortality: Intervention Scenario vs. Base Case (Males & Females, 65+) 2011-2038

Year	Primary Prevention: Impact of Physical Activity on Dementia Incidence		
	Incidence*	Prevalence**	Death With Dementia
2011	-5,075	-4,868	-201
2012	-5,194	-9,456	-574
2013	-5,311	-13,788	-907
2014	-5,430	-17,887	-1,202
2015	-5,554	-21,777	-1,467
2016	-5,686	-25,484	-1,705
2017	-5,826	-29,034	-1,923
2018	-5,978	-32,454	-2,124
2019	-6,143	-35,767	-2,311
2020	-6,321	-38,998	-2,490
2021	-6,515	-42,171	-2,661
2022	-6,724	-45,307	-2,829
2023	-6,948	-48,425	-2,994
2024	-7,186	-51,541	-3,160
2025	-7,437	-54,667	-3,326
2026	-7,698	-57,814	-3,494
2027	-7,968	-60,987	-3,662
2028	-8,243	-64,189	-3,833
2029	-8,520	-67,418	-4,003
2030	-8,797	-70,670	-4,174
2031	-9,072	-73,938	-4,343
2032	-9,342	-77,215	-4,511
2033	-9,604	-80,489	-4,675
2034	-9,858	-83,749	-4,836
2035	-10,101	-86,984	-4,992
2036	-10,333	-90,181	-5,143
2037	-10,552	-93,327	-5,288
2038	-10,758	-96,412	-5,425

*Unlike prevalence which is measured at a specific point in time, Incidence is measured over a specific period (one year period). Therefore, the specific year in the time column actually refer to a period of time over which incidence was measured. For example, 2011 refers to the period 2010 to 2011 (Jan 1st 2010 to Dec. 31st 2010)

**Prevalence is measured at a specific point in time and incorporates all changes from the previous period. For example, the value in year column 2011 is a measure prevalence on Jan 1st 2011.

HEALTHCARE UTILIZATION

Exhibit 132 All-Cause Dementia, Prevalence According to Care Types: Intervention Scenario vs. Base Case (Males & Females, Ages 65+) 2011-2038

Year	Primary Prevention: Impact of Physical Activity on Dementia Incidence		
	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia for No Formal Care
2011	-2,149	-1,589	-1,129
2012	-4,140	-3,142	-2,175
2013	-5,986	-4,655	-3,147
2014	-7,705	-6,130	-4,052
2015	-9,309	-7,568	-4,900
2016	-10,813	-8,972	-5,699
2017	-12,232	-10,347	-6,456
2018	-13,578	-11,698	-7,178
2019	-14,864	-13,032	-7,871
2020	-16,101	-14,358	-8,539
2021	-17,301	-15,681	-9,189
2022	-18,473	-17,011	-9,823
2023	-19,626	-18,354	-10,445
2024	-20,766	-19,717	-11,058
2025	-21,900	-21,104	-11,663
2026	-23,031	-22,521	-12,261
2027	-24,163	-23,971	-12,854
2028	-25,296	-25,454	-13,439
2029	-26,430	-26,970	-14,018
2030	-27,563	-28,519	-14,588
2031	-28,693	-30,098	-15,147
2032	-29,818	-31,702	-15,695
2033	-30,933	-33,327	-16,230
2034	-32,034	-34,967	-16,749
2035	-33,117	-36,617	-17,250
2036	-34,177	-38,269	-17,734
2037	-35,212	-39,918	-18,198
2038	-36,216	-41,556	-18,641

ECONOMIC BURDEN

Exhibit 133 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, Future Values) 2011-2038

Year	Primary Prevention #1: Impact of Physical Activity on Dementia Incidence, Future Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$110,882,840	-\$69,220,034	-\$1,234,892	-\$4,863,193	-\$186,200,960
2012	-\$226,720,261	-\$141,808,225	-\$2,061,990	-\$8,222,088	-\$378,812,564
2013	-\$347,810,463	-\$217,942,598	-\$2,904,062	-\$11,711,113	-\$580,368,236
2014	-\$474,797,494	-\$298,103,037	-\$3,833,364	-\$15,617,056	-\$792,350,950
2015	-\$608,342,374	-\$382,509,660	-\$5,015,601	-\$20,622,115	-\$1,016,489,749
2016	-\$749,245,157	-\$471,560,049	-\$6,403,308	-\$26,546,242	-\$1,253,754,757
2017	-\$898,144,698	-\$565,263,623	-\$8,004,384	-\$33,430,534	-\$1,504,843,239
2018	-\$1,055,071,074	-\$663,567,373	-\$9,732,639	-\$40,918,569	-\$1,769,289,655
2019	-\$1,220,715,570	-\$767,120,265	-\$11,522,544	-\$48,730,150	-\$2,048,088,528
2020	-\$1,397,005,213	-\$877,000,332	-\$13,415,515	-\$57,033,128	-\$2,344,454,189
2021	-\$1,584,934,875	-\$993,217,912	-\$15,338,725	-\$65,511,034	-\$2,659,002,546
2022	-\$1,785,509,001	-\$1,116,536,902	-\$17,224,516	-\$73,864,341	-\$2,993,134,760
2023	-\$1,999,025,952	-\$1,247,243,181	-\$19,094,727	-\$82,175,394	-\$3,347,539,253
2024	-\$2,226,948,925	-\$1,385,470,445	-\$20,944,919	-\$90,415,871	-\$3,723,780,160
2025	-\$2,469,652,168	-\$1,531,241,087	-\$22,771,698	-\$98,562,982	-\$4,122,227,935
2026	-\$2,728,081,129	-\$1,685,700,529	-\$24,552,314	-\$106,510,977	-\$4,544,844,949
2027	-\$3,005,035,894	-\$1,850,938,994	-\$26,417,297	-\$114,820,628	-\$4,997,212,813
2028	-\$3,302,881,117	-\$2,028,064,822	-\$28,314,493	-\$123,262,162	-\$5,482,522,594
2029	-\$3,621,268,276	-\$2,217,517,851	-\$30,440,687	-\$132,689,742	-\$6,001,916,557
2030	-\$3,961,914,418	-\$2,420,004,995	-\$32,598,401	-\$142,241,108	-\$6,556,758,923
2031	-\$4,325,093,786	-\$2,636,112,353	-\$36,207,325	-\$158,112,346	-\$7,155,525,810
2032	-\$4,712,933,840	-\$2,866,433,747	-\$40,534,221	-\$177,107,085	-\$7,797,008,894
2033	-\$5,126,359,070	-\$3,110,608,158	-\$45,453,528	-\$198,673,301	-\$8,481,094,057
2034	-\$5,565,557,157	-\$3,368,998,500	-\$51,018,629	-\$223,038,374	-\$9,208,612,660
2035	-\$6,033,178,971	-\$3,642,649,770	-\$57,045,294	-\$249,389,368	-\$9,982,263,402
2036	-\$6,529,894,762	-\$3,933,232,426	-\$63,371,189	-\$277,008,021	-\$10,803,506,398
2037	-\$7,057,829,303	-\$4,241,709,480	-\$69,983,681	-\$305,830,496	-\$11,675,352,960
2038	-\$7,619,260,229	-\$4,570,207,421	-\$76,699,571	-\$335,048,052	-\$12,601,215,272

Exhibit 134 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	Primary Prevention #1: Impact of Physical Activity on Dementia Incidence, 2008 Present Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$103,204,980	-\$64,427,031	-\$1,149,385	-\$4,526,451	-\$173,307,847
2012	-\$203,489,600	-\$127,277,990	-\$1,850,711	-\$7,379,620	-\$339,997,920
2013	-\$299,616,916	-\$187,743,889	-\$2,501,667	-\$10,088,390	-\$499,950,862
2014	-\$391,326,941	-\$245,695,799	-\$3,159,450	-\$12,871,539	-\$653,053,728
2015	-\$478,537,477	-\$300,891,760	-\$3,945,398	-\$16,221,876	-\$799,596,511
2016	-\$561,099,162	-\$353,144,690	-\$4,795,347	-\$19,880,108	-\$938,919,308
2017	-\$638,547,365	-\$401,881,343	-\$5,690,818	-\$23,767,862	-\$1,069,887,388
2018	-\$710,039,159	-\$446,565,953	-\$6,549,848	-\$27,537,279	-\$1,190,692,239
2019	-\$775,527,135	-\$487,355,610	-\$7,320,334	-\$30,958,525	-\$1,301,161,604
2020	-\$836,149,602	-\$524,911,054	-\$8,029,589	-\$34,136,041	-\$1,403,226,286
2021	-\$892,833,480	-\$559,504,506	-\$8,640,688	-\$36,904,005	-\$1,497,882,678
2022	-\$946,896,746	-\$592,125,360	-\$9,134,560	-\$39,171,969	-\$1,587,328,634
2023	-\$999,545,841	-\$623,642,096	-\$9,547,678	-\$41,089,048	-\$1,673,824,662
2024	-\$1,052,678,863	-\$654,911,946	-\$9,900,664	-\$42,739,587	-\$1,760,231,060
2025	-\$1,107,537,620	-\$686,698,772	-\$10,212,172	-\$44,201,451	-\$1,848,650,015
2026	-\$1,165,402,111	-\$720,110,166	-\$10,488,441	-\$45,500,156	-\$1,941,500,874
2027	-\$1,227,944,546	-\$756,347,186	-\$10,794,871	-\$46,919,028	-\$2,042,005,632
2028	-\$1,296,128,589	-\$795,860,554	-\$11,111,276	-\$48,370,985	-\$2,151,471,405
2029	-\$1,369,408,381	-\$838,570,164	-\$11,511,363	-\$50,177,571	-\$2,269,667,478
2030	-\$1,447,690,980	-\$884,274,377	-\$11,911,517	-\$51,975,168	-\$2,395,852,042
2031	-\$1,530,003,917	-\$932,525,958	-\$12,808,358	-\$55,932,315	-\$2,531,270,548
2032	-\$1,615,775,796	-\$982,724,228	-\$13,896,697	-\$60,719,151	-\$2,673,115,871
2033	-\$1,703,793,225	-\$1,033,839,619	-\$15,106,904	-\$66,030,924	-\$2,818,770,671
2034	-\$1,792,491,941	-\$1,085,049,078	-\$16,431,505	-\$71,833,687	-\$2,965,806,211
2035	-\$1,881,062,601	-\$1,135,728,325	-\$17,785,942	-\$77,756,190	-\$3,112,333,058
2036	-\$1,968,047,777	-\$1,185,438,604	-\$19,099,470	-\$83,487,566	-\$3,256,073,416
2037	-\$2,052,495,849	-\$1,233,536,648	-\$20,352,039	-\$88,938,935	-\$3,395,323,471
2038	-\$2,133,560,760	-\$1,279,758,786	-\$21,477,570	-\$93,820,838	-\$3,528,617,953

SCENARIO 2: IMPACT OF PREVENTION PROGRAMS TO DELAY DISEASE ONSET: SIMULATION RESULTS

LIFE TERMS

Exhibit 135 All-Cause Dementia, Incidence, Prevalence, Mortality: Intervention Scenario vs. Base Case (Males & Females, Ages 65+) 2011-2038

Year	Primary Prevention #2: Impact of Early Diagnosis to Delay Disease Onset		
	Incidence*	Prevalence**	Death With Dementia
2011	-21,975	-21,009	-938
2012	-22,492	-40,690	-2,675
2013	-23,003	-59,153	-4,216
2014	-23,524	-76,520	-5,582
2015	-24,070	-92,913	-6,799
2016	-24,650	-108,458	-7,892
2017	-25,275	-123,280	-8,882
2018	-25,951	-137,502	-9,791
2019	-26,688	-151,247	-10,635
2020	-27,492	-164,631	-11,430
2021	-28,369	-177,765	-12,192
2022	-29,319	-190,752	-12,934
2023	-30,344	-203,683	-13,665
2024	-31,438	-216,638	-14,395
2025	-32,596	-229,680	-15,129
2026	-33,809	-242,859	-15,870
2027	-35,065	-256,205	-16,620
2028	-36,353	-269,736	-17,379
2029	-37,660	-283,450	-18,144
2030	-38,973	-297,334	-18,912
2031	-40,279	-311,361	-19,680
2032	-41,567	-325,494	-20,443
2033	-42,826	-339,687	-21,196
2034	-44,047	-353,888	-21,936
2035	-45,222	-368,043	-22,658
2036	-46,344	-382,093	-23,358
2037	-47,408	-395,980	-24,032
2038	-48,409	-409,647	-24,676

*Unlike prevalence which is measured at a specific point in time, Incidence is measured over a specific period (one year period). Therefore, the specific year in the time column actually refer to a period of time over which incidence was measured. For example, 2011 refers to the period 2010 to 2011 (Jan 1st 2010 to Dec. 31st 2010) **Prevalence is measured at a specific point in time and incorporates all changes from the previous period. For example, the value in year column 2011 is a measure of prevalence on Jan 1st 2011.

HEALTHCARE UTILIZATION

Exhibit 136 All-Cause Dementia, Prevalence According to Care Types: Intervention Scenario vs. Base Case (Males & Females, Ages 65+) 2011-2038

Year	Primary Prevention#2: Impact of Early Diagnosis to Delay Disease Onset		
	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia for No Formal Care
2011	-9,276	-6,854	-4,879
2012	-17,813	-13,520	-9,357
2013	-25,683	-19,995	-13,475
2014	-32,961	-26,280	-17,279
2015	-39,717	-32,382	-20,814
2016	-46,021	-38,312	-24,126
2017	-51,937	-44,091	-27,252
2018	-57,529	-49,748	-30,226
2019	-62,855	-55,312	-33,080
2020	-67,971	-60,821	-35,839
2021	-72,929	-66,310	-38,526
2022	-77,775	-71,817	-41,160
2023	-82,549	-77,377	-43,757
2024	-87,285	-83,024	-46,329
2025	-92,011	-88,784	-48,886
2026	-96,747	-94,681	-51,431
2027	-101,508	-100,730	-53,967
2028	-106,298	-106,942	-56,495
2029	-111,120	-113,319	-59,011
2030	-115,967	-119,857	-61,509
2031	-120,830	-126,548	-63,983
2032	-125,695	-133,374	-66,424
2033	-130,545	-140,317	-68,825
2034	-135,360	-147,354	-71,174
2035	-140,122	-154,457	-73,464
2036	-144,809	-161,597	-75,687
2037	-149,401	-168,745	-77,834
2038	-153,878	-175,868	-79,901

ECONOMIC BURDEN

Exhibit 137 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males& Females, Ages 65+, Future Values) 2011-2038

Year	Primary Prevention#2: Impact of Early Diagnosis to Delay Disease Onset, Future Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$478,467,961	-\$298,690,796	-\$5,863,260	-\$23,090,411	-\$806,112,427
2012	-\$975,597,545	-\$610,212,822	-\$9,873,237	-\$39,369,059	-\$1,635,052,663
2013	-\$1,492,678,928	-\$935,323,340	-\$13,777,249	-\$55,559,053	-\$2,497,338,570
2014	-\$2,032,466,707	-\$1,276,064,206	-\$17,892,549	-\$72,893,915	-\$3,399,317,376
2015	-\$2,597,762,871	-\$1,633,351,285	-\$23,002,193	-\$94,575,682	-\$4,348,692,031
2016	-\$3,191,961,610	-\$2,008,866,852	-\$28,914,589	-\$119,871,429	-\$5,349,614,481
2017	-\$3,817,795,694	-\$2,402,663,564	-\$35,687,715	-\$149,050,746	-\$6,405,197,718
2018	-\$4,475,470,261	-\$2,814,579,717	-\$43,011,684	-\$180,832,407	-\$7,513,894,069
2019	-\$5,168,082,108	-\$3,247,485,980	-\$50,570,795	-\$213,869,651	-\$8,680,008,534
2020	-\$5,904,031,317	-\$3,706,108,198	-\$58,560,066	-\$248,955,307	-\$9,917,654,888
2021	-\$6,687,835,445	-\$4,190,700,469	-\$66,664,780	-\$284,722,406	-\$11,229,923,100
2022	-\$7,524,127,953	-\$4,704,752,694	-\$74,537,077	-\$319,639,285	-\$12,623,057,009
2023	-\$8,414,643,160	-\$5,249,779,433	-\$82,519,370	-\$355,127,447	-\$14,102,069,411
2024	-\$9,366,090,098	-\$5,826,694,176	-\$90,342,360	-\$389,993,537	-\$15,673,120,171
2025	-\$10,380,643,693	-\$6,435,973,414	-\$98,105,250	-\$424,629,989	-\$17,339,352,345
2026	-\$11,462,918,983	-\$7,082,829,356	-\$105,665,771	-\$458,391,194	-\$19,109,805,304
2027	-\$12,625,344,897	-\$7,776,445,643	-\$113,645,242	-\$493,949,785	-\$21,009,385,567
2028	-\$13,878,526,828	-\$8,521,879,360	-\$121,765,650	-\$530,085,325	-\$23,052,257,163
2029	-\$15,221,670,525	-\$9,321,376,460	-\$130,490,147	-\$568,801,351	-\$25,242,338,483
2030	-\$16,662,641,987	-\$10,178,292,438	-\$137,550,572	-\$600,193,417	-\$27,578,678,414
2031	-\$18,203,207,574	-\$11,095,453,901	-\$150,473,406	-\$657,096,407	-\$30,106,231,289
2032	-\$19,852,881,374	-\$12,075,690,763	-\$165,207,066	-\$721,842,945	-\$32,815,622,148
2033	-\$21,616,062,792	-\$13,117,771,030	-\$181,629,924	-\$793,888,133	-\$35,709,351,878
2034	-\$23,493,976,373	-\$14,223,460,436	-\$199,645,378	-\$872,790,616	-\$38,789,872,803
2035	-\$25,498,170,102	-\$15,397,359,084	-\$217,945,091	-\$952,807,584	-\$42,066,281,861
2036	-\$27,631,772,660	-\$16,646,675,575	-\$234,907,848	-\$1,026,828,744	-\$45,540,184,827
2037	-\$29,903,993,262	-\$17,975,600,711	-\$250,848,854	-\$1,096,215,970	-\$49,226,658,796
2038	-\$32,324,640,352	-\$19,393,225,004	-\$264,775,297	-\$1,156,622,479	-\$53,139,263,131

Exhibit 138 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	Primary Prevention #2: Impact of Early Diagnosis to Delay Disease Onset, 2008 Present Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$445,337,404	-\$278,008,549	-\$5,457,270	-\$21,491,562	-\$750,294,785
2012	-\$875,633,936	-\$547,687,986	-\$8,861,585	-\$35,335,149	-\$1,467,518,656
2013	-\$1,285,849,345	-\$805,722,437	-\$11,868,237	-\$47,860,642	-\$2,151,300,661
2014	-\$1,675,154,122	-\$1,051,729,018	-\$14,746,995	-\$60,078,987	-\$2,801,709,122
2015	-\$2,043,465,889	-\$1,284,835,376	-\$18,094,106	-\$74,395,620	-\$3,420,790,991
2016	-\$2,390,415,166	-\$1,504,412,138	-\$21,653,729	-\$89,770,028	-\$4,006,251,061
2017	-\$2,714,310,275	-\$1,708,204,137	-\$25,372,633	-\$105,969,518	-\$4,553,856,563
2018	-\$3,011,891,066	-\$1,894,148,997	-\$28,945,898	-\$121,696,152	-\$5,056,682,113
2019	-\$3,283,310,224	-\$2,063,145,224	-\$32,127,897	-\$135,872,534	-\$5,514,455,879
2020	-\$3,533,740,168	-\$2,218,217,130	-\$35,049,959	-\$149,007,233	-\$5,936,014,490
2021	-\$3,767,425,074	-\$2,360,726,450	-\$37,553,939	-\$160,391,257	-\$6,326,096,720
2022	-\$3,990,219,186	-\$2,495,039,237	-\$39,528,737	-\$169,512,110	-\$6,694,299,270
2023	-\$4,207,459,921	-\$2,624,976,026	-\$41,261,042	-\$177,569,562	-\$7,051,266,551
2024	-\$4,427,351,237	-\$2,754,278,616	-\$42,704,838	-\$184,349,964	-\$7,408,684,655
2025	-\$4,655,292,580	-\$2,886,269,885	-\$43,996,177	-\$190,429,119	-\$7,775,987,762
2026	-\$4,896,815,508	-\$3,025,696,045	-\$45,139,095	-\$195,818,980	-\$8,163,469,627
2027	-\$5,159,080,941	-\$3,177,680,517	-\$46,438,732	-\$201,842,163	-\$8,585,042,352
2028	-\$5,446,261,844	-\$3,344,186,813	-\$47,783,718	-\$208,018,006	-\$9,046,250,381
2029	-\$5,756,183,084	-\$3,524,944,874	-\$49,345,778	-\$215,096,280	-\$9,545,570,016
2030	-\$6,088,560,720	-\$3,719,167,199	-\$50,261,238	-\$219,311,803	-\$10,077,300,961
2031	-\$6,439,393,057	-\$3,925,021,924	-\$53,230,037	-\$232,448,157	-\$10,650,093,174
2032	-\$6,806,334,713	-\$4,140,013,315	-\$56,639,365	-\$247,475,649	-\$11,250,463,041
2033	-\$7,184,299,975	-\$4,359,813,486	-\$60,366,398	-\$263,856,122	-\$11,868,335,981
2034	-\$7,566,675,201	-\$4,580,931,880	-\$64,299,534	-\$281,098,568	-\$12,493,005,183
2035	-\$7,949,980,333	-\$4,800,685,752	-\$67,952,295	-\$297,072,359	-\$13,115,690,740
2036	-\$8,327,951,786	-\$5,017,148,675	-\$70,798,977	-\$309,476,354	-\$13,725,375,793
2037	-\$8,696,416,336	-\$5,227,506,116	-\$72,949,658	-\$318,791,888	-\$14,315,663,997
2038	-\$9,051,611,594	-\$5,430,530,344	-\$74,142,918	-\$323,879,781	-\$14,880,164,637

SCENARIO 3A: INFORMAL CAREGIVER SUPPORT PROGRAMS: IMPACT ON ADMISSION INTO LTC: SIMULATION RESULTS

HEALTHCARE UTILIZATION

Exhibit 139 All-Cause Dementia, Prevalence According to Care Types: Intervention Scenario vs. Base Case (Males & Females, Ages 65+) 2011-2038

Year	Informal Caregiver Support: Impact of Caregiver Support Programs on Admission into LTC		
	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia for No Formal Care
2011	-6,162	6,162	-
2012	-8,701	8,701	-
2013	-8,287	8,287	-
2014	-8,210	8,210	-
2015	-8,262	8,262	-
2016	-8,385	8,385	-
2017	-8,568	8,568	-
2018	-8,813	8,813	-
2019	-9,122	9,122	-
2020	-9,495	9,495	-
2021	-9,923	9,923	-
2022	-10,393	10,393	-
2023	-10,891	10,891	-
2024	-11,403	11,403	-
2025	-11,916	11,916	-
2026	-12,419	12,419	-
2027	-12,902	12,902	-
2028	-13,355	13,355	-
2029	-13,767	13,767	-
2030	-14,127	14,127	-
2031	-14,426	14,426	-
2032	-14,653	14,653	-
2033	-14,801	14,801	-
2034	-14,866	14,866	-
2035	-14,843	14,843	-
2036	-14,735	14,735	-
2037	-14,542	14,542	-
2038	-14,270	14,270	-

ECONOMIC BURDEN

Exhibit 140 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, Future Values) 2011-2038

Year	Informal Caregiver Support: Impact of Caregiver Support Programs on Admission into LTC, Future Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$466,705,802	\$224,493,415	\$424,236	\$1,647,984	-\$240,140,167
2012	-\$692,735,158	\$331,970,932	\$385,164	\$1,516,835	-\$358,862,227
2013	-\$693,564,748	\$331,129,921	\$409,982	\$1,634,782	-\$360,390,063
2014	-\$722,156,224	\$343,558,879	\$470,963	\$1,899,238	-\$376,227,144
2015	-\$763,971,751	\$362,332,753	\$546,639	\$2,226,996	-\$398,865,364
2016	-\$815,228,119	\$385,337,858	\$644,392	\$2,649,478	-\$426,596,392
2017	-\$876,023,734	\$412,550,630	\$758,573	\$3,144,821	-\$459,569,711
2018	-\$947,492,753	\$444,188,679	\$891,289	\$3,722,494	-\$498,690,291
2019	-\$1,030,287,532	\$480,562,436	\$1,038,631	\$4,366,677	-\$544,319,789
2020	-\$1,125,316,394	\$522,262,748	\$1,194,068	\$5,049,848	-\$596,809,731
2021	-\$1,233,800,368	\$569,713,916	\$1,372,135	\$5,833,331	-\$656,880,986
2022	-\$1,355,278,367	\$622,244,822	\$1,570,592	\$6,707,932	-\$724,755,021
2023	-\$1,488,662,353	\$679,439,418	\$1,784,319	\$7,651,743	-\$799,786,873
2024	-\$1,631,997,994	\$740,454,201	\$2,017,363	\$8,681,854	-\$880,844,575
2025	-\$1,784,276,789	\$804,334,676	\$2,268,192	\$9,791,423	-\$967,882,498
2026	-\$1,943,474,132	\$870,072,451	\$2,536,156	\$10,977,269	-\$1,059,888,256
2027	-\$2,107,849,843	\$937,276,070	\$2,826,725	\$12,262,683	-\$1,155,484,364
2028	-\$2,276,883,136	\$1,005,967,086	\$3,137,701	\$13,637,764	-\$1,254,140,585
2029	-\$2,449,399,549	\$1,075,466,140	\$3,473,378	\$15,120,741	-\$1,355,339,289
2030	-\$2,621,780,211	\$1,144,611,676	\$3,834,011	\$16,712,299	-\$1,456,622,225
2031	-\$2,791,815,617	\$1,212,304,109	\$4,211,440	\$18,376,358	-\$1,556,923,709
2032	-\$2,956,086,982	\$1,277,351,739	\$4,776,042	\$20,856,308	-\$1,653,102,894
2033	-\$3,112,602,783	\$1,338,603,901	\$5,377,917	\$23,497,854	-\$1,745,123,112
2034	-\$3,258,702,989	\$1,394,578,709	\$6,015,841	\$26,294,702	-\$1,831,813,738
2035	-\$3,391,502,038	\$1,444,322,548	\$6,669,952	\$29,159,061	-\$1,911,350,476
2036	-\$3,510,076,983	\$1,487,354,400	\$7,336,007	\$32,071,396	-\$1,983,315,180
2037	-\$3,612,523,633	\$1,523,580,055	\$8,001,015	\$34,974,022	-\$2,045,968,541
2038	-\$3,698,251,213	\$1,552,726,301	\$8,666,067	\$37,870,938	-\$2,098,987,907

Exhibit 141 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	Informal Caregiver Support: Impact of Caregiver Support Programs on Admission into LTC, 2008 Present Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$434,389,693	\$208,948,818	\$394,860	\$1,533,873	-\$223,512,142
2012	-\$621,754,755	\$297,955,868	\$345,699	\$1,361,414	-\$322,091,774
2013	-\$597,462,562	\$285,247,674	\$353,174	\$1,408,263	-\$310,453,452
2014	-\$595,199,406	\$283,160,394	\$388,167	\$1,565,347	-\$310,085,498
2015	-\$600,959,476	\$285,020,096	\$430,000	\$1,751,811	-\$313,757,570
2016	-\$610,512,875	\$288,574,104	\$482,576	\$1,984,156	-\$319,472,039
2017	-\$622,820,186	\$293,308,104	\$539,317	\$2,235,850	-\$326,736,915
2018	-\$637,641,363	\$298,929,014	\$599,818	\$2,505,155	-\$335,607,376
2019	-\$654,547,183	\$305,303,888	\$659,848	\$2,774,173	-\$345,809,275
2020	-\$673,535,679	\$312,589,949	\$714,685	\$3,022,486	-\$357,208,559
2021	-\$695,030,624	\$320,934,107	\$772,958	\$3,286,061	-\$370,037,498
2022	-\$718,735,484	\$329,990,830	\$832,921	\$3,557,371	-\$384,354,361
2023	-\$744,355,651	\$339,730,879	\$892,189	\$3,825,997	-\$399,906,585
2024	-\$771,445,530	\$350,012,736	\$953,608	\$4,103,913	-\$416,375,273
2025	-\$800,174,897	\$360,711,085	\$1,017,191	\$4,391,051	-\$434,055,570
2026	-\$830,227,823	\$371,684,060	\$1,083,414	\$4,689,352	-\$452,770,996
2027	-\$861,328,387	\$382,998,100	\$1,155,082	\$5,010,887	-\$472,164,318
2028	-\$893,502,740	\$394,765,253	\$1,231,308	\$5,351,781	-\$492,154,398
2029	-\$926,257,878	\$406,695,178	\$1,313,483	\$5,718,016	-\$512,531,202
2030	-\$958,003,420	\$418,243,259	\$1,400,955	\$6,106,706	-\$532,252,501
2031	-\$987,606,059	\$428,853,137	\$1,489,799	\$6,500,645	-\$550,762,479
2032	-\$1,013,460,820	\$437,925,524	\$1,637,412	\$7,150,348	-\$566,747,536
2033	-\$1,034,502,551	\$444,897,485	\$1,787,401	\$7,809,731	-\$580,007,934
2034	-\$1,049,526,343	\$449,150,198	\$1,937,514	\$8,468,701	-\$589,969,929
2035	-\$1,057,423,901	\$450,319,996	\$2,079,600	\$9,091,396	-\$595,932,909
2036	-\$1,057,903,604	\$448,274,379	\$2,211,002	\$9,666,012	-\$597,752,211
2037	-\$1,050,562,353	\$443,074,153	\$2,326,785	\$10,170,838	-\$594,990,578
2038	-\$1,035,591,833	\$434,797,580	\$2,426,690	\$10,604,697	-\$587,762,867

SCENARIO 3B: INFORMAL CAREGIVER SUPPORT PROGRAMS: IMPACT ON THE INFORMAL CAREGIVER BURDEN: SIMULATION RESULTS

ECONOMIC BURDEN

Exhibit 142 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, Future Values) 2011-2038

Year	Informal Caregiver Support: Impact of Caregiver Support Programs on Amount of Informal Care Provided, Future Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-	-\$1,167,201,957	-\$380,631	-\$1,498,984	-\$1,169,081,573
2012	-	-\$1,279,934,418	-\$730,081	-\$2,911,164	-\$1,283,575,664
2013	-	-\$1,399,962,376	-\$1,074,093	-\$4,331,461	-\$1,405,367,930
2014	-	-\$1,528,503,050	-\$1,400,498	-\$5,705,602	-\$1,535,609,150
2015	-	-\$1,667,856,694	-\$1,729,386	-\$7,110,533	-\$1,676,696,612
2016	-	-\$1,817,977,029	-\$2,052,545	-\$8,509,250	-\$1,828,538,823
2017	-	-\$1,979,962,642	-\$2,381,741	-\$9,947,409	-\$1,992,291,792
2018	-	-\$2,153,286,288	-\$2,715,975	-\$11,418,671	-\$2,167,420,934
2019	-	-\$2,337,614,433	-\$3,059,970	-\$12,940,962	-\$2,353,615,365
2020	-	-\$2,535,151,773	-\$3,430,836	-\$14,585,449	-\$2,553,168,058
2021	-	-\$2,749,034,277	-\$3,819,601	-\$16,313,351	-\$2,769,167,229
2022	-	-\$2,978,711,562	-\$4,237,351	-\$18,171,144	-\$3,001,120,057
2023	-	-\$3,225,991,294	-\$4,695,094	-\$20,205,639	-\$3,250,892,027
2024	-	-\$3,491,161,879	-\$5,197,608	-\$22,437,245	-\$3,518,796,732
2025	-	-\$3,774,141,651	-\$5,750,947	-\$24,891,883	-\$3,804,784,481
2026	-	-\$4,074,639,383	-\$6,363,658	-\$27,606,337	-\$4,108,609,378
2027	-	-\$4,395,392,425	-\$7,039,623	-\$30,597,149	-\$4,433,029,198
2028	-	-\$4,741,435,738	-\$7,783,460	-\$33,883,925	-\$4,783,103,123
2029	-	-\$5,115,106,486	-\$8,603,901	-\$37,504,060	-\$5,161,214,446
2030	-	-\$5,517,068,145	-\$9,491,059	-\$41,413,651	-\$5,567,972,856
2031	-	-\$5,948,711,002	-\$10,028,989	-\$43,795,199	-\$6,002,535,189
2032	-	-\$6,411,147,461	-\$10,551,536	-\$46,103,064	-\$6,467,802,060
2033	-	-\$6,905,524,926	-\$11,085,997	-\$48,455,899	-\$6,965,066,821
2034	-	-\$7,430,716,805	-\$11,630,286	-\$50,844,177	-\$7,493,191,268
2035	-	-\$7,987,385,019	-\$12,185,527	-\$53,272,421	-\$8,052,842,967
2036	-	-\$8,577,807,256	-\$12,770,379	-\$55,821,858	-\$8,646,399,494
2037	-	-\$9,205,696,983	-\$13,405,914	-\$58,584,193	-\$9,277,687,090
2038	-	-\$9,873,078,948	-\$14,041,083	-\$61,335,904	-\$9,948,455,935

Exhibit 143 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	Informal Caregiver Support: Impact of Caregiver Support Programs Amount of Informal Care Provided, 2008 Present Values				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-	-\$1,086,381,393	-\$354,275	-\$1,395,190	-\$1,088,130,858
2012	-	-\$1,148,787,241	-\$655,274	-\$2,612,875	-\$1,152,055,390
2013	-	-\$1,205,979,846	-\$925,264	-\$3,731,282	-\$1,210,636,392
2014	-	-\$1,259,788,500	-\$1,154,287	-\$4,702,543	-\$1,265,645,330
2015	-	-\$1,311,978,202	-\$1,360,379	-\$5,593,325	-\$1,318,931,905
2016	-	-\$1,361,457,433	-\$1,537,122	-\$6,372,457	-\$1,369,367,012
2017	-	-\$1,407,679,554	-\$1,693,329	-\$7,072,237	-\$1,416,445,120
2018	-	-\$1,449,113,357	-\$1,827,790	-\$7,684,509	-\$1,458,625,656
2019	-	-\$1,485,098,960	-\$1,944,015	-\$8,221,463	-\$1,495,264,438
2020	-	-\$1,517,364,521	-\$2,053,459	-\$8,729,830	-\$1,528,147,809
2021	-	-\$1,548,599,805	-\$2,151,677	-\$9,189,719	-\$1,559,941,201
2022	-	-\$1,579,679,678	-\$2,247,166	-\$9,636,578	-\$1,591,563,422
2023	-	-\$1,613,048,684	-\$2,347,624	-\$10,103,152	-\$1,625,499,460
2024	-	-\$1,650,272,387	-\$2,456,910	-\$10,606,087	-\$1,663,335,384
2025	-	-\$1,692,547,605	-\$2,579,063	-\$11,162,988	-\$1,706,289,657
2026	-	-\$1,740,634,942	-\$2,718,475	-\$11,793,082	-\$1,755,146,499
2027	-	-\$1,796,084,422	-\$2,876,594	-\$12,502,880	-\$1,811,463,895
2028	-	-\$1,860,651,413	-\$3,054,414	-\$13,296,853	-\$1,877,002,679
2029	-	-\$1,934,313,936	-\$3,253,626	-\$14,182,427	-\$1,951,749,989
2030	-	-\$2,015,947,076	-\$3,468,051	-\$15,132,626	-\$2,034,547,753
2031	-	-\$2,104,359,255	-\$3,547,760	-\$15,492,572	-\$2,123,399,586
2032	-	-\$2,197,989,032	-\$3,617,474	-\$15,805,911	-\$2,217,412,417
2033	-	-\$2,295,115,583	-\$3,684,534	-\$16,104,770	-\$2,314,904,887
2034	-	-\$2,393,201,546	-\$3,745,752	-\$16,375,320	-\$2,413,322,617
2035	-	-\$2,490,357,291	-\$3,799,280	-\$16,609,611	-\$2,510,766,183
2036	-	-\$2,585,269,000	-\$3,848,870	-\$16,824,174	-\$2,605,942,043
2037	-	-\$2,677,119,839	-\$3,898,590	-\$17,036,940	-\$2,698,055,369
2038	-	-\$2,764,679,665	-\$3,931,813	-\$17,175,405	-\$2,785,786,883

SCENARIO 4A: SYSTEM NAVIGATION: IMPACT ON ADMISSION INTO LTC: SIMULATION RESULTS

HEALTHCARE UTILIZATION

Exhibit 144 All-Cause Dementia, Prevalence According to Care Types: Intervention Scenario vs. Base Case (Males & Females, Ages 65+) 2011-2038

Year	System Navigation: Impact of System Navigation on Admission into LTC		
	Prevalence of Dementia in LTC	Prevalence of Dementia in CC	Prevalence of Dementia for No Formal Care
2011	-6,162	6,162	-
2012	-11,783	11,783	-
2013	-11,097	11,097	-
2014	-10,949	10,949	-
2015	-10,998	10,998	-
2016	-11,148	11,148	-
2017	-11,379	11,379	-
2018	-11,691	11,691	-
2019	-12,089	12,089	-
2020	-12,573	12,573	-
2021	-13,132	13,132	-
2022	-13,750	13,750	-
2023	-14,409	14,409	-
2024	-15,089	15,089	-
2025	-15,774	15,774	-
2026	-16,448	16,448	-
2027	-17,097	17,097	-
2028	-17,708	17,708	-
2029	-18,267	18,267	-
2030	-18,760	18,760	-
2031	-19,173	19,173	-
2032	-19,492	19,492	-
2033	-19,708	19,708	-
2034	-19,813	19,813	-
2035	-19,803	19,803	-
2036	-19,677	19,677	-
2037	-19,438	19,438	-
2038	-19,093	19,093	-

ECONOMIC BURDEN

Exhibit 145 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, Future Values) 2011-2038

Year	System Navigation: Impact of System Navigation on Admission into LTC (Future Values)				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$466,705,802	\$224,493,415	\$424,236	\$1,647,984	-\$240,140,167
2012	-\$938,024,277	\$449,517,813	\$398,287	\$1,568,516	-\$486,539,662
2013	-\$928,750,719	\$443,415,201	\$432,723	\$1,725,460	-\$483,177,335
2014	-\$963,031,682	\$458,153,062	\$517,118	\$2,085,363	-\$502,276,140
2015	-\$1,016,941,517	\$482,310,006	\$622,563	\$2,536,308	-\$531,472,640
2016	-\$1,083,877,619	\$512,321,730	\$756,511	\$3,110,466	-\$567,688,912
2017	-\$1,163,432,800	\$547,901,748	\$912,271	\$3,782,008	-\$610,836,774
2018	-\$1,256,967,625	\$589,271,830	\$1,092,062	\$4,561,026	-\$662,042,706
2019	-\$1,365,393,694	\$636,867,767	\$1,290,952	\$5,427,503	-\$721,807,472
2020	-\$1,490,064,984	\$691,543,673	\$1,500,230	\$6,344,645	-\$790,676,435
2021	-\$1,632,773,990	\$753,942,119	\$1,738,820	\$7,392,213	-\$869,700,837
2022	-\$1,793,048,338	\$823,236,813	\$2,003,966	\$8,558,851	-\$959,248,707
2023	-\$1,969,520,765	\$898,907,694	\$2,289,074	\$9,816,294	-\$1,058,507,703
2024	-\$2,159,619,401	\$979,841,436	\$2,599,560	\$11,187,373	-\$1,165,991,032
2025	-\$2,361,995,078	\$1,064,764,479	\$2,933,521	\$12,663,542	-\$1,281,633,536
2026	-\$2,573,957,680	\$1,152,333,150	\$3,290,250	\$14,241,222	-\$1,404,093,059
2027	-\$2,793,215,869	\$1,242,030,784	\$3,677,054	\$15,951,514	-\$1,531,556,517
2028	-\$3,019,118,932	\$1,333,899,938	\$4,091,109	\$17,781,671	-\$1,663,346,214
2029	-\$3,250,164,608	\$1,427,060,762	\$4,538,262	\$19,756,527	-\$1,798,809,058
2030	-\$3,481,601,061	\$1,519,990,580	\$5,018,901	\$21,877,189	-\$1,934,714,391
2031	-\$3,710,520,090	\$1,611,237,764	\$5,522,468	\$24,096,948	-\$2,069,662,909
2032	-\$3,932,371,602	\$1,699,213,093	\$6,276,429	\$27,408,291	-\$2,199,473,790
2033	-\$4,144,464,906	\$1,782,365,845	\$7,080,967	\$30,939,028	-\$2,324,079,067
2034	-\$4,343,188,381	\$1,858,689,812	\$7,934,570	\$34,681,296	-\$2,441,882,703
2035	-\$4,524,603,924	\$1,926,871,161	\$8,810,988	\$38,519,036	-\$2,550,402,740
2036	-\$4,687,376,304	\$1,986,221,329	\$9,704,679	\$42,426,703	-\$2,649,023,593
2037	-\$4,828,859,019	\$2,036,568,902	\$10,598,358	\$46,327,521	-\$2,735,364,238
2038	-\$4,948,164,368	\$2,077,507,587	\$11,493,415	\$50,226,519	-\$2,808,936,848

Exhibit 146 Total Economic Burden Attributed to All-Cause Dementia and Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	System Navigation: Impact of System Navigation on Admission into LTC (2008 Present Values)				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-\$434,389,693	\$208,948,818	\$394,860	\$1,533,873	-\$223,512,142
2012	-\$841,910,575	\$403,458,428	\$357,477	\$1,407,799	-\$436,686,870
2013	-\$800,060,536	\$381,974,405	\$372,763	\$1,486,376	-\$416,226,992
2014	-\$793,728,373	\$377,608,641	\$426,207	\$1,718,751	-\$413,974,774
2015	-\$799,951,883	\$379,397,233	\$489,723	\$1,995,124	-\$418,069,803
2016	-\$811,700,708	\$383,670,540	\$566,540	\$2,329,384	-\$425,134,244
2017	-\$827,157,307	\$389,537,697	\$648,591	\$2,688,867	-\$434,282,152
2018	-\$845,911,008	\$396,566,720	\$734,933	\$3,069,468	-\$445,539,886
2019	-\$867,441,922	\$404,605,501	\$820,149	\$3,448,122	-\$458,568,150
2020	-\$891,848,671	\$413,909,670	\$897,933	\$3,797,461	-\$473,243,607
2021	-\$919,782,450	\$424,714,464	\$979,521	\$4,164,219	-\$489,924,246
2022	-\$950,895,030	\$436,581,534	\$1,062,749	\$4,538,957	-\$508,711,790
2023	-\$984,792,762	\$449,468,625	\$1,144,574	\$4,908,309	-\$529,271,254
2024	-\$1,020,852,194	\$463,171,094	\$1,228,812	\$5,288,272	-\$551,164,017
2025	-\$1,059,257,835	\$477,503,161	\$1,315,564	\$5,679,079	-\$574,760,031
2026	-\$1,099,562,503	\$492,262,298	\$1,405,553	\$6,083,672	-\$599,810,980
2027	-\$1,141,388,760	\$507,529,687	\$1,502,550	\$6,518,250	-\$625,838,272
2028	-\$1,184,773,603	\$523,453,852	\$1,605,448	\$6,977,948	-\$652,736,355
2029	-\$1,229,072,887	\$539,653,187	\$1,716,176	\$7,471,071	-\$680,232,452
2030	-\$1,272,183,576	\$555,407,417	\$1,833,916	\$7,993,966	-\$706,948,277
2031	-\$1,312,598,190	\$569,976,101	\$1,953,576	\$8,524,306	-\$732,144,207
2032	-\$1,348,168,905	\$582,555,894	\$2,151,802	\$9,396,621	-\$754,064,588
2033	-\$1,377,451,547	\$592,385,904	\$2,353,425	\$10,282,874	-\$772,429,343
2034	-\$1,398,805,179	\$598,625,873	\$2,555,477	\$11,169,761	-\$786,454,068
2035	-\$1,410,709,556	\$600,772,046	\$2,747,145	\$12,009,708	-\$795,180,656
2036	-\$1,412,730,350	\$598,628,096	\$2,924,897	\$12,787,002	-\$798,390,354
2037	-\$1,404,286,313	\$592,257,058	\$3,082,121	\$13,472,562	-\$795,474,572
2038	-\$1,385,595,059	\$581,747,904	\$3,218,409	\$14,064,532	-\$786,564,214

SCENARIO 4B: SYSTEM NAVIGATION: IMPACT ON INFORMAL CAREGIVER BURDEN: SIMULATION RESULTS

ECONOMIC BURDEN

Exhibit 147 Total Economic Burden Attributed to All-Cause Dementia & Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, Future Values: 2011-2038)

Year	System Navigation: Impact of System Navigation on Provision of Informal Care (Future Values)				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-	-\$2,255,144,071	-\$608,361	-\$2,395,818	-\$2,258,148,249
2012	-	-\$2,472,953,799	-\$1,173,189	-\$4,678,033	-\$2,478,805,021
2013	-	-\$2,704,859,113	-\$1,726,735	-\$6,963,347	-\$2,713,549,195
2014	-	-\$2,953,211,798	-\$2,249,027	-\$9,162,495	-\$2,964,623,319
2015	-	-\$3,222,456,157	-\$2,770,472	-\$11,391,055	-\$3,236,617,684
2016	-	-\$3,512,502,777	-\$3,277,772	-\$13,588,684	-\$3,529,369,234
2017	-	-\$3,825,474,232	-\$3,789,749	-\$15,827,993	-\$3,845,091,974
2018	-	-\$4,160,351,836	-\$4,305,690	-\$18,102,249	-\$4,182,759,775
2019	-	-\$4,516,491,165	-\$4,837,179	-\$20,456,980	-\$4,541,785,324
2020	-	-\$4,898,151,904	-\$5,405,966	-\$22,982,281	-\$4,926,540,150
2021	-	-\$5,311,393,039	-\$5,996,293	-\$25,609,909	-\$5,342,999,241
2022	-	-\$5,755,151,176	-\$6,630,037	-\$28,431,760	-\$5,790,212,972
2023	-	-\$6,232,918,900	-\$7,325,784	-\$31,526,984	-\$6,271,771,667
2024	-	-\$6,745,253,434	-\$8,091,433	-\$34,929,425	-\$6,788,274,293
2025	-	-\$7,291,996,997	-\$8,937,704	-\$38,685,159	-\$7,339,619,860
2026	-	-\$7,872,586,907	-\$9,877,187	-\$42,848,458	-\$7,925,312,551
2027	-	-\$8,492,311,982	-\$10,914,083	-\$47,437,173	-\$8,550,663,239
2028	-	-\$9,160,900,242	-\$12,056,758	-\$52,486,973	-\$9,225,443,973
2029	-	-\$9,882,867,306	-\$13,314,454	-\$58,037,174	-\$9,954,218,934
2030	-	-\$10,659,495,075	-\$14,678,687	-\$64,049,545	-\$10,738,223,308
2031	-	-\$11,493,469,713	-\$15,349,200	-\$67,027,819	-\$11,575,846,731
2032	-	-\$12,386,940,489	-\$15,964,206	-\$69,752,763	-\$12,472,657,457
2033	-	-\$13,342,124,296	-\$16,568,121	-\$72,417,772	-\$13,431,110,189
2034	-	-\$14,356,844,452	-\$17,159,955	-\$75,018,252	-\$14,449,022,659
2035	-	-\$15,432,379,851	-\$17,752,407	-\$77,609,583	-\$15,527,741,841
2036	-	-\$16,573,131,200	-\$18,375,970	-\$80,325,006	-\$16,671,832,177
2037	-	-\$17,786,273,266	-\$19,061,365	-\$83,298,656	-\$17,888,633,287
2038	-	-\$19,075,718,054	-\$19,741,874	-\$86,238,766	-\$19,181,698,694

Exhibit 148 Total Economic Burden Attributed to All-Cause Dementia & Informal Care: Intervention Scenario vs. Base Case (Males & Females, Ages 65+, 2008 Present Values) 2011-2038

Year	System Navigation: Impact of System Navigation on Provision of Informal Care (2008 Present Values)				
	Total Direct Health Costs	Total Unpaid Caregiver Opportunity Cost	Indirect Corporate Profits Impact	Indirect Wage Impact	Total Economic Burden
2011	-	-\$2,098,991,131	-\$566,236	-\$2,229,924	-\$2,101,787,291
2012	-	-\$2,219,565,106	-\$1,052,979	-\$4,198,704	-\$2,224,816,788
2013	-	-\$2,330,066,603	-\$1,487,474	-\$5,998,487	-\$2,337,552,564
2014	-	-\$2,434,029,988	-\$1,853,643	-\$7,551,706	-\$2,443,435,337
2015	-	-\$2,534,865,406	-\$2,179,323	-\$8,960,492	-\$2,546,005,221
2016	-	-\$2,630,463,939	-\$2,454,677	-\$10,176,375	-\$2,643,094,991
2017	-	-\$2,719,769,429	-\$2,694,370	-\$11,253,112	-\$2,733,716,911
2018	-	-\$2,799,823,436	-\$2,897,633	-\$12,182,408	-\$2,814,903,476
2019	-	-\$2,869,351,010	-\$3,073,086	-\$12,996,429	-\$2,885,420,525
2020	-	-\$2,931,691,111	-\$3,235,633	-\$13,755,586	-\$2,948,682,329
2021	-	-\$2,992,040,621	-\$3,377,862	-\$14,426,702	-\$3,009,845,185
2022	-	-\$3,052,089,861	-\$3,516,062	-\$15,078,020	-\$3,070,683,944
2023	-	-\$3,116,561,922	-\$3,663,012	-\$15,764,010	-\$3,135,988,945
2024	-	-\$3,188,481,621	-\$3,824,821	-\$16,511,141	-\$3,208,817,583
2025	-	-\$3,270,161,323	-\$4,008,193	-\$17,348,706	-\$3,291,518,222
2026	-	-\$3,363,070,585	-\$4,219,410	-\$18,304,325	-\$3,385,594,320
2027	-	-\$3,470,204,200	-\$4,459,810	-\$19,384,200	-\$3,494,048,211
2028	-	-\$3,594,953,705	-\$4,731,357	-\$20,597,128	-\$3,620,282,190
2029	-	-\$3,737,276,635	-\$5,034,956	-\$21,947,170	-\$3,764,258,761
2030	-	-\$3,894,999,548	-\$5,363,620	-\$23,403,824	-\$3,923,766,992
2031	-	-\$4,065,820,201	-\$5,429,787	-\$23,711,122	-\$4,094,961,109
2032	-	-\$4,246,721,745	-\$5,473,146	-\$23,913,942	-\$4,276,108,834
2033	-	-\$4,434,379,386	-\$5,506,569	-\$24,068,722	-\$4,463,954,677
2034	-	-\$4,623,890,701	-\$5,526,685	-\$24,161,034	-\$4,653,578,420
2035	-	-\$4,811,604,748	-\$5,534,957	-\$24,197,606	-\$4,841,337,310
2036	-	-\$4,994,983,105	-\$5,538,342	-\$24,209,188	-\$5,024,730,634
2037	-	-\$5,172,447,573	-\$5,543,258	-\$24,224,183	-\$5,202,215,015
2038	-	-\$5,341,621,402	-\$5,528,160	-\$24,148,755	-\$5,371,298,316

APPENDIX E: ALZHEIMER'S RESULTS

Note: All estimates of prevalence are measured at a specific point in time and incorporates all changes from the previous period. Therefore, the value in the year column represents finite moment in time. For example, the value in year column 2011 is a measure prevalence on Jan 1st 2011.

All estimates of incidence are measured over a specific period (one year period). Therefore, the specific value in the year column actually refers to a period of time over which incidence was measured. For example, 2011 refers to the period 2010 to 2011 (Jan 1st 2010 to Dec. 31st 2010).

PREVALENCE:

Exhibit 149 Alzheimer's, Prevalence, Males and Females, Expected Value, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Expected Value							
	All Ages (50+)*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	303,878	291,106	10,423	23,279	41,027	62,124	97,066	57,187
2009	314,814	301,386	10,996	23,768	41,285	63,041	100,561	61,737
2010	326,736	312,384	11,819	24,469	41,354	63,691	104,136	66,915
2011	336,193	321,210	12,348	25,028	41,705	64,448	106,148	71,533
2012	345,832	330,105	13,004	25,628	41,914	64,972	108,467	76,121
2013	356,215	339,776	13,630	26,392	42,546	66,097	110,102	81,010
2014	366,575	349,517	14,136	27,073	43,658	67,236	111,827	85,586
2015	376,324	358,343	14,891	27,992	44,389	68,383	113,112	89,576
2016	387,092	368,483	15,418	28,728	45,711	69,975	115,314	93,337
2017	397,164	377,998	15,884	29,584	47,265	71,698	116,256	97,311
2018	408,863	389,160	16,346	30,582	49,436	74,012	117,695	101,088
2019	420,687	400,613	16,641	31,504	51,546	76,690	120,103	104,130
2020	433,147	412,660	16,962	32,655	54,102	79,494	121,494	107,953
2021	445,855	424,981	17,273	33,567	56,266	82,331	124,769	110,773
2022	460,595	439,549	17,386	34,623	59,244	86,114	127,577	114,605
2023	474,951	453,693	17,541	35,693	61,958	89,663	132,099	116,741
2024	490,979	469,639	17,535	36,755	64,636	93,313	136,098	121,302
2025	507,130	485,914	17,405	37,608	67,198	97,328	141,932	124,443
2026	524,432	503,518	17,070	38,424	69,861	101,537	147,886	128,740
2027	542,068	521,098	17,056	39,300	72,125	105,204	154,567	132,847
2028	561,548	540,917	16,703	40,216	75,109	109,666	161,412	137,810
2029	581,062	560,579	16,570	41,015	77,143	114,135	169,335	142,381
2030	600,102	580,059	16,067	41,581	79,337	118,153	177,364	147,556
2031	622,575	602,732	15,844	42,487	81,458	122,730	186,440	153,773
2032	643,206	623,875	15,413	42,868	83,281	126,110	195,255	160,949
2033	663,618	644,729	15,002	43,461	84,820	130,064	203,196	168,186
2034	685,489	666,793	14,808	43,985	86,084	133,598	211,832	176,486
2035	707,741	689,448	14,393	44,444	87,601	137,192	221,067	184,751
2036	729,060	711,033	14,147	44,855	88,471	140,188	229,538	193,834
2037	749,528	731,956	13,747	45,233	88,997	142,872	237,871	203,235
2038	770,811	753,434	13,480	45,601	89,532	145,529	246,711	212,582

*The 65+ population was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals in the age range [50,64] could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations in this age range (50 to 64) must be interpreted with caution.

Exhibit 150 Alzheimer's, Prevalence, Males and Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Lower Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	283,612	272,137	9,341	22,069	37,488	58,668	90,881	53,690
2009	292,916	280,866	9,676	22,748	37,640	59,196	93,772	57,834
2010	304,363	291,383	10,604	23,280	37,739	60,113	96,980	62,666
2011	312,855	299,245	11,128	23,729	37,674	60,785	99,188	66,741
2012	321,567	307,327	11,759	24,325	38,195	61,391	100,233	71,423
2013	329,934	315,289	12,063	25,004	38,516	62,220	102,160	75,326
2014	341,220	325,684	12,834	25,768	39,404	63,600	104,024	80,055
2015	351,280	334,981	13,458	26,558	40,540	64,547	106,415	83,463
2016	359,988	343,193	13,827	27,419	41,677	66,071	107,470	86,730
2017	370,328	352,962	14,361	28,249	43,305	67,684	108,079	91,285
2018	379,684	361,973	14,620	28,998	45,107	69,419	109,396	94,434
2019	391,362	373,274	14,907	30,015	47,243	72,224	111,608	97,277
2020	403,565	384,837	15,437	31,005	49,263	74,367	113,789	100,977
2021	415,523	396,632	15,528	31,876	51,738	77,377	117,122	102,993
2022	427,383	408,441	15,529	32,928	54,013	80,777	118,909	106,285
2023	444,388	425,140	15,744	34,106	56,510	84,737	124,188	109,853
2024	458,779	439,366	15,887	35,020	59,703	88,442	127,214	113,101
2025	472,019	452,912	15,572	35,787	61,702	92,058	131,751	116,042
2026	489,202	470,276	15,328	36,609	64,109	95,430	138,979	119,822
2027	504,171	485,511	15,086	37,354	65,956	99,016	143,866	124,233
2028	521,829	503,330	14,930	38,129	68,166	103,538	150,664	127,903
2029	540,519	522,518	14,416	39,118	70,663	107,474	157,939	132,907
2030	558,468	540,802	14,049	39,709	72,013	111,421	164,926	138,684
2031	578,441	560,930	13,837	40,361	74,187	114,648	173,574	144,323
2032	598,973	582,174	13,211	40,689	75,764	119,216	182,214	151,081
2033	617,585	600,923	13,147	41,432	76,775	122,295	189,880	157,394
2034	637,112	620,715	12,784	41,976	78,058	125,678	199,126	163,094
2035	661,045	644,828	12,483	42,662	80,630	130,572	206,640	171,841
2036	681,085	665,046	12,294	42,869	80,214	132,814	215,532	181,323
2037	697,344	681,710	11,905	42,923	81,648	135,292	221,207	188,737
2038	715,934	700,231	11,813	43,154	80,387	137,302	229,691	197,885

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 151 Alzheimer's, Prevalence, Males and Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	325,646	311,514	11,626	24,465	44,666	65,619	103,922	61,216
2009	336,510	321,630	12,245	25,072	45,132	66,737	106,881	65,562
2010	349,225	333,389	13,078	25,678	44,716	67,283	110,987	71,647
2011	358,055	341,579	13,584	26,323	45,210	67,765	112,973	75,723
2012	368,323	351,092	14,298	26,903	45,495	68,883	114,893	80,619
2013	380,492	362,344	15,084	27,601	46,209	70,168	116,752	86,530
2014	390,687	371,980	15,535	28,241	47,093	71,037	118,981	91,092
2015	400,565	380,975	16,323	29,178	48,192	72,251	120,235	94,795
2016	413,096	392,796	16,880	30,180	49,495	74,352	122,527	99,363
2017	424,141	403,206	17,402	30,992	51,145	75,849	123,709	104,108
2018	438,111	416,498	18,017	32,128	53,917	78,795	125,268	108,373
2019	450,706	428,647	18,382	33,288	56,209	81,129	127,956	111,684
2020	463,426	440,930	18,701	34,083	59,113	84,404	129,847	114,781
2021	475,805	452,977	18,919	35,027	60,886	86,938	132,746	118,460
2022	489,960	467,084	18,933	36,271	63,875	90,908	135,985	121,111
2023	506,658	483,339	19,305	37,313	66,323	94,047	141,283	125,067
2024	523,063	499,706	19,226	38,279	69,818	98,263	145,519	128,599
2025	544,015	520,790	19,092	39,372	73,056	103,202	152,569	133,501
2026	561,823	538,518	19,095	40,338	75,776	107,607	158,303	137,399
2027	581,432	558,241	18,997	41,352	79,537	111,911	165,107	141,337
2028	599,541	576,856	18,472	42,106	81,159	116,772	172,480	145,866
2029	620,987	598,480	18,266	42,739	83,848	120,282	180,915	152,429
2030	643,076	620,605	18,265	43,647	86,447	124,720	189,541	157,986
2031	666,193	644,075	17,861	44,352	88,604	129,782	198,926	164,550
2032	687,826	666,368	17,271	44,964	91,078	134,063	207,825	171,167
2033	709,957	688,732	17,002	45,497	92,515	136,695	217,107	179,916
2034	733,509	712,566	16,721	46,159	93,196	140,640	227,296	188,554
2035	755,401	734,952	16,310	46,447	94,604	144,668	236,105	196,819
2036	778,657	758,512	15,962	46,870	96,141	147,796	246,076	205,667
2037	805,098	785,175	15,676	47,396	97,583	150,732	255,617	218,171
2038	824,991	805,217	15,600	47,650	98,073	154,100	263,601	226,194

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 152 Alzheimer's, Prevalence, Males, Expected Value, By Age Groups: 2008-2038

Year	Prevalence, Males, Expected Value							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	85,488	82,809	2,089	6,895	14,828	20,602	26,120	12,277
2009	89,267	86,422	2,232	7,091	15,052	21,079	27,505	13,463
2010	93,150	90,114	2,402	7,281	15,076	21,404	29,082	14,870
2011	96,508	93,303	2,527	7,436	15,282	21,809	29,940	16,311
2012	99,547	96,214	2,656	7,645	15,417	22,126	30,903	17,466
2013	103,300	99,813	2,781	7,837	15,608	22,700	32,018	18,870
2014	107,063	103,428	2,898	8,065	16,004	23,216	32,988	20,257
2015	110,831	106,991	3,062	8,361	16,516	23,903	33,613	21,536
2016	114,321	110,378	3,159	8,530	16,892	24,388	34,668	22,741
2017	118,024	113,944	3,252	8,845	17,620	25,167	35,117	23,943
2018	121,999	117,823	3,330	9,151	18,230	26,014	36,010	25,089
2019	126,165	121,909	3,379	9,450	18,991	26,997	37,020	26,072
2020	130,759	126,421	3,433	9,852	20,166	28,323	37,725	26,922
2021	135,074	130,697	3,463	10,110	20,770	29,168	38,934	28,252
2022	139,845	135,465	3,450	10,477	21,901	30,601	39,803	29,232
2023	145,009	140,627	3,442	10,836	23,020	32,068	41,103	30,158
2024	150,555	146,229	3,371	11,170	23,998	33,382	42,881	31,426
2025	156,267	152,002	3,316	11,552	25,217	35,007	44,593	32,316
2026	161,896	157,673	3,259	11,863	26,061	36,469	46,558	33,463
2027	168,616	164,402	3,219	12,218	27,102	37,858	49,084	34,920
2028	174,979	170,889	3,094	12,483	28,122	39,459	51,453	36,277
2029	181,829	177,883	2,969	12,777	29,032	41,122	54,159	37,823
2030	188,679	184,850	2,824	12,992	29,640	42,581	57,254	39,560
2031	195,281	191,522	2,740	13,342	30,552	44,059	59,312	41,517
2032	202,501	198,893	2,632	13,496	31,168	45,367	62,892	43,338
2033	210,469	207,015	2,457	13,783	32,225	47,171	65,696	45,682
2034	217,786	214,402	2,390	13,986	32,679	48,472	68,725	48,150
2035	225,133	221,897	2,238	14,206	33,299	49,737	71,596	50,821
2036	232,021	228,851	2,165	14,368	33,514	50,798	74,706	53,301
2037	238,607	235,633	1,983	14,512	33,910	51,793	77,645	55,791
2038	246,032	243,066	1,966	14,702	34,401	52,982	80,496	58,520

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 153 Alzheimer's, Prevalence, Males, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Males, Lower Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	79,460	77,125	1,807	6,552	13,519	19,367	24,421	11,459
2009	82,571	80,142	1,849	6,725	13,819	19,684	25,628	12,436
2010	86,910	84,206	2,090	6,917	13,986	20,266	27,014	13,933
2011	89,539	86,742	2,186	7,093	13,772	20,388	28,127	15,175
2012	93,715	90,734	2,356	7,286	14,319	21,211	29,136	16,426
2013	96,134	93,074	2,419	7,408	14,267	21,297	30,011	17,672
2014	99,428	96,231	2,542	7,700	14,550	21,936	30,680	18,824
2015	103,081	99,735	2,638	7,906	15,119	22,465	31,492	20,114
2016	105,897	102,435	2,757	8,133	15,327	22,968	32,151	21,099
2017	109,803	106,135	2,912	8,444	16,238	23,797	32,703	22,042
2018	113,458	109,802	2,884	8,746	16,784	24,453	33,613	23,322
2019	117,153	113,440	2,897	9,050	17,597	25,451	34,232	24,213
2020	121,050	117,289	2,965	9,280	18,252	26,343	35,025	25,424
2021	125,904	122,024	3,025	9,673	19,157	27,660	36,216	26,293
2022	130,118	126,301	2,987	9,974	19,993	28,798	37,275	27,274
2023	135,140	131,284	2,936	10,396	21,116	30,051	38,396	28,388
2024	140,461	136,645	2,929	10,638	22,309	31,538	40,176	29,055
2025	144,714	141,045	2,772	10,965	23,048	33,023	41,159	30,078
2026	150,626	146,958	2,759	11,270	23,993	34,005	43,696	31,234
2027	156,522	152,907	2,713	11,531	25,028	35,695	45,236	32,704
2028	161,437	157,984	2,544	11,803	25,298	36,943	47,757	33,637
2029	168,287	164,956	2,436	12,167	26,443	38,841	49,977	35,092
2030	174,903	171,667	2,333	12,378	26,840	39,969	53,044	37,103
2031	181,022	177,919	2,200	12,678	28,032	41,366	55,062	38,580
2032	187,489	184,562	2,035	12,807	28,404	42,694	58,240	40,384
2033	195,607	192,807	1,890	13,093	29,449	44,156	61,299	42,922
2034	201,601	198,895	1,809	13,311	29,675	45,472	64,248	44,378
2035	209,458	206,794	1,659	13,594	30,659	47,327	66,409	47,146
2036	216,660	213,985	1,623	13,689	30,417	48,163	70,220	49,873
2037	222,697	220,047	1,495	13,808	31,392	49,260	71,778	52,314
2038	228,642	225,987	1,396	14,012	31,466	50,198	74,979	53,935

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 154 Alzheimer's, Prevalence, Males, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Males, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	91,722	88,707	2,377	7,273	16,035	21,776	28,245	13,002
2009	95,543	92,338	2,526	7,452	16,427	22,384	29,246	14,304
2010	99,617	96,214	2,703	7,591	16,197	22,811	30,994	15,917
2011	103,447	99,880	2,833	7,848	16,588	23,143	32,202	17,265
2012	106,285	102,583	2,972	7,971	16,739	23,414	32,797	18,689
2013	110,598	106,672	3,150	8,168	16,937	24,081	33,924	20,412
2014	114,206	110,130	3,273	8,388	17,332	24,427	34,987	21,723
2015	118,182	113,889	3,468	8,711	17,791	25,234	35,891	22,794
2016	122,426	118,049	3,520	8,978	18,378	26,024	36,893	24,255
2017	125,971	121,451	3,643	9,275	18,958	26,576	37,375	25,624
2018	130,945	126,236	3,808	9,610	19,922	27,677	38,229	26,990
2019	135,238	130,456	3,866	9,910	20,572	28,651	39,456	28,002
2020	139,827	135,034	3,828	10,283	21,757	29,990	40,088	29,089
2021	144,171	139,246	3,948	10,585	22,477	30,799	41,444	29,994
2022	149,154	144,296	3,873	10,911	23,622	32,188	42,555	31,147
2023	154,871	149,930	3,943	11,351	24,725	33,609	44,074	32,227
2024	161,158	156,265	3,853	11,684	26,184	35,210	45,869	33,465
2025	167,279	162,426	3,809	11,965	27,083	36,983	47,779	34,807
2026	172,859	168,039	3,734	12,381	28,122	38,169	49,770	35,863
2027	181,420	176,663	3,694	12,792	29,745	40,572	52,601	37,259
2028	187,882	183,237	3,552	13,096	30,400	41,848	55,446	38,895
2029	194,842	190,193	3,554	13,407	31,673	43,328	57,752	40,479
2030	202,385	197,894	3,397	13,717	32,400	44,973	60,860	42,546
2031	210,161	205,757	3,250	13,941	32,888	46,665	64,105	44,908
2032	216,340	212,096	3,144	14,191	33,745	48,027	66,965	46,024
2033	225,086	221,032	3,020	14,491	35,013	49,806	70,099	48,603
2034	234,175	230,131	2,919	14,701	35,105	51,172	74,200	52,035
2035	241,381	237,467	2,854	14,841	36,255	52,736	76,647	54,134
2036	247,648	243,863	2,701	15,085	36,487	53,726	79,577	56,287
2037	255,192	251,555	2,576	15,150	36,848	54,791	82,832	59,358
2038	261,552	257,926	2,555	15,273	36,880	55,630	85,200	62,388

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 155 Alzheimer's, Prevalence, Females, By Age Groups: 2008-2038

Year	Prevalence, Females, Expected Value							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	218,390	208,296	8,335	16,384	26,199	41,523	70,946	44,910
2009	225,547	214,964	8,764	16,677	26,232	41,961	73,056	48,273
2010	233,586	222,269	9,417	17,188	26,277	42,287	75,054	52,045
2011	239,685	227,906	9,822	17,592	26,423	42,639	76,208	55,222
2012	246,285	233,891	10,348	17,983	26,497	42,845	77,564	58,654
2013	252,915	239,963	10,849	18,555	26,937	43,397	78,085	62,140
2014	259,512	246,089	11,239	19,007	27,655	44,020	78,839	65,330
2015	265,492	251,351	11,828	19,631	27,872	44,480	79,499	68,039
2016	272,771	258,105	12,259	20,197	28,819	45,587	80,647	70,596
2017	279,140	264,054	12,632	20,738	29,645	46,531	81,139	73,368
2018	286,864	271,336	13,016	21,431	31,207	47,999	81,685	75,999
2019	294,522	278,704	13,262	22,054	32,555	49,694	83,083	78,057
2020	302,388	286,239	13,529	22,803	33,936	51,171	83,769	81,031
2021	310,781	294,283	13,810	23,458	35,495	53,164	85,835	82,521
2022	320,751	304,084	13,935	24,146	37,343	55,513	87,773	85,373
2023	329,942	313,066	14,099	24,856	38,937	57,595	90,996	86,583
2024	340,423	323,411	14,164	25,584	40,638	59,931	93,217	89,876
2025	350,863	333,912	14,089	26,056	41,981	62,321	97,339	92,126
2026	362,535	345,845	13,811	26,561	43,801	65,068	101,328	95,277
2027	373,452	356,696	13,837	27,082	45,023	67,346	105,483	97,926
2028	386,569	370,028	13,609	27,733	46,988	70,207	109,959	101,533
2029	399,233	382,697	13,601	28,238	48,111	73,014	115,175	104,558
2030	411,423	395,209	13,243	28,589	49,698	75,572	120,110	107,995
2031	427,294	411,210	13,104	29,145	50,906	78,671	127,128	112,256
2032	440,706	424,982	12,780	29,372	52,112	80,743	132,363	117,611
2033	453,148	437,714	12,545	29,678	52,595	82,893	137,500	122,504
2034	467,703	452,391	12,418	29,999	53,405	85,126	143,107	128,337
2035	482,608	467,551	12,155	30,238	54,303	87,455	149,470	133,930
2036	497,038	482,182	11,982	30,487	54,958	89,390	154,832	140,533
2037	510,922	496,323	11,764	30,722	55,087	91,080	160,226	147,444
2038	524,780	510,368	11,514	30,899	55,130	92,547	166,215	154,062

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 156 Alzheimer's, Prevalence, Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Females, Lower Bound							
	All Ages	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	204,152	195,013	7,534	15,517	23,969	39,301	66,460	42,231
2009	210,345	200,724	7,827	16,023	23,820	39,512	68,144	45,398
2010	217,454	207,177	8,515	16,363	23,753	39,847	69,966	48,733
2011	223,316	212,502	8,941	16,636	23,902	40,397	71,060	51,566
2012	227,852	216,593	9,403	17,039	23,876	40,181	71,097	54,997
2013	233,800	222,215	9,644	17,596	24,248	40,924	72,150	57,654
2014	241,792	229,453	10,292	18,068	24,855	41,664	73,344	61,231
2015	248,199	235,246	10,820	18,651	25,421	42,083	74,923	63,349
2016	254,091	240,758	11,070	19,286	26,350	43,103	75,318	65,631
2017	260,525	246,827	11,449	19,805	27,067	43,887	75,376	69,243
2018	266,227	252,172	11,736	20,252	28,323	44,966	75,783	71,112
2019	274,209	259,834	12,010	20,965	29,646	46,773	77,376	73,064
2020	282,515	267,548	12,472	21,725	31,011	48,024	78,765	75,552
2021	289,618	274,608	12,503	22,202	32,581	49,716	80,906	76,700
2022	297,265	282,140	12,541	22,954	34,021	51,979	81,634	79,011
2023	309,248	293,855	12,808	23,710	35,394	54,686	85,792	81,465
2024	318,318	302,721	12,958	24,382	37,394	56,904	87,037	84,046
2025	327,305	311,868	12,800	24,822	38,654	59,035	90,592	85,964
2026	338,576	323,318	12,569	25,338	40,115	61,425	95,283	88,588
2027	347,649	332,604	12,373	25,823	40,928	63,321	98,630	91,529
2028	360,391	345,346	12,385	26,326	42,868	66,594	102,907	94,266
2029	372,232	357,562	11,981	26,950	44,220	68,634	107,962	97,816
2030	383,565	369,135	11,716	27,331	45,173	71,451	111,882	101,581
2031	397,419	383,011	11,637	27,683	46,155	73,282	118,511	105,743
2032	411,484	397,612	11,176	27,882	47,360	76,523	123,975	110,697
2033	421,978	408,116	11,257	28,339	47,326	78,139	128,582	114,472
2034	435,511	421,821	10,975	28,664	48,383	80,206	134,878	118,715
2035	451,587	438,034	10,823	29,067	49,972	83,245	140,232	124,695
2036	464,425	451,061	10,671	29,180	49,798	84,651	145,311	131,450
2037	474,648	461,663	10,410	29,114	50,256	86,032	149,429	136,422
2038	487,291	474,244	10,416	29,142	48,920	87,104	154,712	143,949

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 157 Alzheimer's, Prevalence, Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Females, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	233,924	222,807	9,249	17,193	28,631	43,843	75,677	48,214
2009	240,968	229,292	9,719	17,620	28,705	44,354	77,636	51,258
2010	249,608	237,175	10,375	18,086	28,519	44,472	79,993	55,730
2011	254,608	241,700	10,752	18,475	28,623	44,622	80,771	58,458
2012	262,038	248,509	11,326	18,932	28,756	45,469	82,096	61,929
2013	269,895	255,672	11,934	19,433	29,272	46,087	82,828	66,118
2014	276,480	261,850	12,262	19,853	29,762	46,610	83,994	69,369
2015	282,383	267,086	12,855	20,467	30,402	47,017	84,344	72,001
2016	290,670	274,748	13,359	21,202	31,117	48,327	85,634	75,108
2017	298,170	281,755	13,759	21,716	32,188	49,274	86,334	78,484
2018	307,166	290,262	14,208	22,518	33,996	51,118	87,039	81,383
2019	315,469	298,192	14,516	23,379	35,637	52,478	88,500	83,681
2020	323,599	305,896	14,873	23,800	37,356	54,414	89,759	85,692
2021	331,633	313,731	14,971	24,442	38,410	56,139	91,302	88,467
2022	340,806	322,788	15,060	25,360	40,253	58,721	93,430	89,964
2023	351,787	333,410	15,362	25,963	41,598	60,439	97,209	92,840
2024	361,905	343,441	15,374	26,595	43,634	63,053	99,651	95,134
2025	376,737	358,364	15,283	27,406	45,973	66,219	104,790	98,693
2026	388,965	370,479	15,361	27,957	47,654	69,438	108,533	101,537
2027	400,011	381,579	15,303	28,560	49,793	71,339	112,506	104,078
2028	411,659	393,619	14,920	29,010	50,759	74,925	117,034	106,971
2029	426,145	408,287	14,712	29,332	52,175	76,954	123,163	111,951
2030	440,691	422,711	14,867	29,930	54,046	79,747	128,681	115,440
2031	456,032	438,318	14,611	30,411	55,716	83,117	134,821	119,642
2032	471,486	454,272	14,127	30,773	57,333	86,036	140,860	125,144
2033	484,871	467,700	13,982	31,006	57,502	86,889	147,008	131,313
2034	499,333	482,435	13,802	31,458	58,091	89,468	153,096	136,519
2035	514,019	497,485	13,456	31,606	58,349	91,931	159,459	142,685
2036	531,009	514,649	13,261	31,785	59,654	94,070	166,498	149,380
2037	549,906	533,619	13,100	32,246	60,734	95,941	172,785	158,813
2038	563,440	547,291	13,045	32,376	61,193	98,470	178,401	163,806

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

INCIDENCE:

Exhibit 158 Alzheimer's, Incidence, Males and Females, Expected Value, By Age Group: 2008-2038

Year	Incidence, Males and Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	51,440	2,080	3,352	5,478	11,017	29,513
2009	53,451	2,246	3,544	5,617	11,143	30,901
2010	55,518	2,356	3,622	5,572	11,272	32,696
2011	57,319	2,495	3,763	5,510	11,437	34,114
2012	58,429	2,524	3,996	5,643	11,435	34,831
2013	60,233	2,386	4,011	5,613	11,664	36,559
2014	62,160	2,982	4,345	5,829	11,561	37,443
2015	63,752	2,968	4,463	5,973	11,971	38,377
2016	65,690	3,003	4,842	6,319	11,998	39,528
2017	66,838	2,837	5,048	6,571	12,096	40,286
2018	68,355	3,317	5,130	6,636	12,561	40,711
2019	70,860	3,286	5,451	7,065	13,101	41,957
2020	72,275	3,060	5,616	7,531	13,146	42,922
2021	74,802	3,389	5,672	7,775	13,933	44,033
2022	77,105	3,394	6,126	8,301	14,567	44,717
2023	79,984	3,635	6,323	8,776	14,963	46,287
2024	81,941	3,660	6,322	8,972	15,649	47,338
2025	85,525	3,959	6,249	9,467	16,662	49,188
2026	88,204	3,391	6,588	9,610	17,374	51,241
2027	90,805	3,494	6,814	9,792	18,288	52,417
2028	96,095	3,911	7,076	10,312	19,176	55,620
2029	98,304	3,592	7,034	10,487	19,733	57,458
2030	102,711	3,624	7,298	10,953	20,492	60,344
2031	105,890	3,911	7,260	11,119	21,032	62,568
2032	110,238	3,785	7,401	11,255	22,285	65,512
2033	115,038	3,820	7,487	11,633	22,895	69,203
2034	118,453	3,575	7,419	12,056	23,738	71,665
2035	122,513	3,570	7,483	11,831	24,547	75,082
2036	125,442	3,766	7,286	11,981	24,874	77,535
2037	129,445	3,408	7,254	12,204	25,079	81,500
2038	133,715	3,436	7,189	12,415	26,173	84,502

Exhibit 159 Alzheimer's, Incidence, Males and Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Males and Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	37,424	30	1,710	3,401	8,197	24,086
2009	40,114	31	1,943	3,434	8,905	25,801
2010	41,613	36	1,943	3,756	8,644	27,234
2011	41,825	38	1,948	3,246	8,840	27,753
2012	43,990	42	2,100	3,532	8,757	29,559
2013	45,169	46	2,249	3,449	9,167	30,258
2014	46,049	49	2,269	3,896	8,864	30,971
2015	46,759	56	2,194	3,714	8,840	31,955
2016	48,646	61	2,704	4,150	9,259	32,472
2017	49,812	69	2,740	4,213	9,614	33,176
2018	50,888	76	2,572	4,320	9,596	34,324
2019	51,131	82	2,585	4,439	10,054	33,971
2020	53,347	92	3,101	4,423	10,151	35,580
2021	55,758	98	3,216	4,986	10,825	36,633
2022	56,128	108	2,880	4,883	11,094	37,163
2023	58,090	116	3,439	5,322	11,273	37,940
2024	60,670	125	3,725	5,752	11,889	39,179
2025	63,008	136	3,774	6,180	12,404	40,514
2026	64,580	155	3,445	6,299	13,044	41,637
2027	67,682	166	3,665	6,148	13,959	43,744
2028	71,218	184	3,935	6,587	14,240	46,272
2029	73,130	211	3,674	6,503	14,939	47,803
2030	75,055	232	3,618	6,987	15,517	48,701
2031	79,450	268	3,950	7,020	16,414	51,798
2032	80,710	310	3,862	7,513	16,654	52,371
2033	86,215	341	4,318	7,419	17,462	56,675
2034	89,464	385	3,867	8,101	18,289	58,822
2035	92,834	440	3,572	7,960	19,149	61,713
2036	95,404	510	4,083	7,721	19,605	63,485
2037	98,740	571	3,646	7,547	19,513	67,463
2038	102,978	625	3,531	8,226	20,350	70,246

Exhibit 160 Alzheimer's, Incidence, Males and Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Incidence, Males and Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	63,931	4,109	4,810	7,439	13,336	34,237
2009	67,060	4,197	5,248	7,398	13,745	36,472
2010	69,631	4,523	5,393	7,528	14,154	38,033
2011	71,887	4,799	5,545	7,660	14,214	39,669
2012	73,365	4,895	5,578	7,418	14,188	41,286
2013	76,385	4,745	5,913	7,860	14,232	43,635
2014	77,139	5,381	6,098	8,108	14,325	43,227
2015	80,578	5,745	6,543	8,416	14,836	45,038
2016	82,411	5,382	7,033	8,382	14,832	46,782
2017	83,270	5,869	7,312	8,682	14,627	46,780
2018	86,556	6,366	7,533	9,413	15,295	47,949
2019	89,408	6,037	7,810	9,610	16,037	49,914
2020	90,172	6,196	8,198	10,079	16,340	49,359
2021	94,739	6,784	8,366	10,727	17,234	51,628
2022	96,428	6,825	8,894	11,250	17,458	52,001
2023	101,723	7,327	9,155	11,631	19,201	54,409
2024	102,547	7,066	9,099	12,001	19,437	54,944
2025	106,089	6,899	9,356	12,497	20,325	57,012
2026	110,325	6,915	9,554	12,868	21,378	59,610
2027	114,045	6,977	9,940	13,100	22,743	61,285
2028	119,932	7,264	9,938	14,239	23,572	64,919
2029	124,083	7,658	10,337	14,448	23,997	67,643
2030	129,759	7,202	10,408	15,328	25,343	71,478
2031	131,378	7,389	10,412	14,952	25,821	72,804
2032	136,323	7,094	10,874	15,379	27,146	75,830
2033	143,499	7,297	10,294	16,268	28,382	81,258
2034	146,902	6,559	11,041	15,910	29,175	84,217
2035	152,102	6,751	10,571	15,861	30,633	88,286
2036	156,828	6,957	10,329	16,948	30,597	91,997
2037	159,567	6,974	10,665	16,425	30,563	94,940
2038	166,156	6,962	10,453	16,664	32,228	99,849

Exhibit 161 Alzheimer's, Incidence, Males, Expected Value, By Age Group: 2008-2038

Year	Incidence, Males, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	18,655	1,104	1,779	3,154	3,535	9,083
2009	19,404	1,227	1,936	3,223	3,626	9,392
2010	20,368	1,206	1,853	3,158	3,756	10,395
2011	21,483	1,304	1,967	3,162	3,990	11,060
2012	21,735	1,314	2,080	3,220	3,820	11,301
2013	22,645	1,234	2,075	3,221	3,959	12,156
2014	23,692	1,623	2,364	3,310	4,026	12,369
2015	24,435	1,566	2,355	3,514	4,066	12,934
2016	25,130	1,629	2,626	3,677	4,193	13,005
2017	25,827	1,514	2,694	3,755	4,222	13,642
2018	26,725	1,754	2,713	3,769	4,463	14,026
2019	27,996	1,765	2,929	4,120	4,617	14,565
2020	28,352	1,604	2,943	4,344	4,580	14,881
2021	29,442	1,802	3,015	4,490	4,852	15,283
2022	30,581	1,781	3,215	4,889	5,228	15,468
2023	32,057	1,921	3,342	5,139	5,357	16,298
2024	32,727	1,957	3,381	5,138	5,556	16,695
2025	34,547	2,123	3,351	5,461	5,919	17,693
2026	35,489	1,763	3,425	5,573	6,264	18,464
2027	36,158	1,880	3,667	5,645	6,420	18,546
2028	39,049	2,129	3,852	6,030	6,818	20,220
2029	39,400	1,921	3,762	5,929	7,022	20,766
2030	41,113	1,994	4,015	6,173	7,351	21,580
2031	42,780	2,116	3,928	6,436	7,514	22,786
2032	44,697	2,013	3,936	6,534	8,017	24,197
2033	46,458	2,105	4,126	6,760	8,217	25,250
2034	48,066	1,982	4,112	7,184	8,451	26,337
2035	49,151	1,957	4,101	6,862	8,929	27,302
2036	50,555	1,997	3,863	7,010	9,043	28,642
2037	52,242	1,799	3,830	7,122	9,092	30,399
2038	54,462	1,825	3,817	7,321	9,650	31,849

Exhibit 162 Alzheimer's, Incidence, Males, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Males, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	11,939	16	944	1,832	2,387	6,760
2009	12,638	17	1,065	1,876	2,677	7,003
2010	13,524	18	1,009	2,083	2,509	7,905
2011	13,773	20	955	1,828	2,668	8,302
2012	14,727	22	1,078	1,919	2,667	9,041
2013	15,150	24	1,148	1,936	2,890	9,152
2014	16,092	27	1,152	2,324	2,935	9,654
2015	16,171	30	1,211	2,250	2,658	10,022
2016	16,510	33	1,539	2,470	2,858	9,610
2017	17,014	37	1,511	2,329	3,103	10,034
2018	17,739	40	1,339	2,402	3,007	10,951
2019	17,284	44	1,304	2,489	3,124	10,323
2020	18,606	48	1,781	2,448	3,323	11,006
2021	19,460	52	1,652	2,822	3,402	11,532
2022	19,588	57	1,412	2,880	3,353	11,886
2023	20,645	61	1,748	3,132	3,630	12,074
2024	21,530	67	2,072	3,322	3,796	12,273
2025	22,651	73	2,027	3,608	3,855	13,088
2026	23,690	81	1,790	3,675	4,236	13,908
2027	24,079	89	1,795	3,586	4,682	13,927
2028	26,084	100	2,180	4,033	4,486	15,285
2029	26,706	113	1,832	4,078	4,765	15,918
2030	26,273	128	1,815	4,075	5,021	15,234
2031	28,994	145	2,147	4,026	5,508	17,168
2032	29,173	165	2,097	4,318	5,515	17,078
2033	31,389	188	2,393	4,395	5,713	18,700
2034	33,090	213	2,186	4,805	5,809	20,077
2035	34,922	241	2,084	4,742	6,718	21,137
2036	35,073	271	2,183	4,356	6,743	21,520
2037	36,088	301	2,022	4,342	6,493	22,930
2038	38,209	332	1,791	4,817	6,749	24,520

Exhibit 163 Alzheimer's, Incidence, Males, 95% Upper Bound, By Age Groups: 2008-2038

Year	Incidence, Males, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	24,578	2,199	2,574	4,222	4,504	11,079
2009	25,860	2,267	2,835	4,214	4,699	11,845
2010	27,126	2,381	2,839	4,360	4,908	12,638
2011	28,334	2,496	2,884	4,360	5,161	13,433
2012	28,966	2,632	2,999	4,250	5,001	14,084
2013	30,691	2,459	3,064	4,658	5,316	15,194
2014	31,116	2,866	3,247	4,686	5,173	15,144
2015	33,108	3,148	3,585	4,796	5,367	16,212
2016	33,239	2,852	3,728	4,786	5,499	16,374
2017	34,201	3,053	3,803	5,054	5,469	16,822
2018	35,832	3,441	4,071	5,445	5,651	17,224
2019	37,599	3,225	4,172	5,641	5,998	18,563
2020	37,952	3,336	4,414	5,857	6,070	18,275
2021	39,647	3,661	4,514	6,259	6,474	18,739
2022	41,054	3,651	4,758	6,440	6,666	19,539
2023	43,395	3,970	4,960	6,757	7,044	20,664
2024	42,941	3,681	4,740	7,048	7,372	20,100
2025	45,126	3,784	5,132	7,210	7,541	21,459
2026	47,193	3,651	5,044	7,472	8,238	22,788
2027	49,034	3,760	5,357	7,492	8,923	23,502
2028	51,773	3,968	5,428	8,398	8,995	24,984
2029	52,722	4,051	5,468	7,932	9,065	26,206
2030	55,168	3,937	5,689	8,621	9,455	27,466
2031	55,101	3,986	5,617	8,620	9,684	27,194
2032	57,925	3,791	5,811	8,715	10,291	29,317
2033	61,770	3,968	5,597	9,490	11,044	31,671
2034	63,046	3,632	6,114	9,482	11,173	32,645
2035	65,161	3,728	5,838	9,154	12,025	34,416
2036	67,158	3,664	5,439	9,931	11,906	36,218
2037	67,755	3,715	5,680	9,559	11,640	37,161
2038	70,290	3,825	5,743	9,576	12,413	38,733

Exhibit 164 Alzheimer's, Incidence, Females, Expected Value, By Age Groups: 2008-2038

Year	Incidence, Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	32,784	976	1,573	2,324	7,482	20,429
2009	34,047	1,019	1,608	2,395	7,516	21,509
2010	35,153	1,151	1,769	2,415	7,516	22,302
2011	35,835	1,191	1,796	2,348	7,447	23,053
2012	36,695	1,210	1,917	2,423	7,615	23,530
2013	37,589	1,152	1,936	2,392	7,705	24,404
2014	38,469	1,360	1,981	2,520	7,534	25,074
2015	39,317	1,402	2,109	2,458	7,905	25,443
2016	40,563	1,375	2,216	2,642	7,806	26,524
2017	41,012	1,323	2,355	2,816	7,874	26,644
2018	41,628	1,563	2,417	2,866	8,097	26,685
2019	42,862	1,520	2,522	2,944	8,484	27,392
2020	43,923	1,456	2,673	3,187	8,566	28,041
2021	45,361	1,588	2,657	3,284	9,082	28,750
2022	46,525	1,613	2,912	3,413	9,339	29,248
2023	47,928	1,714	2,981	3,638	9,605	29,990
2024	49,213	1,703	2,941	3,834	10,093	30,642
2025	50,978	1,836	2,897	4,007	10,743	31,495
2026	52,716	1,628	3,162	4,037	11,111	32,778
2027	54,646	1,613	3,147	4,147	11,868	33,871
2028	57,046	1,782	3,224	4,282	12,358	35,400
2029	58,904	1,671	3,272	4,558	12,711	36,692
2030	61,598	1,630	3,283	4,780	13,142	38,763
2031	63,110	1,795	3,332	4,683	13,518	39,782
2032	65,542	1,772	3,465	4,721	14,268	41,316
2033	68,580	1,715	3,361	4,873	14,678	43,953
2034	70,389	1,594	3,307	4,873	15,287	45,328
2035	73,361	1,613	3,381	4,969	15,618	47,780
2036	74,888	1,770	3,423	4,971	15,831	48,893
2037	77,204	1,609	3,424	5,082	15,987	51,102
2038	79,252	1,611	3,371	5,094	16,523	52,653

Exhibit 165 Alzheimer's, Incidence, Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	25,485	14	765	1,569	5,811	17,326
2009	27,475	14	878	1,558	6,228	18,797
2010	28,089	17	934	1,674	6,135	19,329
2011	28,053	18	994	1,418	6,172	19,451
2012	29,262	20	1,022	1,613	6,090	20,517
2013	30,021	22	1,102	1,513	6,277	21,107
2014	29,957	22	1,117	1,572	5,929	21,317
2015	30,591	27	984	1,464	6,183	21,933
2016	32,135	28	1,164	1,680	6,401	22,862
2017	32,798	32	1,229	1,884	6,511	23,142
2018	33,150	36	1,233	1,918	6,590	23,373
2019	33,846	38	1,281	1,950	6,930	23,647
2020	34,742	44	1,321	1,975	6,828	24,574
2021	36,297	46	1,564	2,164	7,423	25,100
2022	36,539	51	1,467	2,003	7,741	25,277
2023	37,445	55	1,691	2,190	7,643	25,866
2024	39,140	58	1,653	2,430	8,093	26,906
2025	40,357	63	1,747	2,572	8,550	27,425
2026	40,889	74	1,655	2,623	8,808	27,729
2027	43,602	77	1,870	2,562	9,277	29,816
2028	45,136	84	1,755	2,554	9,755	30,988
2029	46,424	98	1,842	2,425	10,174	31,885
2030	48,781	104	1,802	2,912	10,496	33,467
2031	50,456	123	1,803	2,994	10,906	34,630
2032	51,536	145	1,764	3,195	11,139	35,293
2033	54,825	153	1,924	3,024	11,749	37,975
2034	56,375	172	1,681	3,296	12,481	38,745
2035	57,912	199	1,488	3,218	12,431	40,576
2036	60,335	240	1,901	3,365	12,863	41,966
2037	62,651	269	1,624	3,205	13,020	44,533
2038	64,768	293	1,739	3,409	13,601	45,726

APPENDIX F: VASCULAR DEMENTIA RESULTS

Note: All estimates of prevalence are measured at a specific point in time and incorporates all changes from the previous period. Therefore, the value in the year column represents finite moment in time. For example, the value in year column 2011 is a measure prevalence on Jan 1st 2011.

All estimates of incidence are measured over a specific period (one year period). Therefore, the specific value in the year column actually refers to a period of time over which incidence was measured. For example, 2011 refers to the period 2010 to 2011 (Jan 1st 2010 to Dec. 31st 2010).

PREVALENCE:**Exhibit 166** Vascular Dementia, Prevalence, Males and Females, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Expected Value							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	94,183	84,664	8,044	11,393	17,019	19,524	18,213	10,471
2009	98,238	88,249	8,463	11,827	17,363	19,994	19,103	11,499
2010	101,496	90,953	8,941	12,207	17,545	20,252	19,597	12,410
2011	104,362	93,404	9,301	12,539	17,693	20,371	20,270	13,230
2012	107,477	96,044	9,720	12,899	17,881	20,601	20,667	14,276
2013	110,299	98,306	10,199	13,275	18,026	20,845	20,870	15,091
2014	113,795	101,320	10,592	13,648	18,545	21,282	21,408	15,844
2015	116,893	103,926	11,045	14,158	18,833	21,578	21,743	16,568
2016	120,656	107,297	11,365	14,591	19,542	22,192	22,075	17,531
2017	124,215	110,392	11,782	15,094	20,043	22,722	22,528	18,222
2018	128,373	114,137	12,118	15,599	20,845	23,639	23,156	18,780
2019	131,871	117,357	12,381	16,018	21,646	24,467	23,280	19,566
2020	136,606	121,699	12,716	16,480	22,716	25,594	23,918	20,274
2021	140,875	125,645	12,940	17,074	23,999	26,757	23,974	20,901
2022	144,723	129,438	12,999	17,404	24,804	27,785	24,855	21,591
2023	149,019	133,499	13,191	17,873	25,964	28,927	25,508	22,036
2024	153,453	137,716	13,351	18,348	26,810	30,112	26,522	22,574
2025	158,734	142,799	13,467	18,825	28,169	31,570	27,598	23,171
2026	163,921	148,174	13,318	19,219	29,436	33,308	28,758	24,136
2027	167,882	152,099	13,364	19,405	30,066	34,087	29,966	25,210
2028	173,977	158,176	13,321	19,881	31,689	35,960	31,314	26,010
2029	178,774	162,978	13,313	20,298	32,317	37,014	33,226	26,810
2030	184,318	168,634	13,167	20,494	33,747	38,783	34,336	28,107
2031	188,553	172,905	13,127	20,732	33,828	39,496	36,507	29,214
2032	193,402	178,359	12,636	20,839	35,473	41,338	37,444	30,628
2033	198,636	183,390	12,807	21,085	35,807	42,126	39,524	32,041
2034	202,975	187,946	12,570	21,227	36,337	43,149	41,516	33,148
2035	209,380	194,306	12,580	21,631	37,560	44,679	42,844	35,011
2036	214,043	199,426	12,206	21,658	38,102	45,853	45,012	36,595
2037	217,861	203,062	12,350	21,685	37,984	45,990	46,369	38,685
2038	221,220	206,582	12,179	21,753	37,976	46,561	48,025	40,088

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 167 Vascular Dementia, Prevalence, Males and Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Lower Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	82,220	74,168	6,768	10,407	14,719	17,252	15,841	9,181
2009	85,402	76,978	7,108	10,771	14,980	17,522	16,777	9,820
2010	88,775	79,691	7,667	11,097	15,246	17,796	17,110	10,775
2011	89,815	80,531	7,823	11,295	14,686	17,553	17,562	11,613
2012	92,883	83,221	8,187	11,651	15,173	17,902	17,953	12,355
2013	96,592	86,429	8,608	12,092	15,745	18,556	18,199	13,229
2014	98,485	88,032	8,828	12,489	15,926	18,485	18,475	13,828
2015	100,941	89,924	9,343	12,812	16,061	18,789	18,534	14,385
2016	104,684	93,524	9,485	13,121	16,900	19,562	19,135	15,322
2017	108,229	96,363	10,080	13,524	17,182	19,882	19,665	16,030
2018	111,585	99,538	10,220	14,049	17,985	20,752	20,067	16,465
2019	114,590	102,343	10,391	14,484	18,580	21,482	20,391	17,016
2020	118,236	105,675	10,629	15,021	19,320	22,210	20,683	17,811
2021	120,508	108,001	10,543	15,217	20,426	23,343	20,775	17,696
2022	126,407	113,410	10,944	15,846	21,546	24,486	21,985	18,603
2023	130,540	117,064	11,378	16,381	22,489	25,575	22,202	19,039
2024	132,693	119,625	11,062	16,563	23,085	26,138	23,137	19,641
2025	136,606	123,510	11,034	16,843	24,045	27,389	23,813	20,386
2026	141,599	128,305	11,259	17,380	25,077	28,861	24,856	20,871
2027	145,563	132,145	11,321	17,673	25,833	29,758	26,064	21,496
2028	150,823	137,757	11,056	18,031	27,440	31,945	26,950	22,336
2029	155,641	142,450	11,013	18,190	27,928	32,955	29,337	23,027
2030	161,036	147,783	11,036	18,660	29,347	34,411	29,930	24,398
2031	163,583	150,880	10,587	18,591	29,181	35,030	32,126	25,364
2032	168,735	155,982	10,670	18,892	30,641	36,422	32,589	26,768
2033	174,051	161,101	10,705	19,311	31,006	37,563	34,361	28,156
2034	176,012	163,642	10,293	19,198	30,991	37,930	36,502	28,730
2035	181,368	169,127	10,143	19,498	32,198	39,619	37,396	30,273
2036	185,781	174,021	9,757	19,552	32,754	40,661	39,255	32,042
2037	189,238	176,985	10,179	19,840	32,283	40,746	39,929	34,009
2038	192,015	180,187	9,821	19,639	32,304	41,110	42,007	35,306

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 168 Vascular Dementia, Prevalence, Males and Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Males and Females, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	106,890	95,815	9,444	12,507	19,500	21,685	20,819	11,860
2009	111,194	99,495	9,933	12,966	19,817	22,419	21,408	12,952
2010	114,502	102,285	10,432	13,342	19,918	22,435	22,307	13,850
2011	117,186	104,562	10,741	13,516	19,926	22,788	22,751	14,841
2012	121,913	108,641	11,292	14,254	20,546	23,298	23,216	16,036
2013	124,687	111,035	11,673	14,571	20,763	23,318	23,727	16,981
2014	128,273	114,092	12,087	15,011	21,085	23,893	24,259	17,759
2015	131,709	117,088	12,463	15,361	21,537	24,203	24,761	18,764
2016	137,042	121,402	13,383	16,090	22,217	24,873	25,031	19,809
2017	140,505	124,571	13,601	16,556	22,812	25,541	25,708	20,352
2018	146,023	129,516	14,152	17,090	24,132	26,767	25,927	21,448
2019	149,560	132,617	14,466	17,542	24,699	27,445	26,403	22,062
2020	154,837	137,354	14,960	18,212	25,900	28,709	26,968	22,606
2021	159,861	142,442	14,833	18,759	27,508	30,470	27,320	23,551
2022	162,965	145,327	15,002	19,047	27,855	30,761	28,149	24,512
2023	167,983	150,073	15,252	19,568	29,177	32,009	28,939	25,128
2024	174,265	155,911	15,677	20,130	30,593	34,164	29,693	25,654
2025	178,868	160,751	15,338	20,462	31,964	35,162	31,230	26,595
2026	184,407	166,111	15,513	21,096	33,388	36,836	32,087	27,191
2027	189,865	171,496	15,530	21,241	34,304	38,335	33,874	28,213
2028	197,419	178,897	15,702	21,970	36,007	40,205	35,552	29,462
2029	203,223	184,774	15,646	22,169	37,097	42,181	37,132	30,550
2030	207,389	189,191	15,352	22,490	38,205	42,975	38,442	31,727
2031	211,963	194,022	15,146	22,492	38,836	44,402	40,611	32,535
2032	219,404	201,640	15,047	22,966	40,212	46,265	42,640	34,510
2033	225,989	207,831	15,338	23,292	40,551	46,888	45,256	36,505
2034	229,791	211,851	15,086	23,352	41,057	48,214	46,900	37,242
2035	234,585	217,263	14,536	23,324	42,424	49,698	47,940	39,341
2036	242,543	225,027	14,756	23,693	43,260	51,385	50,719	41,212
2037	246,954	229,742	14,459	23,667	43,830	51,850	52,128	43,809
2038	251,547	234,472	14,290	23,725	43,947	52,197	54,491	45,822

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 169 Vascular Dementia, Prevalence, Males, Expected Value, By Age Groups: 2008-2038

Year	Prevalence, Males, Expected Value							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	49,766	43,155	5,636	7,139	9,896	10,261	6,959	3,265
2009	51,965	45,102	5,837	7,425	10,194	10,603	7,384	3,657
2010	53,832	46,543	6,224	7,676	10,307	10,740	7,647	3,950
2011	55,686	48,130	6,442	7,943	10,458	10,896	8,052	4,339
2012	57,350	49,514	6,685	8,155	10,650	11,070	8,273	4,680
2013	59,084	50,845	7,039	8,390	10,698	11,197	8,519	5,002
2014	61,216	52,641	7,323	8,659	11,042	11,473	8,759	5,386
2015	62,933	54,016	7,633	8,976	11,085	11,549	9,128	5,645
2016	65,202	56,070	7,810	9,269	11,637	12,027	9,244	6,083
2017	66,932	57,484	8,083	9,601	11,863	12,201	9,393	6,342
2018	69,559	59,801	8,352	9,916	12,402	12,837	9,721	6,574
2019	71,678	61,782	8,487	10,193	12,991	13,368	9,782	6,962
2020	74,415	64,233	8,714	10,494	13,548	14,021	10,184	7,273
2021	77,204	66,741	8,914	10,869	14,366	14,780	10,245	7,567
2022	79,024	68,560	8,947	11,041	14,796	15,295	10,656	7,826
2023	81,690	70,993	9,121	11,368	15,506	16,008	11,005	7,985
2024	84,065	73,261	9,210	11,651	16,024	16,621	11,436	8,319
2025	87,064	76,052	9,356	11,943	16,820	17,469	11,998	8,466
2026	89,876	79,047	9,215	12,202	17,570	18,517	12,522	9,020
2027	91,756	80,785	9,339	12,324	17,954	18,869	13,027	9,273
2028	95,097	84,149	9,284	12,613	18,933	19,949	13,671	9,700
2029	97,290	86,391	9,240	12,836	19,253	20,498	14,480	10,084
2030	101,170	90,269	9,220	13,074	20,426	21,746	15,185	10,618
2031	102,463	91,553	9,213	13,142	20,191	21,836	16,051	11,120
2032	104,748	94,324	8,818	13,179	21,205	23,058	16,512	11,553
2033	107,788	97,056	9,080	13,395	21,484	23,416	17,457	12,223
2034	109,966	99,493	8,824	13,472	21,887	24,100	18,432	12,778
2035	113,282	102,712	8,892	13,705	22,756	25,111	18,831	13,418
2036	114,924	104,636	8,657	13,710	22,896	25,535	19,919	13,920
2037	117,775	107,328	8,773	13,769	23,041	25,763	20,799	15,183
2038	119,129	108,759	8,696	13,847	23,117	26,112	21,411	15,575

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 170 Vascular Dementia, Prevalence, Males, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Males, Lower Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	43,415	37,783	4,751	6,523	8,531	8,975	6,102	2,901
2009	44,924	39,081	4,957	6,712	8,789	9,120	6,398	3,106
2010	47,209	40,858	5,397	7,009	9,018	9,399	6,635	3,400
2011	48,112	41,587	5,541	7,156	8,803	9,278	6,987	3,821
2012	49,543	42,878	5,675	7,342	8,979	9,562	7,230	4,089
2013	51,810	44,738	6,032	7,715	9,444	9,880	7,350	4,317
2014	53,121	45,908	6,126	7,958	9,602	9,998	7,529	4,695
2015	54,605	46,962	6,519	8,138	9,578	10,014	7,783	4,929
2016	56,271	48,577	6,570	8,297	9,995	10,429	7,953	5,334
2017	58,168	50,026	6,938	8,516	10,189	10,674	8,145	5,564
2018	60,460	52,194	7,074	8,836	10,782	11,217	8,460	5,825
2019	62,385	54,047	7,117	9,205	11,273	11,713	8,634	6,105
2020	64,390	55,842	7,274	9,539	11,655	12,201	8,808	6,365
2021	65,838	57,348	7,197	9,646	12,284	12,802	8,864	6,555
2022	69,354	60,320	7,645	10,079	13,028	13,347	9,296	6,924
2023	72,009	62,641	7,958	10,493	13,622	14,159	9,351	7,059
2024	72,906	63,766	7,779	10,577	13,904	14,388	9,922	7,196
2025	74,398	65,383	7,636	10,667	14,353	15,007	10,429	7,290
2026	78,346	68,941	8,004	11,144	15,110	16,022	10,909	7,751
2027	79,930	70,564	7,960	11,242	15,561	16,387	11,379	8,035
2028	83,167	73,910	7,844	11,526	16,561	17,685	11,837	8,457
2029	84,898	75,671	7,728	11,517	16,748	18,233	12,771	8,673
2030	88,483	79,183	7,821	11,755	17,789	19,310	13,289	9,219
2031	88,206	79,307	7,498	11,656	17,456	19,125	13,997	9,576
2032	91,156	82,122	7,634	11,902	18,399	20,186	14,172	9,830
2033	94,938	85,795	7,617	12,251	18,877	20,951	15,238	10,862
2034	95,605	86,887	7,330	12,147	18,906	21,295	16,249	10,960
2035	98,553	89,825	7,349	12,410	19,701	22,343	16,450	11,572
2036	99,312	90,967	6,983	12,317	19,621	22,241	17,382	12,423
2037	102,001	93,347	7,246	12,553	19,615	22,567	17,902	13,464
2038	102,663	94,378	6,922	12,420	19,627	23,152	18,717	13,540

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 171 Vascular Dementia, Prevalence, Males, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Males, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	56,068	48,417	6,556	7,850	11,164	11,374	7,808	3,664
2009	59,135	51,074	6,881	8,217	11,654	12,126	8,143	4,054
2010	60,395	52,028	7,176	8,408	11,597	11,899	8,487	4,461
2011	62,363	53,816	7,321	8,541	11,871	12,365	8,875	4,843
2012	65,304	56,227	7,771	9,075	12,063	12,646	9,432	5,240
2013	66,521	57,254	7,980	9,263	12,162	12,576	9,620	5,652
2014	68,750	59,141	8,193	9,496	12,461	12,957	9,946	6,089
2015	70,213	60,245	8,544	9,724	12,524	12,915	10,065	6,473
2016	74,436	63,574	9,329	10,343	13,023	13,444	10,545	6,889
2017	75,889	65,074	9,265	10,456	13,429	13,933	10,946	7,046
2018	79,229	67,926	9,739	10,902	14,206	14,571	10,886	7,623
2019	81,724	70,090	9,980	11,153	14,826	15,122	11,167	7,842
2020	84,522	72,598	10,225	11,598	15,477	15,853	11,392	8,054
2021	87,258	75,369	10,154	12,001	16,261	16,834	11,744	8,375
2022	88,715	76,718	10,239	12,123	16,485	17,054	11,978	8,839
2023	91,326	79,184	10,370	12,393	17,310	17,646	12,420	9,046
2024	95,286	82,907	10,613	12,764	18,303	19,028	12,915	9,284
2025	97,361	84,990	10,506	12,991	18,823	19,421	13,421	9,828
2026	101,692	89,077	10,760	13,502	20,007	20,640	14,067	10,101
2027	103,069	90,540	10,628	13,429	20,355	21,169	14,648	10,310
2028	107,751	95,050	10,816	14,048	21,292	22,404	15,636	10,854
2029	110,495	97,816	10,826	14,066	21,914	23,390	16,233	11,387
2030	113,529	100,867	10,769	14,347	22,941	24,085	16,913	11,812
2031	115,211	102,810	10,496	14,230	23,260	24,773	17,805	12,247
2032	119,701	107,312	10,586	14,595	24,252	26,013	18,787	13,080
2033	122,434	109,881	10,658	14,808	24,289	26,281	20,083	13,761
2034	124,813	112,384	10,500	14,737	24,728	27,226	20,961	14,232
2035	126,889	114,858	10,158	14,725	25,535	27,909	21,206	15,324
2036	130,921	118,608	10,436	15,037	26,024	28,842	22,452	15,816
2037	133,930	121,881	10,206	14,982	26,503	29,678	23,598	16,913
2038	134,888	122,962	10,085	14,989	26,457	29,421	24,273	17,737

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 172 Vascular Dementia, Prevalence, Females, Expected Value, By Age Groups: 2008-2038

Year	Prevalence, Females, Expected Value							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	44,417	41,509	2,409	4,254	7,123	9,263	11,254	7,207
2009	46,273	43,147	2,626	4,402	7,169	9,390	11,719	7,842
2010	47,664	44,410	2,718	4,531	7,239	9,513	11,949	8,460
2011	48,676	45,274	2,859	4,596	7,235	9,475	12,218	8,892
2012	50,127	46,530	3,034	4,744	7,231	9,532	12,393	9,596
2013	51,215	47,461	3,161	4,885	7,328	9,648	12,351	10,089
2014	52,579	48,679	3,269	4,990	7,503	9,810	12,649	10,458
2015	53,960	49,910	3,412	5,182	7,747	10,029	12,615	10,924
2016	55,453	51,226	3,555	5,322	7,905	10,165	12,831	11,448
2017	57,283	52,908	3,698	5,494	8,180	10,521	13,136	11,880
2018	58,813	54,336	3,766	5,683	8,444	10,802	13,435	12,206
2019	60,194	55,575	3,894	5,825	8,655	11,098	13,498	12,604
2020	62,191	57,466	4,002	5,986	9,168	11,573	13,735	13,001
2021	63,671	58,904	4,026	6,205	9,633	11,976	13,729	13,334
2022	65,699	60,878	4,052	6,363	10,008	12,490	14,200	13,766
2023	67,328	62,506	4,070	6,505	10,458	12,919	14,503	14,051
2024	69,388	64,455	4,141	6,697	10,786	13,490	15,086	14,255
2025	71,670	66,747	4,111	6,882	11,349	14,101	15,600	14,705
2026	74,045	69,127	4,102	7,017	11,866	14,790	16,236	15,116
2027	76,126	71,314	4,025	7,081	12,113	15,219	16,938	15,938
2028	78,879	74,027	4,037	7,269	12,757	16,011	17,644	16,310
2029	81,483	76,587	4,073	7,462	13,064	16,516	18,746	16,726
2030	83,149	78,365	3,947	7,420	13,320	17,037	19,152	17,489
2031	86,090	81,352	3,913	7,590	13,638	17,661	20,456	18,094
2032	88,655	84,035	3,819	7,660	14,268	18,280	20,933	19,075
2033	90,848	86,334	3,727	7,690	14,323	18,709	22,067	19,818
2034	93,008	88,453	3,746	7,754	14,451	19,049	23,084	20,369
2035	96,098	91,594	3,688	7,926	14,804	19,568	24,014	21,593
2036	99,118	94,790	3,549	7,948	15,207	20,319	25,093	22,675
2037	100,086	95,734	3,577	7,916	14,942	20,226	25,569	23,503
2038	102,091	97,823	3,483	7,906	14,858	20,449	26,613	24,513

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 173 Vascular Dementia, Prevalence, Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Prevalence, Females, Lower Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	38,806	36,385	2,017	4,254	6,188	8,277	9,739	6,280
2009	40,478	37,897	2,152	4,402	6,191	8,403	10,379	6,715
2010	41,566	38,833	2,270	4,531	6,228	8,397	10,475	7,375
2011	41,703	38,945	2,283	4,596	5,882	8,275	10,575	7,791
2012	43,340	40,343	2,512	4,744	6,194	8,340	10,723	8,266
2013	44,781	41,691	2,576	4,885	6,300	8,676	10,849	8,912
2014	45,364	42,123	2,703	4,990	6,324	8,487	10,946	9,132
2015	46,336	42,962	2,824	5,182	6,482	8,776	10,750	9,456
2016	48,413	44,946	2,915	5,322	6,906	9,133	11,182	9,988
2017	50,061	46,337	3,142	5,494	6,993	9,208	11,520	10,467
2018	51,124	47,344	3,146	5,683	7,203	9,536	11,607	10,640
2019	52,205	48,296	3,274	5,825	7,307	9,768	11,757	10,911
2020	53,847	49,833	3,355	5,986	7,665	10,010	11,875	11,447
2021	54,670	50,653	3,346	6,205	8,142	10,541	11,911	11,142
2022	57,053	53,091	3,298	6,363	8,518	11,139	12,689	11,679
2023	58,531	54,422	3,420	6,505	8,867	11,417	12,851	11,980
2024	59,787	55,859	3,283	6,697	9,181	11,749	13,215	12,445
2025	62,209	58,127	3,397	6,882	9,693	12,381	13,384	13,095
2026	63,253	59,364	3,255	7,017	9,968	12,839	13,946	13,120
2027	65,633	61,581	3,361	7,081	10,271	13,370	14,686	13,461
2028	67,656	63,847	3,211	7,269	10,879	14,260	15,113	13,879
2029	70,743	66,779	3,285	7,462	11,180	14,721	16,565	14,354
2030	72,553	68,600	3,214	7,420	11,559	15,101	16,641	15,179
2031	75,377	71,573	3,090	7,590	11,725	15,904	18,130	15,788
2032	77,579	73,860	3,036	7,660	12,242	16,237	18,418	16,937
2033	79,113	75,305	3,088	7,690	12,129	16,612	19,122	17,293
2034	80,407	76,755	2,963	7,754	12,084	16,635	20,253	17,770
2035	82,816	79,302	2,794	7,926	12,497	17,276	20,946	18,701
2036	86,470	83,054	2,774	7,948	13,133	18,419	21,873	19,619
2037	87,236	83,638	2,933	7,916	12,668	18,179	22,027	20,544
2038	89,352	85,809	2,900	7,906	12,677	17,959	23,290	21,765

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

Exhibit 174 Vascular Dementia, Prevalence, Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Prevalence, Females, Upper Bound							
	All Ages*	Ages 65+	65-69	70-74	75-79	80-84	85-89	90+
2008	50,822	47,398	2,887	4,657	8,336	10,311	13,011	8,196
2009	52,059	48,420	3,052	4,749	8,163	10,294	13,265	8,898
2010	54,107	50,257	3,256	4,935	8,320	10,536	13,820	9,389
2011	54,823	50,747	3,420	4,975	8,054	10,423	13,876	9,998
2012	56,608	52,414	3,521	5,179	8,482	10,651	13,784	10,796
2013	58,166	53,781	3,693	5,308	8,601	10,742	14,107	11,329
2014	59,523	54,951	3,894	5,515	8,624	10,936	14,313	11,670
2015	61,496	56,844	3,919	5,637	9,013	11,288	14,696	12,291
2016	62,606	57,829	4,054	5,746	9,194	11,428	14,486	12,920
2017	64,616	59,496	4,336	6,100	9,383	11,608	14,763	13,307
2018	66,795	61,590	4,413	6,188	9,926	12,196	15,041	13,825
2019	67,835	62,526	4,486	6,388	9,873	12,324	15,235	14,220
2020	70,315	64,756	4,735	6,614	10,423	12,856	15,576	14,552
2021	72,603	67,073	4,679	6,759	11,248	13,636	15,576	15,176
2022	74,250	68,608	4,763	6,924	11,369	13,707	16,172	15,673
2023	76,657	70,889	4,882	7,176	11,866	14,364	16,519	16,082
2024	78,979	73,004	5,064	7,366	12,290	15,136	16,778	16,369
2025	81,506	75,761	4,833	7,471	13,141	15,740	17,809	16,767
2026	82,715	77,034	4,753	7,593	13,382	16,196	18,020	17,090
2027	86,796	80,957	4,901	7,813	13,949	17,166	19,226	17,902
2028	89,667	83,847	4,886	7,921	14,714	17,800	19,917	18,608
2029	92,728	86,958	4,820	8,103	15,183	18,791	20,899	19,163
2030	93,860	88,324	4,583	8,143	15,264	18,890	21,529	19,915
2031	96,751	91,211	4,649	8,262	15,577	19,630	22,805	20,288
2032	99,703	94,329	4,461	8,372	15,960	20,253	23,853	21,430
2033	103,555	97,950	4,681	8,483	16,262	20,607	25,173	22,744
2034	104,977	99,468	4,586	8,615	16,330	20,987	25,939	23,011
2035	107,696	102,405	4,377	8,599	16,889	21,789	26,734	24,017
2036	111,622	106,419	4,320	8,656	17,237	22,543	28,267	25,395
2037	113,024	107,861	4,253	8,684	17,326	22,172	28,530	26,897
2038	116,659	111,509	4,204	8,737	17,490	22,775	30,218	28,086

*The population over the age of 65 was simulated within the current model using data obtained from the Canadian Study of Health and Aging. The data regarding individuals under the age of 65 could not be obtained from this study (or any other consistent study) and were therefore interpolated mathematically. As a result, any simulations regarding populations under the age of 65 must be interpreted with caution.

INCIDENCE:

Exhibit 175 Vascular Dementia, Incidence, Males and Females, Expected Value, By Age Group: 2008-2038

Year	Incidence, Males and Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	21,837	2,313	2,941	6,018	4,823	5,741
2009	22,457	2,588	2,997	6,211	4,827	5,834
2010	22,881	2,633	3,093	6,174	4,873	6,108
2011	23,465	2,746	3,267	6,039	4,939	6,474
2012	24,297	2,976	3,453	6,273	5,072	6,523
2013	24,433	3,017	3,399	6,233	4,987	6,797
2014	25,307	3,114	3,632	6,442	5,035	7,083
2015	26,507	3,332	3,885	6,787	5,004	7,499
2016	26,954	3,487	4,054	6,834	5,099	7,481
2017	27,886	3,601	4,127	7,354	5,217	7,587
2018	28,985	3,843	4,419	7,648	5,465	7,611
2019	29,764	3,886	4,538	7,958	5,473	7,909
2020	30,566	3,570	4,608	8,396	5,843	8,150
2021	31,400	3,860	4,905	8,687	5,932	8,016
2022	33,024	4,102	5,191	9,238	6,014	8,480
2023	34,679	4,351	5,208	9,631	6,654	8,835
2024	35,448	4,139	5,520	9,812	6,846	9,132
2025	36,474	4,205	5,363	10,359	7,230	9,317
2026	37,805	4,276	5,633	11,059	7,348	9,488
2027	38,710	4,228	5,656	11,141	7,807	9,877
2028	40,129	4,153	5,818	11,292	8,158	10,708
2029	41,628	4,324	5,757	11,689	8,722	11,136
2030	42,999	4,128	6,076	12,249	9,211	11,336
2031	44,168	4,092	6,282	12,316	9,496	11,982
2032	45,526	4,463	6,426	12,642	9,435	12,560
2033	47,042	4,178	6,435	13,140	9,883	13,406
2034	47,362	4,275	6,124	13,217	10,153	13,594
2035	48,813	4,220	6,502	13,103	10,549	14,439
2036	49,661	4,157	6,136	13,281	11,353	14,734
2037	49,816	4,064	6,243	13,473	11,072	14,965
2038	51,479	4,269	5,944	13,703	11,261	16,303

Exhibit 176 Vascular Dementia, Incidence, Males and Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Males and Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	14,582	1,290	1,721	4,665	2,907	3,998
2009	15,125	1,219	1,791	4,721	3,387	4,007
2010	15,370	1,426	1,787	4,701	3,306	4,150
2011	15,826	1,284	2,134	4,543	3,381	4,483
2012	16,458	1,430	2,228	4,621	3,571	4,607
2013	16,576	1,679	2,169	4,779	3,385	4,563
2014	16,963	1,555	2,006	5,011	3,432	4,959
2015	17,576	1,205	2,491	4,948	3,654	5,278
2016	18,120	1,460	2,650	5,227	3,614	5,168
2017	19,150	1,852	2,744	5,883	3,660	5,010
2018	19,128	1,840	2,667	5,817	3,583	5,221
2019	20,168	1,881	2,798	6,044	3,828	5,616
2020	20,710	1,648	2,911	6,328	4,118	5,704
2021	21,174	1,732	3,263	6,695	4,189	5,294
2022	22,561	1,875	3,353	6,762	4,295	6,276
2023	23,163	1,850	3,333	6,959	4,591	6,430
2024	23,944	1,982	3,421	7,639	4,830	6,072
2025	23,734	2,255	3,348	7,378	4,772	5,982
2026	26,120	2,348	3,473	8,274	5,418	6,607
2027	26,504	2,098	3,465	8,328	5,529	7,083
2028	28,152	1,510	4,002	9,211	5,895	7,534
2029	28,942	2,094	3,672	9,565	6,035	7,577
2030	29,536	1,912	4,181	9,394	6,385	7,663
2031	30,135	1,892	3,763	9,732	6,290	8,458
2032	30,021	2,108	3,971	9,725	6,518	7,700
2033	31,997	1,673	4,223	10,324	6,826	8,951
2034	32,134	2,198	3,696	10,269	6,733	9,239
2035	32,504	1,966	4,124	10,048	7,125	9,240
2036	34,529	2,000	4,070	10,003	7,742	10,715
2037	33,917	1,834	4,133	10,219	7,328	10,404
2038	35,126	2,076	4,298	10,339	7,798	10,615

Exhibit 177 Vascular Dementia, Incidence, Males and Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Incidence, Males and Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	28,784	3,584	3,917	7,499	6,147	7,636
2009	29,770	3,898	4,151	7,678	6,257	7,787
2010	30,168	4,012	4,232	7,366	6,359	8,199
2011	31,015	4,208	4,212	7,601	6,503	8,491
2012	32,279	4,487	4,592	7,866	6,580	8,754
2013	32,744	4,601	4,607	7,882	6,563	9,091
2014	33,979	4,790	5,137	8,196	6,633	9,224
2015	34,642	5,220	5,083	8,324	6,691	9,325
2016	36,117	5,332	5,641	8,526	6,615	10,002
2017	36,194	5,281	5,538	9,021	6,689	9,665
2018	38,465	5,767	6,266	9,410	6,940	10,082
2019	39,329	5,893	5,994	9,896	7,036	10,509
2020	41,075	5,625	6,708	10,407	7,426	10,908
2021	41,783	5,928	6,745	10,770	7,654	10,687
2022	43,979	6,095	6,877	11,630	7,961	11,416
2023	45,379	6,390	7,021	11,658	8,763	11,547
2024	47,019	6,453	7,710	12,294	8,754	11,809
2025	48,364	6,453	7,288	12,532	9,727	12,364
2026	50,169	6,486	7,667	13,493	9,417	13,106
2027	51,318	6,379	7,624	13,866	10,162	13,286
2028	53,626	6,598	8,136	14,199	10,769	13,925
2029	54,064	6,636	8,008	14,386	11,248	13,786
2030	56,783	6,703	8,077	15,148	12,020	14,835
2031	58,129	6,553	8,491	15,368	12,186	15,530
2032	60,662	6,750	8,971	15,691	12,707	16,543
2033	61,219	6,342	8,950	16,054	12,812	17,061
2034	62,379	6,285	8,172	16,309	13,346	18,267
2035	63,729	6,473	8,802	16,403	13,713	18,336
2036	64,549	6,300	8,369	16,239	14,603	19,038
2037	66,649	6,615	8,375	16,957	14,974	19,727
2038	67,295	5,814	8,006	17,153	14,780	21,542

Exhibit 178 Vascular Dementia, Incidence, Males, Expected Values, By Age Group: 2008-2038

Year	Incidence, Males by Age, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	9,919	1,426	2,262	2,631	1,916	1,685
2009	10,375	1,516	2,359	2,706	1,992	1,801
2010	10,425	1,540	2,373	2,679	1,971	1,862
2011	10,893	1,636	2,542	2,647	2,023	2,046
2012	11,496	1,806	2,725	2,744	2,078	2,143
2013	11,495	1,784	2,706	2,748	2,044	2,214
2014	12,086	1,864	2,833	2,948	2,086	2,356
2015	12,768	2,002	3,056	3,048	2,142	2,521
2016	12,989	2,077	3,254	2,959	2,166	2,532
2017	13,315	2,062	3,223	3,247	2,224	2,559
2018	13,984	2,235	3,429	3,411	2,370	2,540
2019	14,254	2,295	3,599	3,485	2,264	2,611
2020	14,793	2,124	3,592	3,767	2,462	2,847
2021	15,393	2,371	3,884	3,899	2,543	2,696
2022	16,238	2,527	4,041	4,120	2,544	3,006
2023	16,969	2,660	4,094	4,276	2,792	3,148
2024	17,418	2,539	4,266	4,500	2,984	3,129
2025	17,803	2,645	4,200	4,686	3,019	3,253
2026	18,240	2,436	4,372	4,877	3,197	3,358
2027	18,959	2,542	4,423	4,983	3,429	3,581
2028	19,534	2,527	4,551	5,188	3,430	3,837
2029	20,129	2,747	4,484	5,107	3,736	4,055
2030	20,684	2,589	4,794	5,316	3,983	4,001
2031	21,570	2,502	4,974	5,429	4,271	4,394
2032	21,993	2,736	5,030	5,758	3,979	4,490
2033	22,584	2,560	5,138	5,843	4,312	4,731
2034	22,943	2,628	4,792	5,915	4,497	5,112
2035	23,692	2,550	5,157	5,928	4,666	5,392
2036	23,965	2,541	4,870	6,066	4,952	5,536
2037	23,631	2,472	4,886	6,072	4,862	5,341
2038	24,262	2,680	4,714	6,108	4,724	6,037

Exhibit 179 Vascular Dementia, Incidence, Males, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Males, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	6,254	874	1,427	1,858	1,095	1,001
2009	6,467	803	1,510	1,924	1,267	964
2010	6,999	1,071	1,479	2,046	1,167	1,236
2011	6,801	847	1,771	1,824	1,272	1,088
2012	7,193	806	1,856	1,874	1,467	1,190
2013	7,618	1,087	1,835	2,078	1,324	1,293
2014	7,560	979	1,659	2,238	1,330	1,354
2015	7,840	809	2,068	2,153	1,362	1,448
2016	8,220	926	2,169	2,261	1,440	1,425
2017	8,627	1,170	2,216	2,535	1,473	1,234
2018	8,688	1,250	2,178	2,512	1,402	1,346
2019	9,225	1,389	2,362	2,595	1,366	1,513
2020	9,685	1,067	2,495	2,753	1,609	1,762
2021	10,060	1,273	2,694	2,946	1,690	1,456
2022	10,782	1,262	2,916	2,811	1,809	1,985
2023	10,531	1,082	2,860	2,994	1,658	1,937
2024	11,240	1,287	2,758	3,297	1,925	1,973
2025	10,990	1,598	2,828	3,042	1,829	1,692
2026	12,182	1,577	2,971	3,616	2,037	1,982
2027	12,316	1,348	2,904	3,481	2,350	2,234
2028	12,703	659	3,450	3,976	2,365	2,253
2029	13,312	1,398	3,145	3,922	2,484	2,364
2030	13,413	1,369	3,477	3,874	2,667	2,027
2031	13,440	1,097	3,144	4,180	2,453	2,566
2032	13,327	1,356	3,247	4,157	2,606	1,960
2033	14,607	998	3,499	4,482	3,006	2,623
2034	14,811	1,335	3,177	4,446	2,825	3,028
2035	14,868	1,199	3,561	4,201	2,967	2,940
2036	15,763	1,376	3,421	4,426	3,288	3,252
2037	15,192	1,158	3,554	4,499	2,992	2,989
2038	15,579	1,357	3,563	4,384	3,264	3,011

Exhibit 180 Vascular Dementia, Incidence, Males, 95% Upper Bound, By Age Groups: 2008-2038

Year	Incidence, Males, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	13,485	2,081	2,997	3,391	2,506	2,510
2009	14,201	2,396	3,181	3,375	2,538	2,710
2010	14,404	2,347	3,130	3,342	2,798	2,786
2011	14,838	2,449	3,212	3,347	2,828	3,002
2012	15,538	2,729	3,502	3,542	2,716	3,050
2013	15,796	2,726	3,436	3,493	2,808	3,332
2014	16,381	2,734	3,915	3,686	2,823	3,222
2015	17,072	3,255	3,833	3,652	2,949	3,383
2016	18,140	3,242	4,423	3,908	2,938	3,628
2017	17,967	3,122	4,209	3,964	2,980	3,692
2018	19,130	3,205	4,796	4,377	3,075	3,677
2019	19,372	3,439	4,506	4,421	3,003	4,003
2020	20,554	3,341	5,047	4,791	3,330	4,045
2021	21,394	3,609	5,155	4,901	3,486	4,243
2022	21,913	3,640	5,202	5,255	3,401	4,415
2023	22,466	3,714	5,389	5,104	3,871	4,388
2024	23,912	3,973	5,879	5,537	3,892	4,631
2025	24,285	4,114	5,509	5,773	4,070	4,819
2026	25,131	3,886	5,761	6,103	4,188	5,193
2027	25,881	3,721	5,663	6,387	4,673	5,438
2028	26,843	3,982	6,216	6,457	4,794	5,394
2029	27,104	3,927	5,943	6,623	5,117	5,495
2030	28,503	4,073	6,166	7,044	5,503	5,717
2031	29,406	4,001	6,612	7,066	5,473	6,253
2032	30,289	4,025	6,794	7,143	5,756	6,570
2033	30,274	3,775	6,906	7,373	5,605	6,615
2034	30,343	3,657	6,145	7,287	6,016	7,238
2035	32,098	3,877	6,805	7,605	6,413	7,398
2036	31,869	3,756	6,367	7,538	6,458	7,750
2037	33,042	3,972	6,346	7,639	7,175	7,911
2038	33,294	3,435	6,029	7,886	7,000	8,944

Exhibit 181 vascular Dementia, Incidence, Females, Expected Value, By Age Groups: 2008-2038

Year	Incidence, Females, Expected Value					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	11,918	887	679	3,387	2,908	4,056
2009	12,083	1,072	638	3,505	2,835	4,033
2010	12,456	1,093	720	3,496	2,902	4,246
2011	12,571	1,110	725	3,392	2,916	4,428
2012	12,802	1,171	729	3,528	2,994	4,380
2013	12,938	1,233	693	3,485	2,943	4,583
2014	13,221	1,250	799	3,495	2,950	4,727
2015	13,739	1,331	829	3,739	2,862	4,978
2016	13,965	1,410	800	3,875	2,933	4,949
2017	14,571	1,539	904	4,108	2,993	5,028
2018	15,001	1,608	989	4,237	3,095	5,071
2019	15,510	1,591	938	4,473	3,209	5,298
2020	15,773	1,446	1,016	4,629	3,380	5,303
2021	16,007	1,489	1,021	4,789	3,389	5,319
2022	16,786	1,575	1,149	5,118	3,470	5,474
2023	17,710	1,691	1,114	5,355	3,863	5,687
2024	18,030	1,600	1,253	5,312	3,862	6,003
2025	18,671	1,560	1,163	5,673	4,210	6,064
2026	19,565	1,840	1,261	6,182	4,151	6,131
2027	19,751	1,686	1,234	6,158	4,378	6,296
2028	20,596	1,626	1,267	6,104	4,728	6,870
2029	21,499	1,577	1,273	6,582	4,986	7,080
2030	22,315	1,539	1,282	6,932	5,228	7,335
2031	22,598	1,590	1,308	6,887	5,225	7,587
2032	23,533	1,728	1,396	6,884	5,455	8,071
2033	24,457	1,618	1,297	7,297	5,570	8,675
2034	24,419	1,647	1,331	7,302	5,656	8,482
2035	25,120	1,670	1,345	7,175	5,883	9,048
2036	25,697	1,616	1,266	7,215	6,401	9,198
2037	26,185	1,592	1,357	7,401	6,210	9,625
2038	27,217	1,589	1,230	7,595	6,537	10,266

Exhibit 182 Vascular Dementia, Incidence, Females, 95% Lower Bound, By Age Groups: 2008-2038

Year	Incidence, Females, Lower Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	8,328	416	294	2,808	1,812	2,998
2009	8,658	416	281	2,797	2,120	3,043
2010	8,371	355	307	2,655	2,139	2,914
2011	9,024	437	364	2,719	2,109	3,395
2012	9,265	624	372	2,747	2,105	3,417
2013	8,958	592	334	2,701	2,060	3,270
2014	9,403	576	348	2,773	2,102	3,605
2015	9,736	396	422	2,796	2,292	3,830
2016	9,900	534	481	2,966	2,175	3,743
2017	10,522	682	528	3,348	2,188	3,776
2018	10,440	590	490	3,305	2,180	3,875
2019	10,943	492	436	3,449	2,463	4,103
2020	11,024	581	416	3,575	2,509	3,943
2021	11,114	459	569	3,749	2,499	3,838
2022	11,779	613	438	3,950	2,486	4,291
2023	12,632	768	473	3,965	2,933	4,493
2024	12,704	696	663	4,342	2,905	4,098
2025	12,745	656	520	4,336	2,943	4,290
2026	13,938	772	503	4,659	3,380	4,625
2027	14,188	750	561	4,847	3,180	4,849
2028	15,449	851	552	5,234	3,530	5,281
2029	15,630	696	527	5,643	3,550	5,213
2030	16,123	543	704	5,521	3,718	5,636
2031	16,695	795	619	5,552	3,837	5,892
2032	16,694	752	724	5,568	3,911	5,740
2033	17,390	675	725	5,842	3,820	6,329
2034	17,322	863	518	5,823	3,908	6,211
2035	17,636	767	563	5,848	4,158	6,300
2036	18,766	623	649	5,577	4,453	7,463
2037	18,725	676	579	5,719	4,335	7,416
2038	19,547	719	734	5,955	4,535	7,604

Exhibit 183 Vascular Dementia, Incidence, Females, 95% Upper Bound, By Age Groups: 2008-2038

Year	Incidence, Females, Upper Bound					
	Ages 65+	65-69	70-74	75-79	80-84	85+
2008	15,299	1,503	921	4,109	3,641	5,125
2009	15,570	1,502	970	4,302	3,719	5,077
2010	15,764	1,665	1,102	4,024	3,561	5,412
2011	16,177	1,759	1,000	4,255	3,675	5,489
2012	16,741	1,758	1,089	4,325	3,864	5,704
2013	16,948	1,874	1,171	4,389	3,755	5,759
2014	17,599	2,056	1,222	4,509	3,810	6,002
2015	17,571	1,965	1,250	4,672	3,742	5,942
2016	17,977	2,090	1,218	4,618	3,677	6,374
2017	18,227	2,159	1,329	5,057	3,709	5,973
2018	19,335	2,561	1,470	5,033	3,865	6,406
2019	19,956	2,454	1,488	5,475	4,032	6,507
2020	20,521	2,284	1,661	5,616	4,097	6,863
2021	20,389	2,319	1,589	5,869	4,168	6,444
2022	22,066	2,454	1,675	6,375	4,561	7,001
2023	22,913	2,675	1,633	6,554	4,892	7,159
2024	23,107	2,480	1,832	6,757	4,861	7,177
2025	24,079	2,339	1,779	6,758	5,657	7,546
2026	25,038	2,600	1,906	7,390	5,229	7,913
2027	25,437	2,658	1,961	7,480	5,489	7,849
2028	26,784	2,616	1,921	7,742	5,974	8,531
2029	26,960	2,709	2,065	7,763	6,131	8,291
2030	28,280	2,630	1,911	8,104	6,518	9,118
2031	28,723	2,553	1,878	8,302	6,713	9,277
2032	30,373	2,725	2,176	8,548	6,951	9,973
2033	30,945	2,567	2,045	8,681	7,207	10,445
2034	32,036	2,628	2,027	9,022	7,330	11,029
2035	31,631	2,596	1,998	8,799	7,301	10,938
2036	32,680	2,544	2,002	8,701	8,145	11,288
2037	33,607	2,643	2,029	9,318	7,799	11,817
2038	34,001	2,379	1,977	9,267	7,780	12,598

APPENDIX G: DETAILED LIFE AT RISK® METHODOLOGY

Life at Risk® Dementia Model Methodology: Mathematical Model.

Dementia Model Methodology

Life at Risk: Mathematical Model



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GENERAL METHODOLOGY

1 General Structure of the Mathematical Model

The model uses a continuous cell based macro simulation approach to compute the future dynamics of population health[3]. A population which is divided into N sub-groups (population cells) each of which contains $P_I(t)$ individuals with $I = \{1, \dots, N\}$ is considered. The individuals within each population cell are said to be indistinguishable with respect to a finite set of identifying characteristics (such as gender, age, health state etc). We identify the normalized state vectors $\hat{e}_I = P_I / \|P_I\|$ with each population cell (index I) such that each cell has an independent and unique representation in the N dimensional vector space $V_P = \{\hat{e}_1, \hat{e}_2, \dots, \hat{e}_I, \dots, \hat{e}_N\}$ such that the number of individuals across all of the population cells I at time t can be written as the state vector ([1]):

$$P(t) = \sum_{I=1}^N P_I(t) \hat{e}_I \quad (1)$$

In general, the state vector will evolve over time as:

$$\frac{dP(t)}{dt} = \frac{dP_I(t)}{dt} \hat{e}_I + P_I(t) \frac{d\hat{e}_I}{dt}$$

In other words, the population can evolve (over time) through a combination of population flows dP_I/dt (within each population cell identified by a constant state vector \hat{e}_I) and evolving state vectors $d\hat{e}_I/dt$ (for each constant number of individuals $P_I(t)$). This suggests that three types of modeling strategies can be adopted:

- A Static State Model: The identity of each population cell does not evolve in time ($d\hat{e}_I/dt = 0$). All changes in population are attributed to the flow of individuals between population cells ($dP_I(t)/dt \neq 0$).
- A Dynamic State model: The identity of each population cell evolves in time ($d\hat{e}_I/dt \neq 0$) while no flow of individuals is allowed between the cells ($dP_I(t)/dt = 0$). These types of models can be used to simulate a longitudinal cohort.
- Hybrid State model: Both, the population flow dP_I/dt and the cell identity $d\hat{e}_I/dt$ are allowed to evolve in time.

Within the static state model (currently implemented) individuals from population P_I can move to population P_J between time t and $t + dt$ under dynamical constraints while keeping their definitions (characterized by the state vectors $\{\hat{e}_I\}$) constant. The constraints (transition coefficients) are in essence rates of flow associated with the instantaneous movement of individuals from one population cell to another. Figure 1, shows the representation of N population as the vertices of the $(n-1)$ -simplex in R^{N-1} with the edges identifying the rates $\lambda_{I \rightarrow J}$ at which individuals from cell I can flow into to cell J . The diagram represents the topology of a generic model.

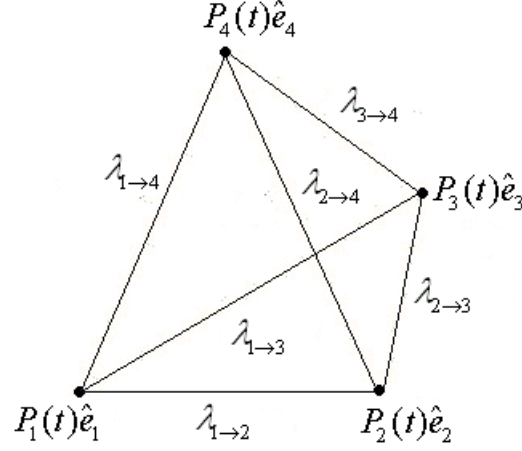


Figure 1. The state of sub-population (cell) I at time t is characterized by the state vector \hat{e}_I and the number of indistinguishable individuals $P_I(t)$ who are currently in that population. Each population cell is identified with a vertex of a simplex such that the edge connecting any two vertices I and J is associated with the rate of flow $\lambda_{I\rightarrow J}$ of individuals (transition coefficient) between these populations.

We associate the actual number of individuals which have moved between populations I and J within the period $t \in [t, t + \Delta t]$ with a process $X_{IJ}(t, t + \Delta t)$. We define the cumulative process by:

$$CX_{IJ}(t) = \sum_{i=0}^n X_{IJ}(t_i, t_i + \Delta t)$$

We can identify the normalized state vectors $\hat{f}_{IJ} = \hat{f}_K$ with each cumulative process $CX_{IJ}(t)$ such that each cell has an independent and unique representation in the M dimensional vector space $V_{CX} = \{\hat{f}_1, \hat{f}_2, \dots, \hat{f}_K, \dots, \hat{f}_M\}$. We expand the vector space of the population to include the process states $V_S = V_P \otimes V_{CX}$. The full state of the population can then be written as:

$$P(t) = \sum_{I=1}^N P_I(t) \hat{e}_I + \sum_{K=1}^M CX_K(t) \hat{f}_K \quad (2)$$

We associate $dV_P = \{d\hat{e}_1, \dots, d\hat{e}_I, \dots, d\hat{e}_N, d\hat{f}_1, \dots, d\hat{f}_I, \dots, d\hat{f}_M\}$ with the differential of the population state vector known as the vector bundle associated with $V_P = \{\hat{e}_1, \hat{e}_2, \dots, \hat{e}_I, \dots, \hat{e}_N, \hat{f}_1, \hat{f}_2, \dots, \hat{f}_I, \dots, \hat{f}_M\}$ associated with the mapping:

$$F : V_S \rightarrow dV_S$$

The processes are identified with the (time dependent) flow of individuals from one population cell into another. This flow can then be identified with the function (mapping) $F = \{F_1, \dots, F_m\}$ from the system space S into that of dS :

$$dS = F_m(S, t)dt \quad (3)$$

In addition we identify the stochastic nature of each process with another mapping G_j :

$$dS = G_{mj}(S, t)dW \quad (4)$$

Each function F_m and G_j is associated with a specific class of processes. In this way the change in the state of the system can be written (in general) as:

$$\begin{pmatrix} dP_1 \\ dP_2 \\ \vdots \\ dP_N \\ dCX_1 \\ dCX_2 \\ \vdots \\ dCX_M \end{pmatrix} = \sum_m F_m \begin{pmatrix} P_1 \\ P_2 \\ \vdots \\ P_N \\ CX_1 \\ CX_2 \\ \vdots \\ CX_M \end{pmatrix} dt + \sum_{m,j} G_{mj} \begin{pmatrix} P_1 \\ P_2 \\ \vdots \\ P_N \\ CX_1 \\ CX_2 \\ \vdots \\ CX_M \end{pmatrix} dW_j \quad (5)$$

Equation (5) allows us to write down the evolution of the state of the population as a system of stochastic differential equations which are defined by a series of m independent process maps F_m along with their corresponding stochastic functions G_{mj} (the second term in the equation is associated with stochastic noise). In this sense, we identify the function (mapping) $G : V_P \rightarrow dV_P$ with a Wiener process[4] (standard Brownian motion) defined by W_j . In general the functions F_m and G_{mj} can be non-linear in the vectors $\{P_1, \dots, P_N\}$ allowing for processes to be defined based on interactions between multiple population groups. In general, the system of vector equations can simply written as a set of differential equations:

$$\begin{aligned}
\frac{d}{dt} P_1 &= \sum_{Jm} \left(\lambda_{1 \rightarrow J}^m(P_1, \dots, P_N) + \tilde{\lambda}_{1 \rightarrow J}^m(P_1, \dots, P_N) \right) P_J \\
\frac{d}{dt} P_2 &= \sum_{Jm} \left(\lambda_{2 \rightarrow J}^m(P_1, \dots, P_N) + \tilde{\lambda}_{2 \rightarrow J}^m(P_1, \dots, P_N) \right) P_J \\
\frac{d}{dt} P_3 &= \sum_{Jm} \left(\lambda_{3 \rightarrow J}^m(P_1, \dots, P_N) + \tilde{\lambda}_{3 \rightarrow J}^m(P_1, \dots, P_N) \right) P_J \\
&\vdots \\
\frac{d}{dt} P_I &= \sum_{Jm} \left(\lambda_{I \rightarrow J}^m(P_1, \dots, P_N) + \tilde{\lambda}_{I \rightarrow J}^m(P_1, \dots, P_N) \right) P_J \\
&\vdots
\end{aligned} \tag{6}$$

In equation (6), $\lambda_{I \rightarrow J}^m$ and $\tilde{\lambda}_{I \rightarrow J}^m$ represent the mean and stochastic (noise) rate of flow contributions between population cells I and J respectively. The stochastic noise term $\tilde{\lambda}_{I \rightarrow J}^m$ is said to be negligible if all $G_{mj}(P_1, \dots, P_N) = 0$.

2 Dementia Model

Within the dementia model, Canadian population is divided into unique population cells $P_I(t)$ based on age, gender and health states. The processes within the model can be roughly divided into two categories:

- Demographic processes: Processes which are not specific to the dementia disease model. These include: aging, death, birth and migration. The processes are essential in establishing a “base” population model in which the burden of Dementia is not considered.
- Model specific processes: Processes which are specific to the dementia disease model. These include: incidence of new cases, case specific mortality, Treatment and care giver assistance.

2.1 Demographic Functions

2.1.1 Aging Function

The individuals in population $P_I(t)$ are separated into sub-populations based on M age intervals $a = \{[0, a_1), \dots, [a_{M-1}, a_M)\}$. The aging function is responsible for moving individuals in population cells $P_a(t)$ into those of $P_{a+1}(t + \Delta t)$ (indices regarding all other population characteristics are suppressed). Let the age axis be partitioned into M intervals of widths $\Delta_a = \{\Delta_{[0, a_1)}, \Delta_{[a_1, a_2)}, \dots, \Delta_{[a_{M-1}, a_M)}\}$ with populations $P_{[0, a_1)}, P_{[a_1, a_2)}, \dots, P_{[a_{M-1}, a_M)}$. The population density function on age group a is then approximately $\frac{P_a}{\Delta_a}$. After time Δt the new population density function is a translate (by Δt) of the old one (ignoring all other processes such as death and migration), so the number of people aging *out* of the interval is the product of the density and the time.

$$\Delta P_a|_{out} \approx -\frac{P_a}{\Delta_a} \Delta t$$

This same number of people must age into the next age interval.

$$\Delta P_{a+1}|_{in} \approx \frac{P_a}{\Delta_a} \Delta t$$

These approximations lead to differential equations that model aging.

$$dP_a = (a > 0) \frac{P_{a-1}}{\Delta_{a-1}} dt - \frac{P_a}{\Delta_a} dt$$

It is worthwhile to note that people don't age into $P_{[0,a_1]}$, but are born into it. The differential equations assume that the population density function is constant over each interval. The (potential) numerical error associated with this assumption may be reduced by taking the widths Δ_a to be smaller.

2.1.2 Mortality Function

The mortality function is associated with the flow of individuals in population cells $P_I(t)$ into those in $CD_I(t + \Delta t)$. The historical death data from Statistics Canada is given in cohort form. The model is designed to operate on age-based data so the historical data must be transformed into the correct form. Let $P(t, [a_i, a_{i+1}])$ be the number of people between age a_i and a_{i+1} at time t . The cumulative population, $CP(t, a)$, is the number of people below age a at time t . From the population data, the cumulative population can be calculated at the boundaries of the age groups.

$$CP(t, a_i) = \sum_{j=0}^{i-1} P(t, [a_j, a_{j+1}])$$

A smooth estimate of the cumulative population, $\widetilde{CP}(t, a)$, can be obtained using a monotonic cubic interpolation of $CP(t, a_i)$. The cumulative population can also be calculated from the population density, $\rho(t, a)$, using $CP(t, a) = \int_0^a \rho(t, u) du$. Equating both expressions for the cumulative population and differentiating with respect to a yields:

$$\rho(t, a) = \frac{d}{da} \int \rho(t, a) da = \frac{d}{da} \widetilde{CP}(t, a)$$

where . Let $\mu(t, a)$ be the fractional death rate density so the change in population density due to death is

$$\left. \frac{\partial \rho}{\partial t} \right|_{\text{Death}} = -\rho\mu$$

The historical cohort data is related to ρ and μ via

$$D([t_i, t_{i+1}], [a_j, a_{j+1}]) = \int_{t_i}^{t_{i+1}} \int_{a_j}^{a_{j+1}} \rho(t, u + t - t_i) \mu(t, u + t - t_i) du dt$$

The age interval can be extended from $-\infty$ to a to define:

$$D([t_i, t_{i+1}], a) = D([t_i, t_{i+1}], [-\infty, a]) = \int_{t_i}^{t_{i+1}} \int_{-\infty}^a \rho(t, u + t - t_i) \mu(t, u + t - t_i) du dt$$

Differentiating with respect to a then yields

$$\frac{dD([t_i, t_{i+1}], a)}{da} = \int_{t_i}^{t_{i+1}} \rho(t, a + t - t_i) \mu(t, a + t - t_i) dt$$

Finally, the t integral can be approximated to get

$$\frac{dD([t_i, t_{i+1}], a)}{da} = \rho(t_i, a) \mu(t_i, a) (t_{i+1} - t_i)$$

Since the derivative on the left can be estimated directly from the cohort data, the historical values of μ can be calculated. The quantity $\mu^{-1} \frac{d\mu}{dt}$ is assumed to be normally distributed which yields the stochastic differential equation

$$d\mu = \bar{\mu}dt + \sigma dW$$

The death rate at time t is then given by:

$$\frac{dCD(t, [a_j, a_{j+1}])}{dt} = \int_{a_j}^{a_{j+1}} \rho(t, a) \mu(t, a) da$$

The integral can be numerically approximated as:

$$\frac{dCD(t, [a_j, a_{j+1}])}{dt} = \frac{1}{2} (\rho(t, a_j) \mu(t, a_j) + \rho(t, a_{j+1}) \mu(t, a_{j+1})) (a_{j+1} - a_j)$$

2.1.3 Birth Function

Let $CB(t)$ be the cumulative birth, the number of births between time 0 and time t . Births are dependent on a representative subset $P_{REP}(t)$ of the female population which is taken to be all females aged 15 to 45. The deterministic definition of birth rate $R_{det}(t)$, is the rate of change of cumulative birth over the representative population.

$$R_{det} = \frac{dCB}{dt} / P_{REP}$$

The birth rate is considered to be more or less constant over time, but with some noise. Cumulative birth is therefore modeled by a stochastic differential equation.

$$dCB = \mu P_{REP} dt + \sigma P_{REP} dW$$

Historical data are used to estimate CB and its derivative at many points in time, along with estimates for P_{REP} at these times. These quantities provide a set of values $\left\{ \frac{dCB}{dt} / P_{REP} \right\}_t$ assumed to be normally distributed. The parameters μ and σ in the stochastic differential equation are estimated as the mean and standard deviation of this distribution.

2.1.4 Migration Function

Historical migration rates do not have any dominant trends as historical birth and death rates do. This is due to the fact that migration rates depend much more strongly upon the state of the economy and government policies than birth and death. Therefore, the mean historical migration rates are used. The instantaneous immigration and emigration rates, respectively, are

$$\begin{aligned} \nu_i(t) &= P(t)^{-1} \frac{d}{dt} CI(t) \\ \nu_e(t) &= P(t)^{-1} \frac{d}{dt} CE(t) \end{aligned}$$

where $CI(t)$ and $CE(t)$ are the cumulative number immigrations and emigrations up to time t . The mean historical rates are then given by:

$$\begin{aligned} \bar{\nu}_i &= \sum_{t_H} v_i(t_H) \\ \bar{\nu}_e &= \sum_{t_H} v_e(t_H) \end{aligned}$$

where t_H are the historical times where population is known. The time derivatives for evolution are then given by:

$$\begin{aligned}\frac{dCI}{dt} &= \bar{\nu}_i P \\ \frac{dCE}{dt} &= \bar{\nu}_e P \\ \frac{dP}{dt} &= \bar{\nu}_i P - \bar{\nu}_e P\end{aligned}$$

2.2 Dementia Specific Functions

The Dementia specific functions represent all of the processes which are necessary in the establishing of Dementia specific health states. Figure 2 illustrates all of the states which had been identified in the current study.

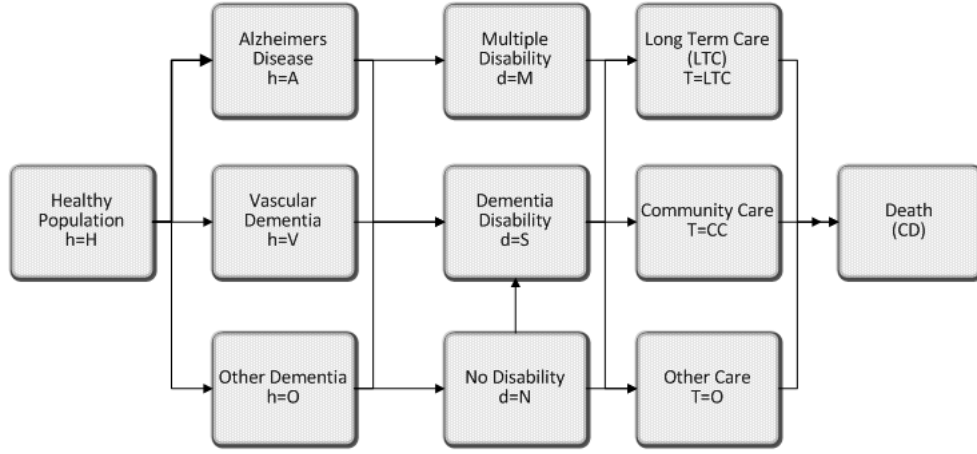


Figure 2: The dementia specific part of the topology of the Rising Tides Project.

The population of Canada can be divided into the following population states:

1. Healthy population ($P_h(t)$ with $h = H$): All of those individuals who had never been (previously) diagnosed with any form of dementia.
2. Alzheimer Disease Population ($P_h(t)$ with $h = A$): All of those individuals who had previously been diagnosed with Alzheimer's disease
3. Vascular Dementia Population ($P_h(t)$ with $h = V$): All of those individuals who had previously been diagnosed with Vascular dementia
4. Other Dementia Population ($P_h(t)$ with $h = O$): All of those individuals who had previously been diagnosed with other forms of dementia (other than Alzheimer's disease or Vascular Dementia)

Each of the Dementia population states can be further decomposed into:

1. Dementia population ($P_{hd}(t)$ with $h \neq H$ and $d = M$): All of those individuals who previously been diagnosed with any form of dementia and are disabled due to multiple conditions (eg. Cardiovascular disease) including dementia.
2. Dementia population ($P_{hd}(t)$ with $h \neq H$ and $d = S$): All of those individuals who previously been diagnosed with any form of dementia and are disabled due to dementia only.
3. Dementia population ($P_{hd}(t)$ with $h \neq H$ and $d = N$): All of those individuals who previously been diagnosed with any form of dementia but currently experience no disability (due to dementia or otherwise)

Finally, the disabled populations are a subject to various forms of treatment/care:

1. Dementia population ($P_{hdT}(t)$ with $h \neq H$, $d = \{M, S\}$ and $T = LTC$): All of those individuals with any form of dementia who currently receive treatment/care at a long term care facility (LTC)
2. Dementia population ($P_{hdT}(t)$ with $h \neq H$, $d = \{M, S\}$ and $T = LTC$): All of those individuals with any form of dementia who currently receive treatment/care at their communities (CC)
3. Dementia population ($P_{hdT}(t)$ with $h \neq H$, $d = \{M, S\}$ and $T = LTC$): All of those individuals with any form of dementia who currently receive treatment/care elsewhere

2.2.1 Differential Equations in Dementia Incidence Prevalence Module

The healthy population is initially divided into two groups based on the current level of physical activity $k = \{Low, Moderate, High\}$. Those who are associates with low or moderate levels of activity can be said to be at elevated levels of risk ρ_k with respect to those individuals with high level of physical activity ($\rho_{k=High} = 1$). The incidence of dementia is then computed as a function of this excess relative risk. We compute the change in cumulative incidence in the case in which excess relative risk is present (among those individuals who participate in low or moderate physical activity) as:

$$dCI_w^{ag} = R_0^{ag} \left(\sum_k \rho_k^{ag} \alpha_{kw}^{ag} \right) \left(\sum_h P_{hw}^{ag} \right) dt$$

Alternatively, we compute the change in cumulative incidence in the case in which no excess relative risk is present (among those individuals who participate in high physical activity) as:

$$dCI_w^{ag} = f_w R^{ag} \left(\sum_h P_{hw}^{ag} \right) dt$$

Increasing high physical activity prevalence (or reducing low physical activity prevalence) among the healthy population is then equivalent to a scenario in which the incidence fraction is reduced. The start date of this reduction may be adjusted. The change in cumulative incidence provides the rate of change of population due to incidence.

$$\begin{aligned} dP_{Sw}^{ag}|_{incidence} &= dCI_w^{ag} \\ dP_{Hw}^{ag}|_{incidence} &= -dCI_w^{ag} \end{aligned}$$

The desired prevalence distribution is maintained in the base population by setting the derivative equal to the desired minus the actual.

$$dP_{hB}^{ag}|_{correction} = \left(\theta_h^{ag} \sum_{h'} P_{h'B}^{ag} - P_{hB}^{ag} \right) dt$$

where θ indicates the magnitude of the reduction. The change in the base population is implemented as the change due to incidence along with the correction term.

$$dP_{hB}^{ag} = dP_{hB}^{ag}|_{incidence} + dP_{hB}^{ag}|_{correction}$$

The change in the base population is in theory due to incidence and other factors.

$$dP_{hB}^{ag} = dP_{hB}^{ag}|_{incidence} + \Delta_h^{ag} \sum_h P_{hB}^{ag}$$

This is not an equation of the system, but it provides a way to solve for the other factors.

$$\Delta_h^{ag} = \frac{dP_{hB}^{ag}|_{correction}}{\sum_h P_{hB}^{ag}}$$

Assume that the same changes due to other causes are present in the scenario population.

$$dP_{hC}^{ag}|_{correction} = \Delta_h^{ag} \sum_h P_{hC}^{ag}$$

The total change in population output from this module is due to the incidence and the other causes.

$$dP_{hw}^{ag} = dP_{hw}^{ag}|_{incidence} + dP_{hw}^{ag}|_{correction}$$

2.2.2 Differential Equations for Death

The dementia death with bias module is derived from the total death with bias given to those with dementia. The base module provides the change in cumulative death dCD_B^{ag} and the change in cumulative death among the sick $dC\tilde{D}_B^{ag}$ in the base population. (Changes in the scenario population are also provided but these are overwritten by this module.) The change in cumulative death among the healthy is given by subtraction [3].

$$dC\hat{D}_B^{ag} = dCD_B^{ag} - dC\tilde{D}_B^{ag}$$

The death rates among the healthy and the sick are computed from the base population.

$$\begin{aligned} \delta_H^{ag} &= \frac{dC\hat{D}_B^{ag}}{P_{HB}^{ag}} \\ \delta_S^{ag} &= \frac{dC\tilde{D}_B^{ag}}{P_{SB}^{ag}} \end{aligned}$$

(Division by zero is taken to be zero, since for example $dC\tilde{D}_B^{ag}$ and P_{SB}^{ag} are both zero for $a < 65$.) These death rates are assumed to be the same in the scenario population.

$$\begin{aligned} dC\hat{D}_C^{ag} &= \delta_H^{ag} P_{HC}^{ag} \\ dC\tilde{D}_C^{ag} &= \delta_S^{ag} P_{SC}^{ag} \end{aligned}$$

The total change in cumulative death in the scenario is given by addition.

$$dCD_C^{ag} = dC\hat{D}_C^{ag} + dC\tilde{D}_C^{ag}$$

The change in population output from this module is the change due to death.

$$\begin{aligned} dP_{Hw}^{ag} &= -dC\hat{D}_w^{ag} \\ dP_{Sw}^{ag} &= -dC\tilde{D}_w^{ag} \end{aligned}$$

The output derivatives are dCD_w^{ag} , $dC\tilde{D}_w^{ag}$ and dP_{hw}^{ag} . The death with bias module is derived from the death module. The base module provides the change in cumulative death dCD_w^{ag} . Let ρ_w^{ag} be the disease prevalence.

$$\rho_w^{ag} = \frac{P_{Sw}^{ag}}{\sum_h P_{hw}^{ag}}$$

The changes in cumulative death among the healthy, among the sick, and among the sick due to other causes are calculated from the prevalence, the bias factor β , and the total change in cumulative death.

$$\begin{aligned} dC\hat{D}_w^{ag} &= \frac{1 - \rho_w^{ag}}{1 + (\beta - 1)\rho_w^{ag}} dCD_w^{ag} \\ dC\tilde{D}_w^{ag} &= \frac{\beta\rho_w^{ag}}{1 + (\beta - 1)\rho_w^{ag}} dCD_w^{ag} \text{ if all deaths considered} \\ dC\tilde{D}_w^{o,ag} &= \frac{\rho_w^{ag}}{1 + (\beta - 1)\rho_w^{ag}} dCD_w^{ag} \end{aligned}$$

When only healthy deaths are considered, the deaths among the sick are the same as the deaths among the sick due to other causes.

$$dC\tilde{D}_w^{ag} = dC\tilde{D}_w^{o,ag} \text{ if only healthy deaths}$$

The output derivatives include $dC\hat{D}_w^{ag}$ and $dC\tilde{D}_w^{ag}$.

2.2.3 Dementia Incidence, Prevalence and Mortality Nomenclature

Incidence and Prevalence

Axes

Name	Description	Index and Abbreviation
Age	[0 1], [1,2],..., [90 100]	$a \in \{0, 1, ..., 90\} = (91)$
Gender	Male, Female	$g \in \{M, F\}$
Health State	Healthy, Sick	$h \in \{H, S\}$
Activity	Active, Inactive	$k \in \{A, I\}$
Scenario	Base, Scenario	$w \in \{B, C\}$

Quantities

Name	Time Axis	Axes (not including time)	Symbol
Population	yes	$(91) \times \{M, F\} \times \{H, S\} \times \{B, C\}$	P_{hw}^{ag}
Base Health State Distribution	no	$(91) \times \{M, F\} \times \{H, S\}$	θ_h^{ag}
Cumulative Incidence	yes	$(91) \times \{M, F\} \times \{B, C\}$	CI_w^{ag}
Activity Distribution	no	$(91) \times \{M, F\} \times \{A, I\} \times \{B, C\}$	α_{kw}^{ag}
Relative Risk	no	$(91) \times \{M, F\} \times \{A, I\}$	ρ_k^{ag}
Total Incidence Rate	no	$(91) \times \{M, F\}$	R^{ag}
No Risk Incidence Rate	no	$(91) \times \{M, F\}$	R_0^{ag}
Incidence Fraction	no	$\{B, C\}$	f_w

Mortality

Axes

Name	Description	Index and Abbreviation
Age	[0 1], [1,2],..., [90 100]	$a \in \{0, 1, \dots, 90\} = (91)$
Gender	Male, Female	$g \in \{M, F\}$
Health State	Healthy, Sick	$h \in \{H, S\}$
Scenario	Base, Scenario	$w \in \{B, C\}$

Quantities

Name	Time Axis	Axes (not including time)	Symbol
Population	yes	$(91) \times \{M, F\} \times \{H, S\} \times \{B, C\}$	P_{hw}^{ag}
Cumulative Death	yes	$(91) \times \{M, F\} \times \{B, C\}$	CD_w^{ag}
Cumulative Death Among the Healthy	yes	$(91) \times \{M, F\} \times \{B, C\}$	\hat{CD}_w^{ag}
Cumulative Death Among the Sick	yes	$(91) \times \{M, F\} \times \{B, C\}$	\tilde{CD}_w^{ag}
Death Rate	yes	$(91) \times \{M, F\} \times \{H, S\}$	δ_h^{ag}

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APPENDIX H: LIFE AT RISK® ECONOMIC FRAMEWORK

Life at Risk®: Economic Modeling Framework.

Life at Risk

Economic Modeling Framework

June 2009



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Life at Risk Platform: General Overview

This section outlines the general approach adopted by Life at Risk[®] for quantifying and evaluating the impact of disease and injury on a community and its economy. Covered are the topics of: discrete event simulation; study design of the life and economic burden of disease; model modularization; attributable risk; direct/indirect costs; treatment of indirect costs; simulation; a structural model of the Canadian economy; sensitivity analysis; and model validation and transparency.

Life at Risk Approach: Discrete event simulation

Developed by RiskAnalytica, Life at Risk[®] is a 'discrete event simulation' decision analytic policy platform that incorporates the design of peer reviewed empirical models (eg. clinical trials) and empirical data (eg. historical and surveillance data, health costs) into modularized discrete event simulations.

A decision analytic policy simulation model can be defined as: an analytic methodology that simulates events over time and across populations, that is based on data drawn from primary and/or secondary sources, and whose purpose is to estimate the effects of an intervention on valued health consequences and costs.¹ A simulation model can be defined as “. . . a replicable, objective sequence of computations used for generating estimates of quantities of concern. . .”²

Discrete event simulation represents the operation of a system as a chronological sequence of events. Each event occurs at a recorded time and marks a change of state in the system³. The approach is based upon concepts such as entities, resources, topology, that describes entity flow and resource sharing.^{4 5} A discrete event simulation represents the course of disease very naturally, with few restrictions. Neither mutually exclusive branches nor states are required, nor is a fixed cycle. All relevant aspects can be incorporated explicitly and efficiently. Flexibility in the handling of perspectives and carrying out sensitivity analyses, including structural variations, is incorporated and the entire model can be presented very transparently.⁶ Via discrete event simulation, the analysis of the life and economic burden of disease is used to characterize the life and economic dimensions of various health problems/conditions as a key input for planning, budgeting, and priority setting.

Empirical models describe relationships between predictive factors and outcomes without attempting to explain the underlying mechanism that gives rise to these relationships.⁷ In contrast to empirical models, discrete event simulation models can extrapolate beyond existing data by incorporating judgments to

¹ Cohen and Neumann (2008)

² National Research Council. (1991)

³ Robinson (2004)

⁴ Borshchev and Filippov (2004)

⁵ Caro (2005)

⁶ Caro (2005)

⁷ Weinstein *et al* (2001)

systematically integrate multiple data sets.^{8 9 10} Discrete event simulation models can also be used to address counterfactual scenarios (ie, to ask “what if” questions) and to make forecasts of what may occur.^{11 12} This is achieved in Life at Risk[®] through the use of a base scenario against which the scenario of interest is compared and contrasted.^{13 14}

The Life at Risk[®] approach is designed to respond to the many research questions that can be proposed by different perspectives of a health care system and the community it serves. For example, the Life at Risk[®] approach can be used to: (1) define the magnitude of disease in patient volume, potential years of life lost and in dollar terms; (2) justify intervention programs; (3) assist in the allocation of research dollars on specific diseases; (4) provide a basis for policy and planning relative to prevention and control initiatives; and (5) provide a life impact and economic framework for program evaluation.¹⁵

Within the Life at Risk[®] platform, the possible future health states of a population along with the associated disability and economic burden are simulated. By incorporating the relationships between the population, the natural history of the disease, socio-economic risk factors, epidemiology and economic impacts, the simulation framework generates the possible future states for a series of important variables. These include the possible future risk factor exposures and their impacts upon the future states of a health condition, the performance of screening examinations (if applicable), the effectiveness of treatment in various stages, the risks of complications, the competing mortality risks, and the direct and indirect loss of income from disability, death or treatment.

The results of discrete event simulation provide a region of future possibilities¹⁶ which can be interpreted and managed by decision-makers. The Life at Risk[®] management framework is a reliable, robust, objective and independent means of evaluating the life and economic burdens of different diseases and the cost-effectiveness evaluations of health interventions proposed by the literature and subject matter experts.

⁸ Groothuis *et al* (2001)

⁹ Harper *et al* (2004)

¹⁰ Harper *et al* (2005)

¹¹ Weinstein *et al* (2001)

¹² Cooper *et al* (2006)

¹³ Davies *et al* (2003)

¹⁴ Caro (2005)

¹⁵ Rice (2000)

¹⁶ The results of the simulations are not just one solution trajectory but rather multiple trajectories or possibilities. The region in which all trajectories lie is known as the possibility space and represents the region of all possible future outcomes based on the information provided by peer reviewed empirical models (eg. clinical trials) and empirical data (eg. historical and surveillance data, health costs).

Life and Economics with and without disease: Concept of life and economic burden

Recorded history has the implications of disability and death from disease and injury embedded within it. This is the case for both life data (such as population surveillance data) and economic data (such as historical production, income tax, consumption data).

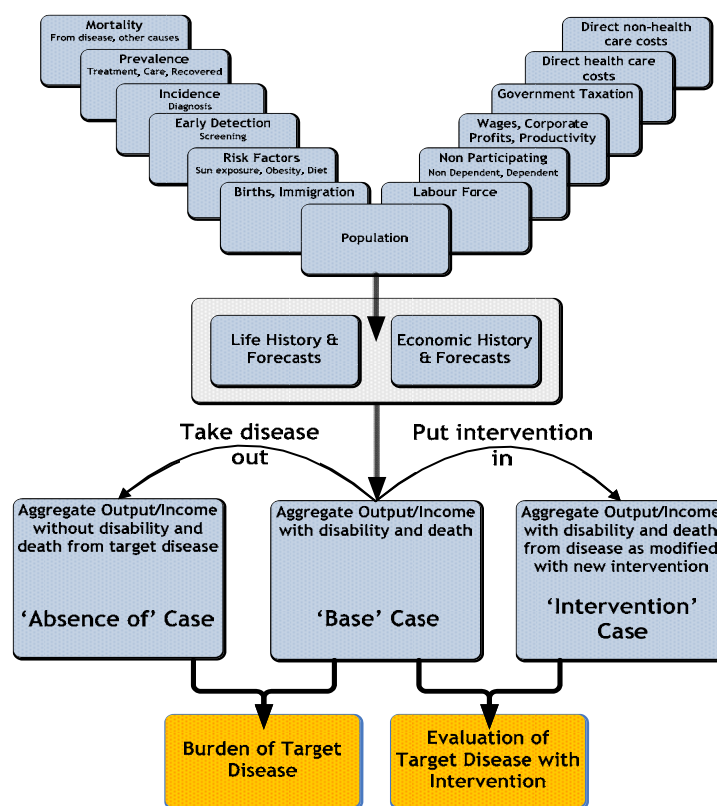
In order to run models that forecast life and economic quantities from such data requires that forecasts properly account for the implications of disability and death from disease and injury that is contained within the data. Such forecasts constitute a base case from which other forecasts of change can be compared.

In the Life at Risk[®] framework, a measure of the burden of disease either in life or economic terms is the result of running a hypothetical scenario that assumes the non presence of the disease. The resultant forecast, called the 'absence of' case is then compared with the base case to yield the result of what value would have been realized either in life or economic terms, if the disease of interest had not existed. This value is a measure of burden of disease as it represents a loss to society (in life or economic terms) due to the presence of disease. The equation below describes how the burden of disease is calculated:

$$\text{Burden of Disease} = \text{Base case} - \text{'Absence of' Case}$$

The below section provides a step by step description of the process used in the Life at Risk[®] framework to determine the burden of disease and the value of health interventions.

Exhibit 1 S&L: Economics with and without disease: Concept of life and economic burden



Study design of the life and economic impacts of disease and injury

The study design of the life and economic impacts of disease and the evaluation of different health care policies, in terms of cost-effectiveness and cost-benefit analyses, is structured in accordance with the following steps:^{17 18 19}

- A. **Identification of the perspective:** The Life at Risk[®] framework takes on different societal perspectives (e.g. Canadian, provincial, regional) and considers the financial and disability adjusted life year effects regardless of who pays the costs and who benefits from the effects. The relevant direct and indirect financial costs and DALY effects are measured using resource utilization rates, patient volumes, epidemiological and demographic data.
- B. **Identification of the quantities of concern:** The relevant quantities of interest for a burden of disease study and policy decision-making metrics are identified. Such quantities take the form of life and economic attributes.

¹⁷ Drummond *et al* (1997)

¹⁸ Gold *et al* (1996)

¹⁹ Rice (2000)

- i. Life attributes include (by age, gender, geography, disease type and severity): incidence, prevalence, mortality, disability adjusted life years²⁰ (from both prevalence and mortality);
 - ii. Economic attributes include (by age, gender, geography, disease type and severity, economic disability): direct health care cost components, direct non-health care cost components and indirect cost components;
- C. **Identification of the history:** An understanding of the future requires an analysis of the past that incorporates peer reviewed empirical models (eg. clinical trials) and the appropriate data (eg. historical and surveillance data, health costs);
- D. **Simulation of the base case:** As derived from A and C, the future life and economic burden of disease (expressed in terms of the quantities in B) is simulated without any proposed changes to the population's health state. This is called a base simulation of the population health and economic results and forms the basis of what the literature calls the burden of disease.²¹ These results represent the expected state of the population's health and economics without the benefits of an intervention. The results are expressed in terms of health, disability, health costs and economic productivity.
- E. **Simulation of the absence of disease case:** Derived from A, B and C, simulations of the life and economic values that would have resulted had the disease in question not existed are conducted. These values, when compared with the base case values, provide an estimate of the true burden of disease; not considering any health interventions.
- F. **Identification of the alternatives:** "Alternatives" represent health interventions designed to improve the health status of the population or mitigate the negative effects disease. Interventions can take the form of: candidate prevention, screening and treatment policies. The interventions implemented represent "alternate" scenarios that are required to be compared with the base case results that represent a 'usual care' scenario.^{22 23}
- G. **Simulation of different intervention scenarios:** As derived from C, D and F, the future life and economic burden of disease is simulated with the proposed health interventions. These 'alternate' scenarios represent the state of the population, measured by health status and economic outcomes, under the added constraint of the interventions proposed by disease subject matter experts.
- H. **Analysis of the Burden of Disease:** The difference between the simulation of the absence of disease case in E and the base analysis in D yields the burden of disease. The burden of disease is expressed in both life and economic term. Life terms represent the diseases contribution to mortality and disability, whereas economic values are represented by lost wages, output,

²⁰ Disability adjusted life years (DALYs) combine premature mortality and morbidity into a single measure to represent the healthy life years lost due to morbidity and those lost from premature mortality; Murray and Acharya (1997).

²¹ Rice (2000)

²² Drummond *et al* (1997)

²³ Gold *et al* (1996)

corporate profits, tax revenue, ect. The burden of disease can be represented by the below equation:

$$\text{Burden of Disease} = \text{Absence of Case} - \text{Base case}$$

- I. **Analysis of the value proposition of different intervention scenarios:** The difference between the 'alternate' scenario simulations in G and the base analysis in D and yields the value proposition of the health intervention. Cost effectiveness and cost-benefit analyses will be tested using specific statistical techniques.^{24 25 26 27 28} The costs and effects of the base case results and the 'alternate' scenario results are analyzed separately. Subsequently, the two sets of results are then compared to determine whether the differences in costs and effects with a 95% confidence interval (CI) are statistically significant. The result is a measure of the extent to which the interventions proposed by disease subject matter experts are expected to influence the future health of the population as well as the related economics. These results support policy makers in their evaluations of simulated health care interventions in terms of cost-effectiveness analysis and cost-benefit analysis.^{29 30} The value of an intervention can be expressed in terms of the change in the burden of disease and can be represented by the below equation:

$$\text{Change in the Burden of Disease} = \text{The Intervention Case} - \text{Base Case}$$

- J. **Sensitivity analysis:** Sensitivity analysis is an important part of the assessment of model integrity. Probabilistic sensitivity analyses³¹ is conducted which examines the effect of varying all variables simultaneously within plausible ranges^{32 33 34}.

²⁴ Barber and Thompson(1998)

²⁵ Thompson and Barber (2000)

²⁶ Coyle *et al* (1998)

²⁷ Coyle (1996)

²⁸ Desgagne' *et al* (1998)

²⁹ Drummond *et al* (1997)

³⁰ Korthals-de Bos *et al* (2004)

³¹ Claxton K *et al* (2005)

³² Briggs *et al* (1994)

³³ Briggs and Sculpher (1995)

³⁴ Briggs (2000)

Modularized Discrete Event Simulations

Conducting life/economic burden of disease simulations and the evaluation of different health care policies is no trivial task. It requires the mapping and modeling of many facets of the community that are directly related to the response to disease (eg. provision of health care) and those facets that respond to the provision of health care. Given the complexity associated with the task, Life at Risk[®] is structured as a set of modules which allow for the proper identification of inputs and outputs that are relevant to the decision-making perspective of the economic evaluation³⁵ and the distinction between simulation cell types. The components of the Life at Risk[®] simulation module are:

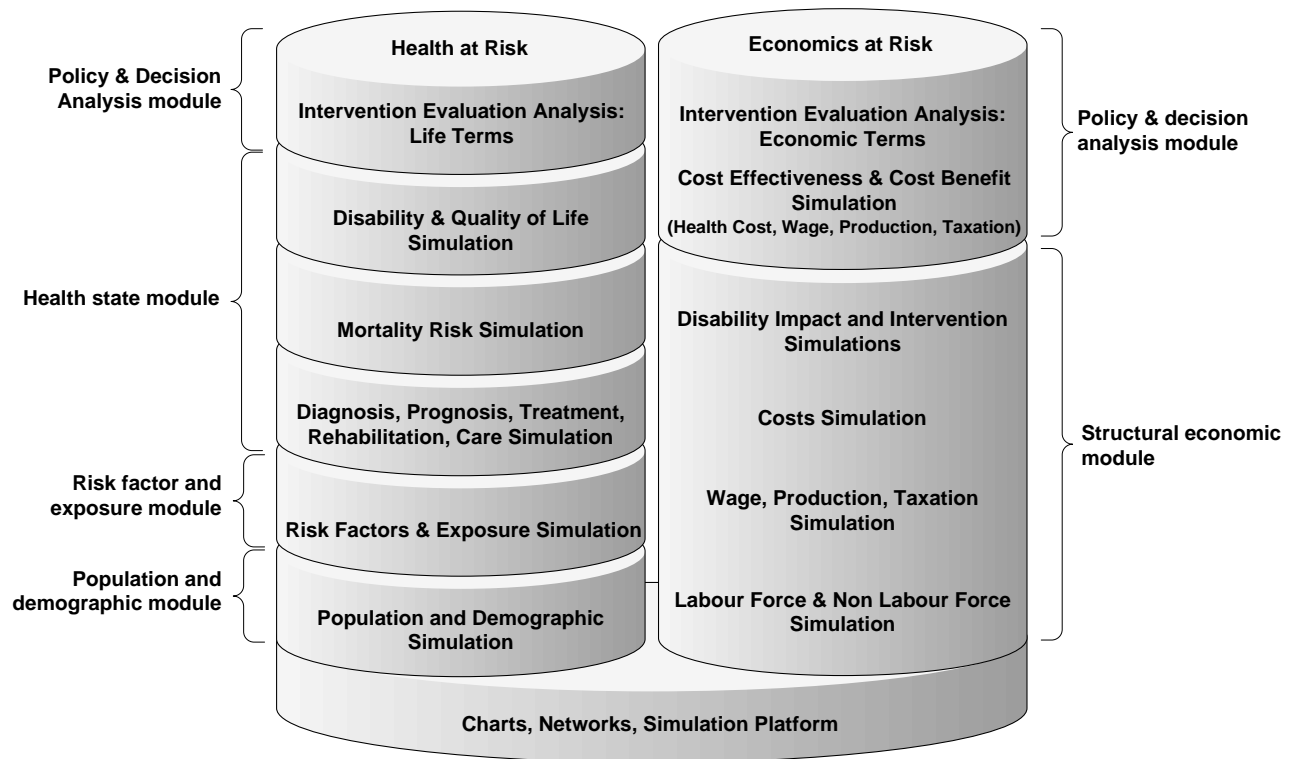
- Population and demographic module: includes all model specifications and simulations of the population are in terms of age, gender, race, other important demographic factors, region.
- Risk factor and exposure module: includes all model specifications and simulations of disease risk factor exposures and the attributable risk (etiologic fractions, excess fractions, relative risk).
- Health state: includes all model specifications and simulations of screening routines, incidence (by severity/stage of disease), mortality (by severity/stage of disease and other causes), prevalence (by severity/stage of disease, time lived with disease); treatment routines, after hospital care routines, disability (by severity/stage of disease, by economic and non-economic).
- Structural economic module: includes all model specifications and simulations of the labour force (by industry and employment status.), dependents and non-dependents, wages, production functions, income and consumption taxation rates (by government type), corporate revenues and profits, consumption from wages, consumption from production functions, interest rates, inflation rates (by CPI basket components), Gross Domestic Product (key income and expenditure components), demand for health care services and products, ;
- Policy and decision analysis module: includes all model specifications and simulations of cost effectiveness, cost benefit, direct impact from disability³⁶, life time cost of disease, indirect impact from disability (using same attributes as direct impact from disability).

The structure of Life at Risks[®] life and economic framework can be seen in the diagram below:

³⁵ Weinstein *et al* (2003)

³⁶ This variable is expressed in terms of population non-economic DALY, non-participating in labour force non-economic DALY, labour force non-economic DALY, population economic DALY, labour force economic DALY, wages by industry, corporate profits by industry, costs and demand for health care services and products, costs and demand for non-health care services and products, GDP key income and expenditure components.

Exhibit 2 Modularized Discrete Event Simulations



Economic Model Framework

The description of the economic model embedded in the Life at Risk Platform is divided into four sections. The first section discusses some of the basic principles and variables used in the economic analysis and how they are affected by changes in the health profile of the population. The second section discusses key concepts and methods relevant to the measurement of life, the economic impact of disease, and the value of government health policy interventions. Section three provides a detailed account of the decisions, costs and ultimately the level of output that results from changes in the health profile of an economy. Section four extends the framework presented in section three to include specific disability modules that deal with the unique issues that arise when modeling specific health events.

Section 1: Structural Model of Economy

There are many ways to build structural models of the economy. The Life at Risk[®] framework is partly used to estimate the costs of disease in terms of lost productivity. For this reason, the structural model presented below explicitly includes a demand-for-labour component and relevant economic variables are “built-up” from the underlying industry data.

The economic model embedded in the Life at Risk framework is a version of a model known as Klein’s Model 1.³⁷ The model incorporates stochastic equations and identities. Stochastic equations are solved with respect to the constraining identities (from either the structure and logic of the model and/or historical constraints on relationships). The frequency of the data is typically annual and applies to either provinces and territories or Canada as a whole.

In a structural economic model an important consideration is the difference between endogenous and exogenous variables. Endogenous variables are solved within the model and exogenous variables are taken as given. Ultimately, all economic variables can be *endogenized*. However, for practical reasons it is necessary to take certain variables as given. Usually variables that are of little interest or that have a minimal influence on the research question asked are assumed to be exogenous. For example, taking net exports as given will not affect the explanatory power of the model, given that net exports are such a small share of GDP.

The key exogenous variables in the Life at Risk Economic Framework are:

- Inflation: inflation rates are modeled independently to assess the upper and lower bounds and expected values of future inflation rates. Usually the focus of health care analysis is not on how inflation rates respond to macroeconomic factors of demand and supply. Hence, the simulated expected inflation rate for a relevant variable is used exogenously to the model. Where a

³⁷ L. Klein (1950), *Economic Fluctuations in the United States 1921-1941*, Wiley, pp. 58-80.

specific project demands analysis of the sensitivity of inflation rates to macroeconomic factors, the Life at Risk[®] platform is able to endogenize inflation rates;

- Interest rates: interest rates are modeled independently to assess the upper and lower bounds and expected values of future interest rates. As with inflation rates, the focus of health care analysis is typically not on how interest rates respond to macroeconomic factors. Hence, the simulated expected interest rates are introduced exogenously to the model. Where a specific project demands analysis of the sensitivity of interest rates to macroeconomic factors, the Life at Risk[®] platform is able to endogenize interest rates.
- Wages: wages are modeled independently to assess the upper and lower bounds and expected values of future wages. Although the Life at Risk[®] Economic framework often deviates from the assumptions of models based on perfect competition it does however adopt the assumption that firms are “wage taker.” This implies that an individual firm is not large enough to influence the price of labour in a meaningful way. Like inflation and interest rate, should a specific project demand analysis of the sensitivity of wages to macroeconomic factors, the Life at Risk[®] platform is able to endogenize the wage rate.

Theoretical Framework

All structural economic models require that some equilibrium is achieved. This generally means that a shock to the system (i.e., an exogenous change to health care practices) eventually results in a stable final condition, where the endogenous variables, settle to a stable value. In economics terms, this is satisfied through a market-clearing condition. Many structural economic models use the following identity³⁸:

$$(1) \quad Y \equiv C + I + G + X$$

Where,

Y = aggregate output or income

C = private consumption

I = private investment

G = government consumption and investment

X = net exports (or exports less imports)

Equation 1 ensures that what is produced in the economy exactly equals what is consumed and/or invested – by definition, this condition must hold. However, certain economic variables are contemporaneously related to income (or analogously aggregate income). For instance, consumption this period is related to income. If incomes increase, consumption this period is expected to increase.

³⁸ In economics the identity discussed below is known as the national income identity and must hold in all economic models. Even if a production function is used to calculate output, output must still be comprised of the identities elements. For an example, see the Solow Growth Model.

Furthermore, since individuals do not consume every additional dollar they earn, investment is also expected to increase.³⁹ Equation 2 (below) takes these relationships into account, where consumption and investment are directly related to current income levels⁴⁰ (note: the market-clearing identity also implies that aggregate output exactly equals aggregate income).

$$(2) \quad Y = C(Y) + I(Y) + G + X$$

If interest rates are introduced into the model – denoted by the letter r – and assuming a closed economy for the time being (i.e. does not trade with world or exports and imports equal zero) then Equation 2 becomes the following⁴¹:

$$(3) \quad Y = C(Y, r) + I(Y, r) + G$$

Consumption this period is inversely related to the level of interest rates; whereas, the quantity of investment is positively related to interest rates. An increase in interest rates causes rational economic agents to invest more today – or analogously consume less today – in exchange for more consumption in the future.

A second way to measure aggregate output rather than the expenditure method that is used above is the production method. The production method calculates aggregate output by summing what is produced by each industry. What is produced by each industry depends on the labour and capital employed. At a high-level, this can be represented by the following equation.⁴²

$$(4) \quad Y_i = F(K_i, L_i)$$

Where,

K = capital invested for industry i

L = number of labour hours for industry i

At least theoretically, the production method and expenditure method should yield equivalent results. Due to statistical sampling techniques used to estimate GDP via the two methods, they almost never equate. Fortunately, this discrepancy tends to be small. A condition of the economic model embedded

³⁹ The terms savings and investment are analogous since S (Savings) = I . The financial sector is the market through which savings of individuals are made available to those wanting to take out loans to make investments.

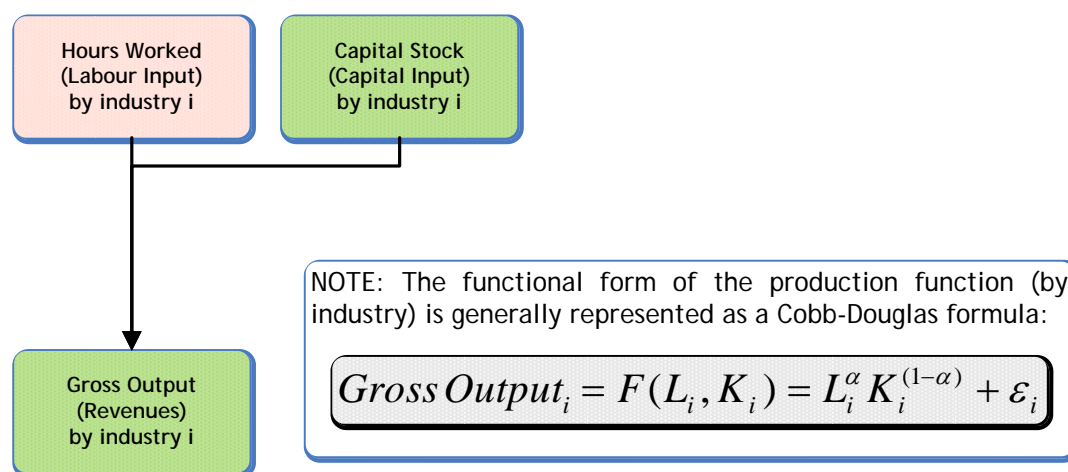
⁴⁰ This is based on the traditional Keynesian consumption function where “the amount of aggregate consumption mainly depends on the amount of aggregate income.” Regarding investment the Keynesian consumption function predicts “higher absolute level of income ...will lead to a greater portion income being saved”

⁴¹ A fall in consumption following an increase in the interest rate is consistent with the predictions of the Ramsey-Cass-Koopmans model. However, Mankiw (1981) and Hall (1988) estimate this effect to be relatively small.

⁴² For examples of models that use this approach see: the Ramsey-Cass-Koopmans model, the Diamond overlapping generations model and Real-Business-cycle theory.

in the Life at Risk[®] framework is that simulated production and simulated expenditure yield equivalent results in time. The production method is conceptually illustrated in the below structure and logic diagram.

Exhibit 3 S&L 1 - Production Function



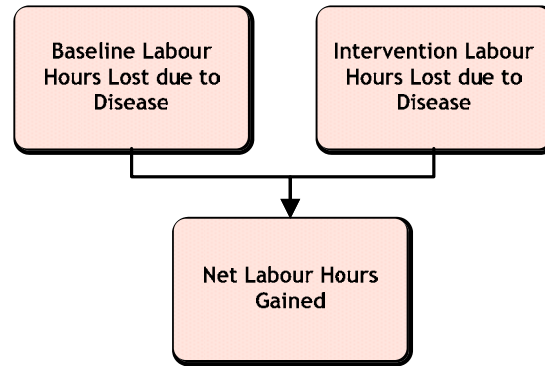
Both the expenditure and production approaches to measuring aggregate output differ in one important respect. The expenditure approach focuses on what it spent/consumed, while the production approach focuses on the value of what is produced in a given year. By definition, what is produced must exactly equal what is consumed and/or invested.

Employment

Industry production depends on the capital stock and the number of labour hours employed. An increase in any of these variables will result in increased output. Increasing the health profile of the population is consistent with increasing the number of labour hours. However, the increase in labour hours will not cause a uniform increase in production in all industries. The size of the increase in production for each industry will depend on the current mix of capital and labour being employed and the marginal product of labour (which is also related to the mix of capital and labour). The marginal product of labour is the added production associated with employing one additional unit of labour.

The labour hours gained through a health intervention is required to be netted against the baseline. This is similar to the process used to calculate the overall economic benefits of increasing the health profile of the population. In this case, the intervention scenario will yield less labour hours lost to disease than the baseline. This idea is conceptually illustrated in the structure and logic diagram below:

Exhibit 4 S&L - Net Labour Hours Gained

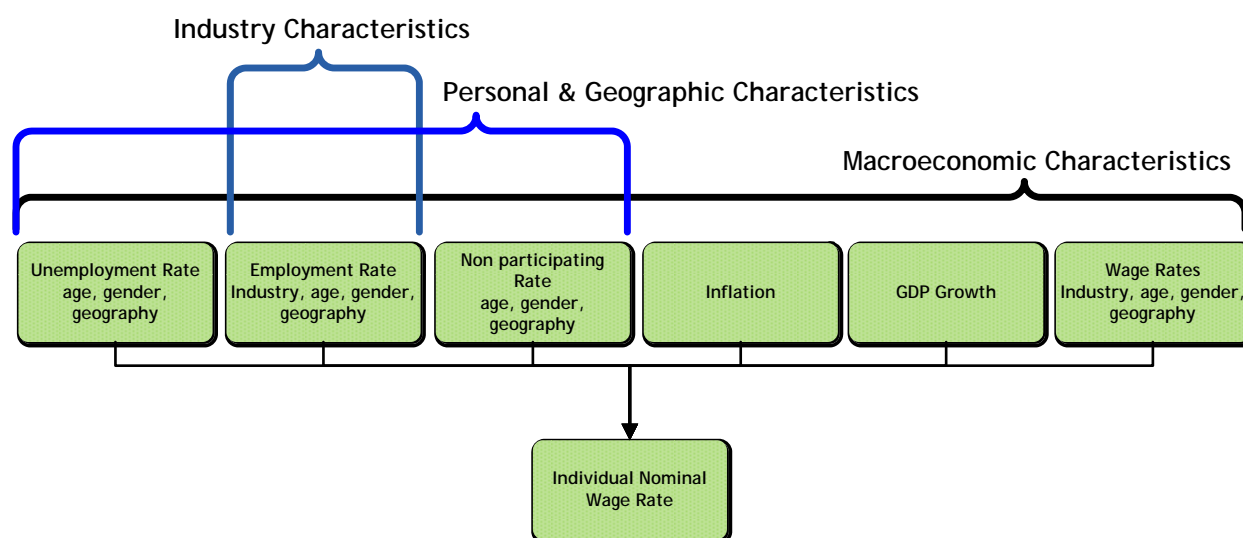


The severity and duration of the disease, whether a death occurs, expected life expectancy, the discount rate, whether a job replacement occurs and macroeconomic, geographical and industrial characteristics that may shorten or lengthen the employee replacement process are all factors that need to be considered when estimating the net labour hours lost due to disease (all of these factors will be discussed in more detail below).

Wage Determination

The Life at Risk economic framework expresses industry output in terms of production equivalent wages. In addition, wages are an essential piece to calculating personal loss associated with disability or death from disease. An individual's wage is determined by a host of macroeconomic, industrial, geographic and personal characteristics and is conceptually illustrated in the diagram below:

Exhibit 5 S&L - Wage Determination



Consumption

As individuals earn more they consume more. Therefore, increasing the health profile of the population will result in increased production and increased consumption. The degree to which consumption increases depends on the marginal propensity to consume (MPC). The MPC is the increase in consumption associated with an increase in income (analogous to output). The MPC will also depend on whether the increase in income is temporary or permanent. For temporary increases in income the economic literature suggests that the MPC is between 0.2 and 0.4. This is based on various empirical studies that estimated the effects of temporary increases in income on consumption. For instance, Bird and Bodkin (1965) found a MPC associated with a one-time and unanticipated life insurance dividend paid to US WWII veterans in 1950 of nearly 0.4 (i.e. 40% of the temporary increase in income was consumed). Landsberger (1970) estimated that for Israeli citizens receiving non-recurring restitution payments in 1957-58 from Germany, consumption increased by nearly 20%. Provided that the health intervention is expected to permanently increase the health profile of the population, it can be assumed that the increase in income that ensues is more consistent with a permanent increase in income. For permanent increases in income, the MPC is less than but close to unity (Barro 1997).

Net Investment (Private)

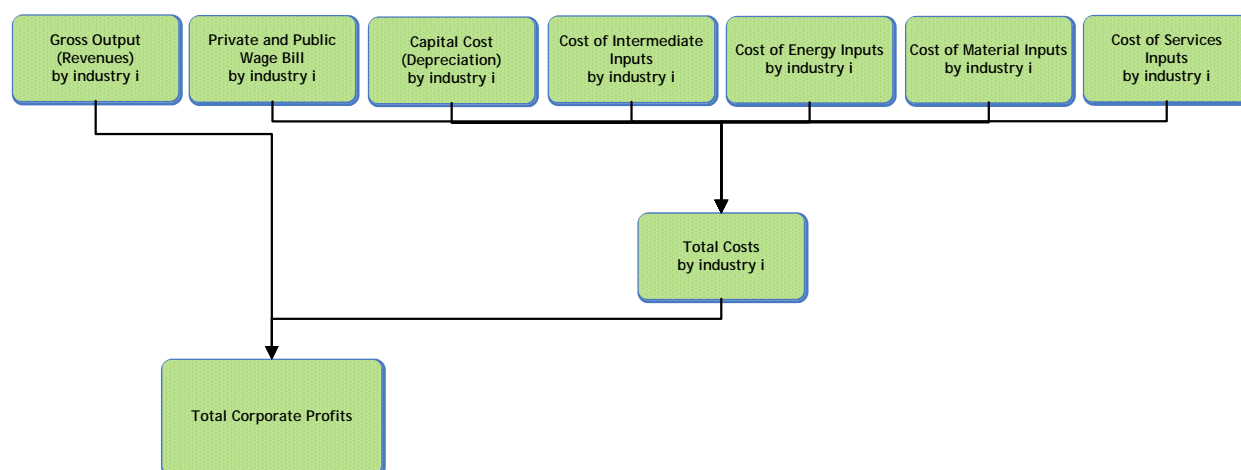
The main determinant of investment is interest rates and income (including corporate profits). Interest rates, personal incomes and corporate profits are all positively related to investment. Hence, an increase in the health profile of the population, which results in an increase in the labour input for production, leads to increased investment. Since income is either consumed or invested, the marginal impact of a one dollar increase in income can be calculated as one less the MPC, which equals the marginal propensity to save (MPK). Since it is assumed that a health intervention will raise the incomes permanently, the MPK, will be close to zero (Thaler 1990).

Corporate Profits by Industry

From a national account standpoint, corporate profits are calculated as revenues (total production) less the cost of goods sold. Cost of goods sold is calculated as the sum of the labour wage bill and the depreciation of the capital stock. Corporate profits are the basis for corporate tax revenues and can be used to calculate GDP via the income method.

Increasing the health profile of society leads to increased productivity and hence profitability of firms. As mentioned above, increasing the labour input in the production function means more output and revenue for firms. However, this is not the only effect of increased labour. An increase in labour hours also implies that the wage bill firms' face will increase. The latter effect works to increase costs. As a general rule, the increase in output outweighs the increase in the wage bill. The structure and logic diagram below conceptually illustrates of how corporate profits are calculated, from a national accounts standpoint.

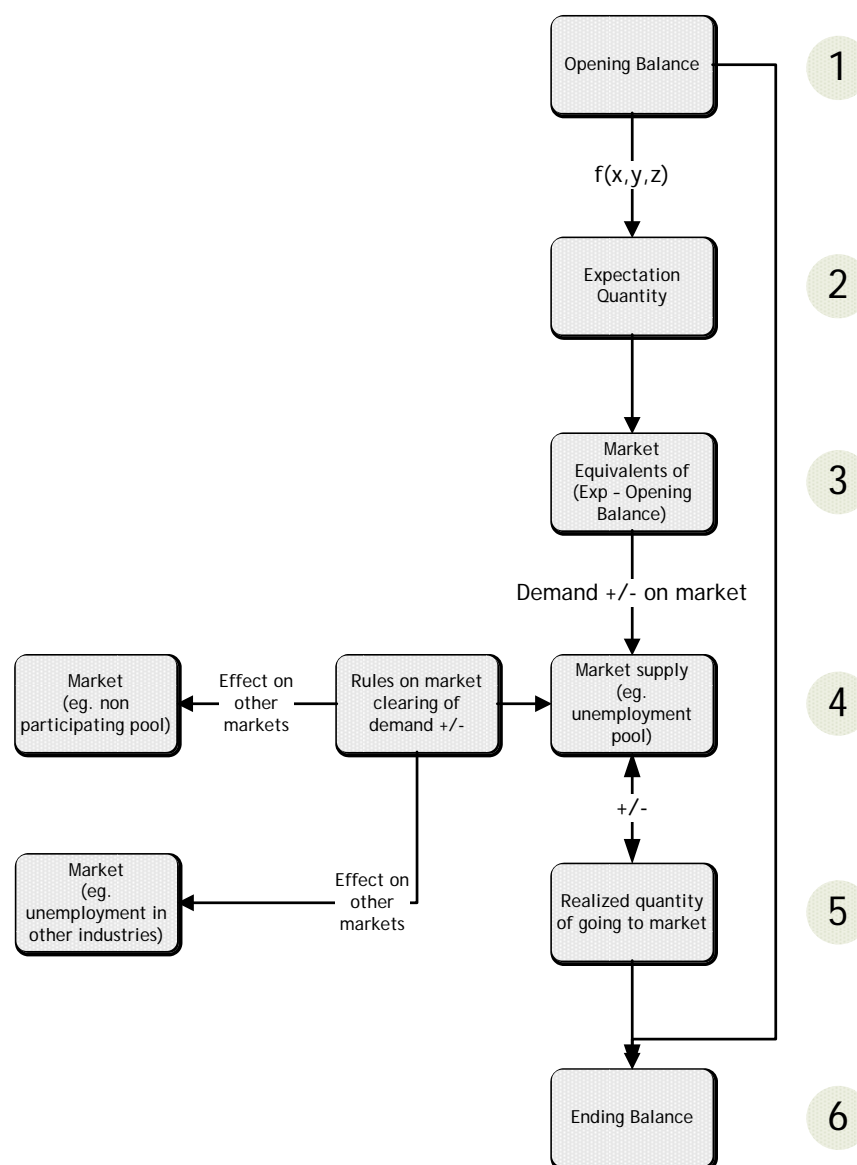
Exhibit 6 S&L - Components of Corporate Profits



Demand and Supply Expectation and Realization Modeling

Up to this point the model has assumed that an infinite supply of labour is available (at the current market wage) to any firm wishing to expand output. However, this assumption does not accurately describe reality. In reality imperfections exist in the labour market that prevents firms from achieving their equilibrium level of new employees. The below structure and logic diagram conceptually illustrates the process that results in a firms desired level of employment differing from its realized value (each stage in the below structure and logic diagram will be discussed in next section of the document).

Exhibit 7 S&L General Form of Demand/Supply Expectation Setting and Realization



(1) Opening Balance:

The opening balance consists of stock variables such as: the labour force, the capital stock, and the working-age population. Stock variables are variables that are dependent on previous period's value. For instance, population is a classic stock variable. Population this period equals the population last period plus births less deaths plus net migration (immigration less emigration).

(2) Expectation quantity:

How agents in economic theory form expectations is open to some debate. The two rival methods suggesting how expectations are formed are: Rational and Adaptive expectations. Adaptive expectations were originally proposed as a way of forming inflation expectation by Cagan (1956) and assume that the current period's expectations are adjusted from what was expected last period only by some fraction, γ , of the mistake between last periods realized result and what was originally expected.⁴³ Adaptive expectations can be summarized in the below equation where "X" is the forecasted value of interest

$$X(t)^e - X(t-1)^e = \gamma[X(t-1) - X(t-1)^e]$$

The adaptive expectations method is not without its detractors. Lucas (1976) most famously critiqued the approach stating: "Only trivial problems in which agents can safely ignore the future can be formulated under such a vague description of market constraints."⁴⁴

Lucas's 1976 critique led to a shift in focus from adaptive expectation to rational expectations. Rational expectations can be represented by the equation below:

$$X(t)^e = E[X(t)]$$

Where E is the expectations operator, what is rational from this point of view is that expectations are formed by the statistical expected value of X, generated by the model that determines X.⁴⁵ This theory is in keeping with the assumptions of neoclassical economics. In particular, it assumes that agents have a complete and accurate knowledge of the model that determines X.⁴⁶

When implementing the rational expectations approach proponents tend simplify matters by assuming that the act of accessing and manipulating information is expensive, in terms of both money and effort.^{47 48} Others have circumvented the restrictive assumptions of perfect information by incorporating mistaken expectations into their model; most notably the Lucas-Phelps model.⁴⁹

⁴³ Smithin (2003)

⁴⁴ Lucas (1976)

⁴⁵ Smithin (2003)

⁴⁶ Smithin (2003)

⁴⁷ Black (2002)

Lucas (1976) insists that the rational expectation approach is of crucial importance for achieving accurate long run projections. Referring to adaptive expectations he states “For longer term forecasting and policy simulations, however, ignoring the systematic sources of drift will lead to large, unpredictable errors.”⁵⁰ Other studies have shown the rational expectations to produce more accurate forecasts than adaptive expectations.^{51 52}

In the economic model embedded in the Life at Risk[®] platform, economic agents use opening balances in conjunction with the relationships between the various economic variables to “rationally” form expectations. A firm’s expected output is value that would be selected in the absence of frictions and is derived from standard conditions for profit or utility maximization. This approach provides the all of advantages of the rational expectations approach while at the same time avoids its more restrictive assumptions.

(3) Expectation-Opening Balance Deviation:

The difference between the expected quantity and the opening balance is the firm’s desired change in output for the period. Firms, then seek to produce this desired level of output by hiring the appropriate amount of labour.

(4) Available Market Supply:

Economic agents may not be able to obtain the additional labour required to meet their new production expectation because of frictions in the labour market.⁵³ The available market supply is the amount of production input units that are obtainable. Various market clearing rules are used to portion the available supply between the economic agents. The difference between expected and realized values may vary across industries and will impact the future allocation of resources. For instance, industries that are best able to minimize the expectation-opening balance deviation will have higher production and higher corporate profits.⁵⁴ These assumptions regarding imperfections in available market supply are well documented in the macroeconomic theoretical literature on unemployment and are consistent with searching and matching models where workers and jobs are heterogeneous.^{55 56 57 58}

⁴⁸ Muth (1961)

⁴⁹ Romer (2006)

⁵⁰ Lucas (1976)

⁵¹ Heady and Kaldor (1954)

⁵² Modigliani and Weingartner (1958)

⁵³ This concept is familiar to the costly adjustment models of macroeconomics, for examples see: Brayton and Tinsley (1996), Sargent (1978), and Kennan (1979)

⁵⁴ When appropriate the Life at Risk simulation platform presents economic results by industry; otherwise results will be presented at the national level.

⁵⁵ Diamond (1982)

⁵⁶ Pissarides (1985)

⁵⁷ Mortensen (1986)

⁵⁸ Mortensen and Pissarides (1999)

(5) Realized Quantity Going to Market:

After the frictional demand/supply clearing process describe above is completed, the additional production units obtained are added to the opening balances to yield the realized quantity.

(6) Ending Quantity:

Using the final production input values; realized outputs can be calculated using a simple production function. The same relationships that are used to calculate the expectation quantity are applied to the ending balances.

Section 2: Economic Evaluations of Government Health Initiatives

Over the course of history three methods for evaluating the economic impact of government health initiatives have emerged. The first approach is known as the “willingness to pay” method. The second is the “human capital” method. The third, which is also the approach implemented in the Life at Risk[®] economic framework, is a variation of the human capital method known as the “friction cost” method.

The willingness-to-pay approach attempts measure how much an individual would be “willing to pay” for the improvement in his/her health associated with a government health initiative. The approach is consistent with neoclassical welfare economics which focuses on consumer behavior in purchasing goods and services, including expenditure on lifesaving programs. The intuitive rational underlying the willingness-to-pay approach is that each person considers the value of his or her life to be infinite, but does not feel the same about small statistical changes in risk. If the cost of the health program or regulation exceeds its benefits, as measured by the beneficiaries “willingness to pay”, then the program or regulation is not economically efficient and should not be adopted.⁵⁹ The willingness-to-pay approach focuses on a subjective evaluation by the beneficiaries rather than an objective measure such as lives saved or years of disability reduced.

Numerous economists have attempted to measure societies willing-to-pay empirically. A variety of techniques ranging from direct surveys⁶⁰ to studying compensating wage differentials of workers in hazardous jobs⁶¹ have been implemented. However, the empirical methods used have come under intense criticism among economists. “The numbers themselves have ranged from implausibly high to implausibly low, and there exist willingness-to-pay figures capable of justifying or rejecting almost any proposed program.”⁶² It was these shortcomings of the willingness-to-pay method that led to the adoption of a variation of the human capital method for the economic framework of the Life at Risk[®] platform.

The human capital method was first developed by Mushkin in 1962.⁶³ It is a simple and straightforward method which uses the value of lost production, which results from a disease or disability, as the basis for determining the burden of that disease and ultimately the efficiency of a particular health intervention.⁶⁴ If the cost of the government health intervention (in terms of tax payer dollars) is less than the value of lost production; then the intervention is deemed efficient and should be adopted. The

⁵⁹ Robinson (1986)

⁶⁰ Acton (1976)

Jones-Lee (1976)

Schelling (1968)

⁶¹ Olsen (1981)

⁶² Robinson (1986)

⁶³ Mushkin (1962)

⁶⁴ Brouwer et al. (1997)

methods implemented in the human capital approach, have a long history in economic theory, and are based on principles of welfare economics that are used quite regularly in other fields of economics.⁶⁵

The human capital method measures lost production using gross income at the individual level. Regardless of the length of the period of absence, the gross wage that a person would have earned during absence is taken as an approximation of lost production. For example, if a person were to suddenly die or become 100% disabled at age 28 earning \$50 000 per year at that time, the human capital method counts his wage of \$50 000 times the number of years that he would have worked were he/she still alive. Similarly, if a person were to become ill for a number of days the human capital method would use the value of lost wages that accrued while absent as a measure of the indirect burden of illness. However, discounted future earnings are not considered by proponents of the human capital method to be a complete measure of a health program. “The expenditures on medical care that would have been incurred by the prevented accident or illness are also calculated” (Robinson 1986).

The human capital approach is not without its faults. The approach makes a number of assumptions that although consistent with neo-classical economics don’t accurately describe reality. In particular, the human capital method assumes full employment, making it impossible for a firm to replace a disabled or ill employee. In reality, often times unemployment in an economy is higher than frictional unemployment making it possible to replace disabled employees. By not allowing firms to hire new employees the human capital method tends to overstate the economic burden of disease because the cost of disability accrue until the employee completely recovers and returns to work.⁶⁶ It was these restrictive assumptions that led to the adoption of a slightly modified version of the human capital method known as the “friction cost method,” for the Life at Risk[®] economic framework.

The friction cost method allows for unemployment and other realistic circumstances to exist in its productivity costs calculations as it distinguishes between a friction period, in which productivity loss occurs and a further period where a sick worker has been replaced.⁶⁷ Furthermore, the friction cost method takes into account the reduced productivity of employees temporarily constrained in conducting their work while providing informal care to dependents. The Friction cost approach is especially relevant for chronic diseases in which periods of reduced productivity alternate with illness related events over time.⁶⁸

The unique friction cost method implemented in the Life at Risk[®] approach (like the vast majority of studies employing the human capital method), does not use a shadow pricing approach to value the lost productivity of those outside the workforce that are impaired by disease. Instead, the effect of those outside the workforce that are impaired by disease is measured by the friction cost’s component that considers the reduced productivity of employees providing informal care to dependents.

⁶⁵ The human capital approach is base the pareto optimal condition with income distribution. International trade theory uses this same method to determine the gains from trade. (Krugman 2000)

⁶⁶ In the case of an employee death, costs are calculated according to the life expectancy of that employee.

⁶⁷ Brouwer (1997)

⁶⁸ Kessler et al (2003)

In addition to the more realistic assumptions, the friction cost method has been shown to produce more realistic estimates of the burden of disease than the human capital method. Both the human capital and the friction cost method were implemented to determine the indirect costs due to disease, disability and death in The Netherlands in 1988.⁶⁹ The human capital method was calculated at 80.9 billion guilders, whereas the friction cost method estimated these costs at 'only' 9.5 billion guilders, implying an overestimation of costs by a factor of more than 8.⁷⁰

A more detailed definition of each cost included in the friction cost method is provided below while Section 3 provides a detailed description of the unique friction cost method implemented in the Life at Risk[®] economic framework.

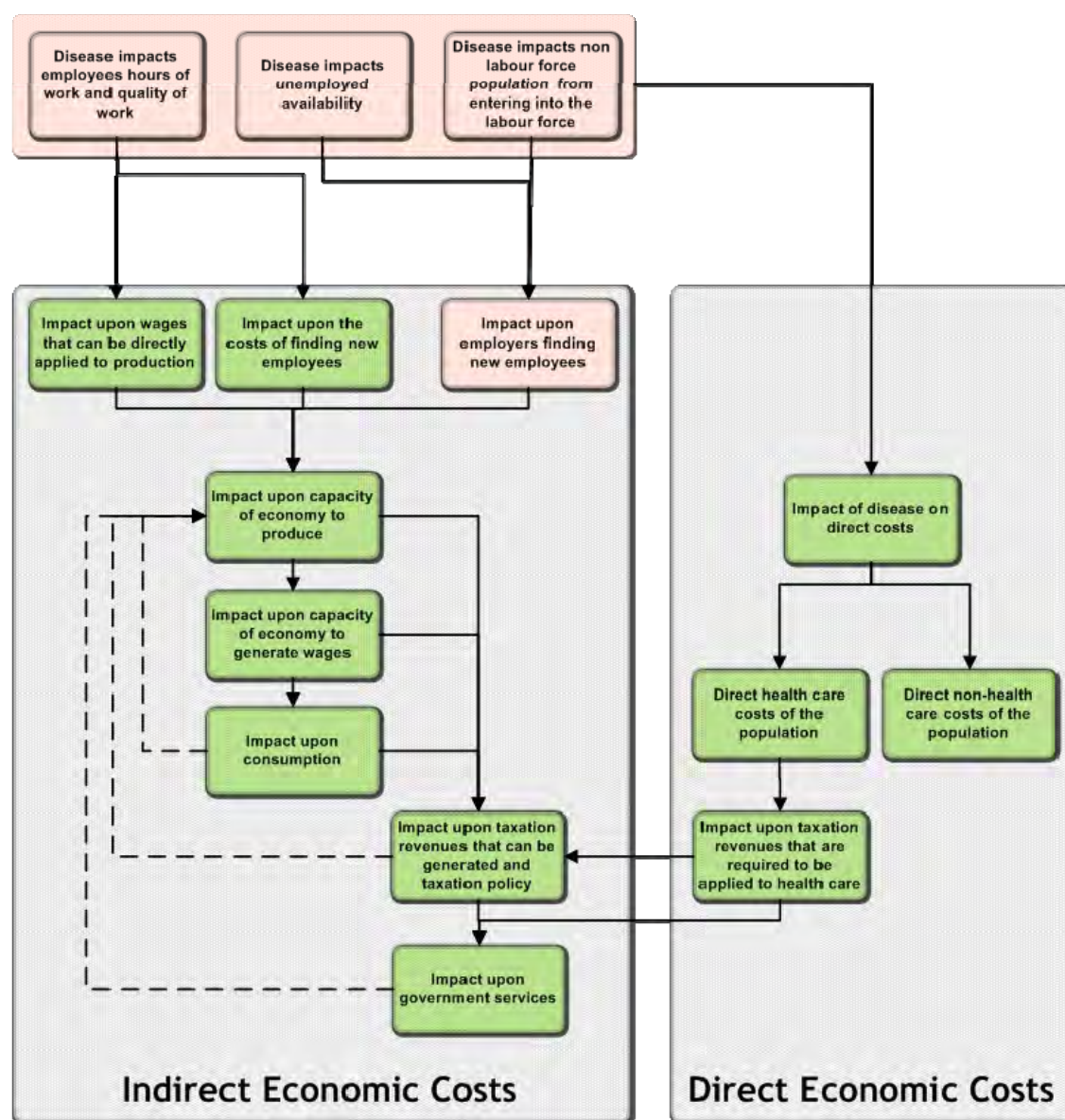
⁶⁹ Koopmanschap et al. (1995)

⁷⁰ Koopmanschap et al. (1995)

Direct and Indirect Costs

Economic costs are subdivided into three categories: direct healthcare costs, direct non-healthcare costs, and indirect costs.⁷¹ How these cost affect the economy can be conceptually illustrated in the structure and logic diagram below:

Exhibit 8 S&L Direct and Indirect Economic Costs



⁷¹ Drummond *et al* (1997)

Direct Healthcare Costs: Are economic costs of activities within the formal health care system that are directly related to treating the disease in question. In a public health care system, these costs affect government tax revenue, which ultimately influences the next period's tax policy (this concept will be elaborated on in Section 3). Next period's tax policy in turn contributes to indirect economic costs.

Direct Non-healthcare Costs: Are the costs of activities outside the formal health care system that are directly related to a disease. This may include, for example, the costs of over-the-counter medication or alternative treatments not included in the formal health care system (eg. Acupuncture)

Indirect Costs: Are costs that have no direct connection with the medical condition, but are a consequence of it. Indirect costs outside the health care system are the costs of production losses caused by work absenteeism, work disability, or death of a patient (includes lost wages, corporate profit, tax revenue impacts from: lost wages, corporate profits, and consumption

The valuation of medical resource consumption is calculated using real costs. The costs of medical resources (eg. personnel, materials, office space, depreciation, overheads) are charged to each intervention separately. Ideally, real costs will be calculated for each treatment session, which involves the costs of labour, the costs of the materials used, and the costs of capital.

Section 3: Private and Public Sector Expectations, Clearing and Realizations

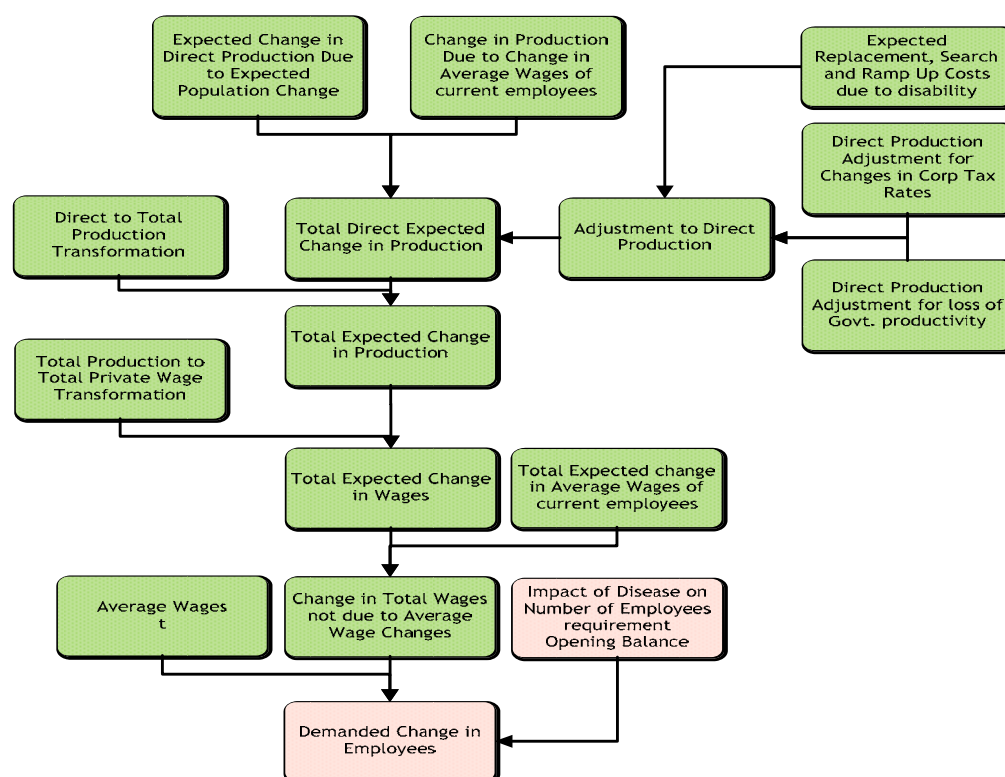
Private Sector Production and Labour Expectations

This section provides a detailed account of how firms forecast the level of production for the current period. From this production forecast the amount of labour employed is adjusted in an attempt to meet the targeted production level. This is consistent with the observation that capital is fixed in the short-run. In other words, it is relatively easy for firms to increase the amount of labour they employ within the production process.

The model assumes that production decisions are made at the beginning of each period.⁷² Once a production decision is made, firms must then adapt to the unexpected changes in its labour force, and the imperfections that exist in the labour market (This will be discussed in more detail in the next section).

The structure and logic diagram below conceptually this process:

Exhibit 9 Private Sector Production Expectations and Demand for Labour



⁷² This assumption is consistent with the costly adjustment models of macroeconomics, for examples see: Brayton and Tinsley (1996), Sargent (1978), and Kennan (1979)

A Firm forms expectations (forecasts) of future production by first determining how its current employees average wage is going to change and how this change in cost will impact the profit maximizing level of output.

This change in wages is illustrated by the equation below:

$$\Delta W_{[t-1,t]}^{a,g,i,k} \Big|_{\text{wage growth}} = \sum_k (w_t^{a,g,i} (1 - d^k) \tilde{E}_*^{a,g,i,k} - w_{t-1}^{a,g,i} (1 - d^k) E_{t-1}^{a,g,i,k})$$

Where,

- $E_*^{a,g,i,k}$ Represents an estimate of the employed population from period t-1 after aging to period t.
- d^k Represents the disability index, which takes a value between zero and one for disease k.⁷³
- $w_t^{a,g,i}$ Represents wages per person in period t for individuals of age a, gender g, working in industry i.
- $E_{t-1}^{a,g,i,k}$ Represents an estimate of the employed population in period t-1 of age a, gender g, working in industry i.

The firm then compares this number to the expected change in demand for its product, which is determined by the expected change in the population. This is given by the equation below:

$$\Delta \tilde{\pi}_t^i \Big|_{\text{population}} = \Pi_{t-1}^i \frac{P_t - P_{t-1}}{P_{t-1}}$$

Where,

- Π_{t-1}^i represents the total economic production in industry i at time t-1 (this variable will be elaborated on below)
- P_t and P_{t-1} , are the populations at times t and t-1 respectively.

The firm now has an idea of how it should change the production level based on changes in demand for its product and the cost of production (wages).

Next, the firm must adjust its production forecast to account for the lost labour productivity associated with changes in the disability level of its workforce. The firm estimates how the replacement, search, and ramp up costs will impact production in the current period (these concepts are elaborated on in the preceding section). Also considered at this stage is how changes in the corporate income tax rate and lost government productivity will impact the production decision (these concepts are elaborated on below).

⁷³ Indexes of this nature are used quite often in the health economic literature. Examples include DALY weights and the Stanford Presenteeism Scale (2002)

At this point the total expected change in production can be determined.⁷⁴ The total direct expected change in production which is comprised of the numerous independent effects, can be represented by the equation below:

$$\Delta \tilde{\pi}_t^i = \Delta \tilde{\pi}_t^i|_{\text{population}} + \Delta \tilde{\pi}_t^i|_{\text{wages}} - \Delta \tilde{\pi}_t^i|_{\text{disease}} - \Delta \tilde{\pi}_t^i|_{\text{tax rate change}} - \Delta \tilde{\pi}_t^i|_{\text{Government}}$$

Where,

- $\Delta \tilde{\pi}_t^i$ Represents the expected change in total direct economic production in industry i for time t.
- $\Delta \tilde{\pi}_t^i|_{\text{population}}$ Represents the expected change in total direct economic production resulting from a change in the population.
- $\Delta \tilde{\pi}_t^i|_{\text{wages}}$ Represents the expected change in total direct economic production resulting from a change in the wages.
- $\Delta \tilde{\pi}_t^i|_{\text{disease}}$ Represents the expected change in total direct economic production resulting from a change in disability due to disease (this will be described in more detail in the employer response to disability section).
- $\Delta \tilde{\pi}_t^i|_{\text{tax rate change}}$ Represents the expected change in total direct economic production resulting from a change in government tax rates.
- $\Delta \tilde{\pi}_t^i|_{\text{Government}}$ Represents the expected change in total direct economic production resulting from a change in government productivity levels (described in more detail below in the preceding sections).

From the total change in direct production the firm applies a standard macro-economic multiplier to arrive at the expected change in total production. The expected change in total production is represented by the equation below:

$$\Delta \tilde{\Pi}_t^i = \Delta \tilde{\pi}_t^i f^{\text{Indirect}} + \Pi_{t-1}^i \frac{\Delta f_t^{\text{Indirect}}}{f_t^{\text{Indirect}}}$$

Where, f^{Indirect} represents a macroeconomic multiplier, that converts direct production into total production. This multiplier is determined by the below equation⁷⁵:

$$f^{\text{Indirect}} = \frac{\Pi_t^i}{\pi_t^i}$$

⁷⁴ This decision is assumed to be made in accordance with neo-classical economic theory and represents the equilibrium level of output determined through profit maximization/ cost minimization.

⁷⁵ This function is known in the literature as a Keynesian Income multiplier and varies with aggregate marginal propensity to consume.

Total expected production is then converted from units of output to production equivalent wages in order to determine the wage bill (number employed times wages) required meet the production expectation for the current period. This process is described by the equation below:

$$\Delta \tilde{W}_t^i = \Delta \tilde{\Pi}_t^i f^{Wages\ to\ production\ ratio}$$

Where, $f^{Wages\ to\ production\ ratio}$ represents wages per unit output.

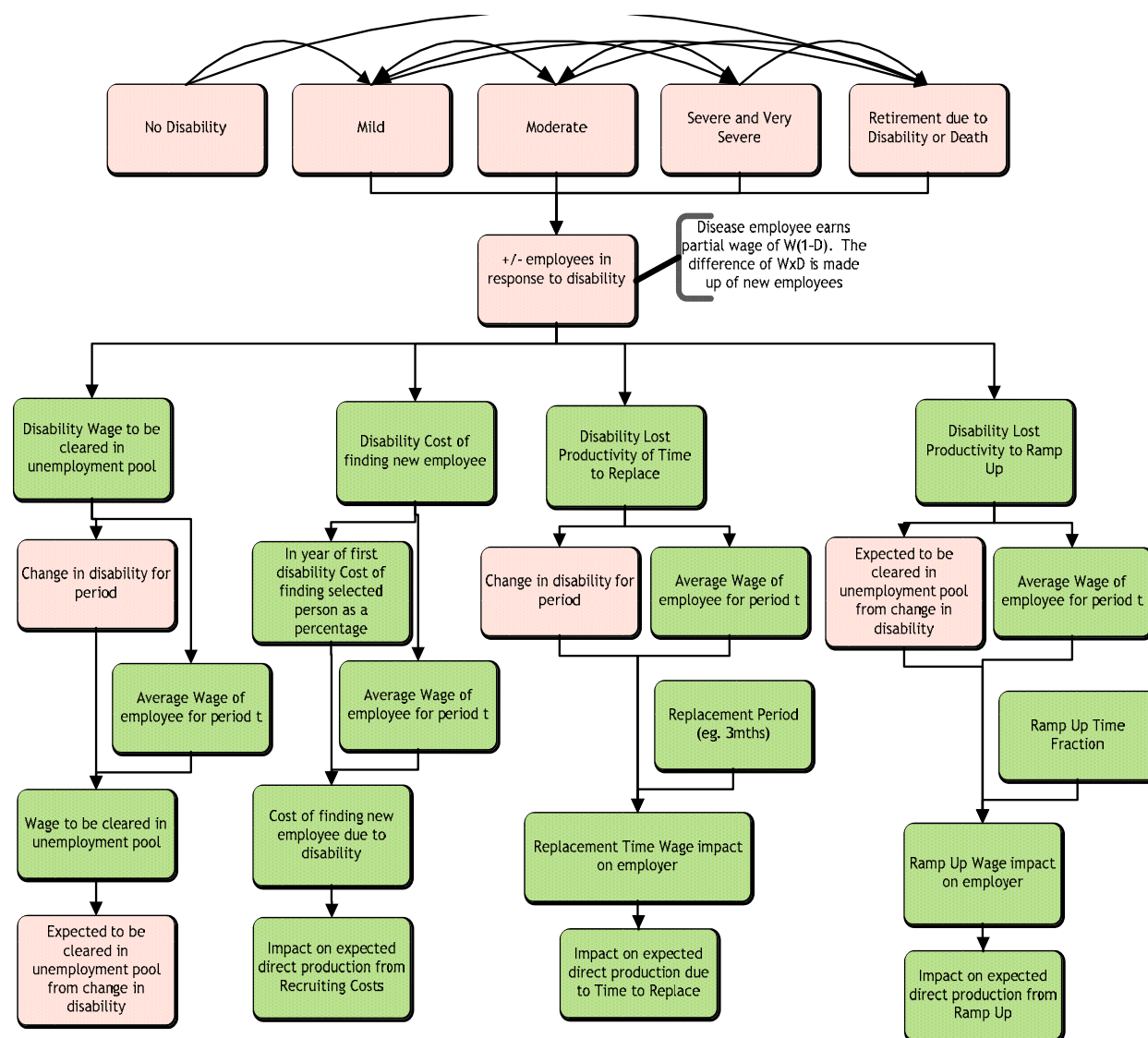
The expected change in the wage bill is then adjusted to account for the expected change in wages of the current employees so that only the residual expected total wage change is used as the basis of the industry's demand for new employees.

The firm now has an estimate of its demand for new employees which it then attempts to satisfy in the labour market. The intricacies of the labour market clearing process will be discussed below. However, before that, a more detailed description of an employer's response to disability will be presented.

Private Employer Response to Disability and Death

This section explores in more detail how a firm responds to disability in its workforce. In particular, this section provides an account of the components that comprise the total change in direct economic production resulting from a change in disability due to disease.⁷⁶ The structure and logic diagram below conceptually illustrates how firms respond to changes in the prevalence of disease among their employees:

Exhibit 10 General Private Employer Response to Chronic Disability and Death



⁷⁶ The productivity related costs presented in this section are familiar to the Health and productivity management model presented in Goetzel et al (2002) and Druss et al (2002)

The prevalence of disability (or disease) in the employment pool is comprised of:

- The previous year's prevalence of disability in the employment pool;
- Plus, incidence of new disability in the current year's employment pool;
- Plus, new employees entering the employment pool that have a disability;
- Minus, mortality from both disability and other causes, and employees with disability retiring from the employment pool.

Prevalence of disability in the employment pool is accounted for using a disability scale that ranges from 0% to 100% disability. Measures of disability can be either discrete (predefined disability stages as discrete categories) or continuous (a distribution of disability within which a person is classified). For example, the above structure and logic diagram illustrates five discrete disability stages (No Disability, Mild Disability, Moderate Disability, Severe and Very Severe Disability, Retirement due to Disability or Death).

Each period a firm experiences either a positive or negative impact on its workforce from a change in the prevalence of disability. If a firm experiences a negative impact from disability it incurs a variety of costs, which vary with the severity of the disability. Broadly speaking, these costs are associated with a fall in the productivity of the labor force resulting from the change in disease prevalence. Productivity is measured as output per unit of input. In this case when an employee becomes disabled he/she can no longer perform their job to the same extent. In economic terms the disabled individual exerts the same amount of effort (labour input) but produces fewer units of output.

Given that productivity has fallen, a firm now requires additional employees to keep output at a constant level (or increase output in case of an increase in demand). The firm is then required to hire new employees from the labour market in an attempt to compensate for the lost productivity of its current employees. However, imperfections exist in the labor market that could potentially prevent an employer from obtaining the desired number of employees. The equation below represents the lost productivity of the firm due to disability from disease and the amount of new employment the firm requires to meet its output expectation (measured in production equivalent wages).

$$\Delta W_{[t-1,t]}^{a,g,i,k} \Big|_{Lost} = w_{t-1}^{a,g,i} \left[\sum_k \sum_j I_{[t-1,t]}^{a,g,i,j \rightarrow k} (d^k - d^j) + \sum_k (1 - d^k) D_{[t-1,t]}^{a,g,i,k} \right]$$

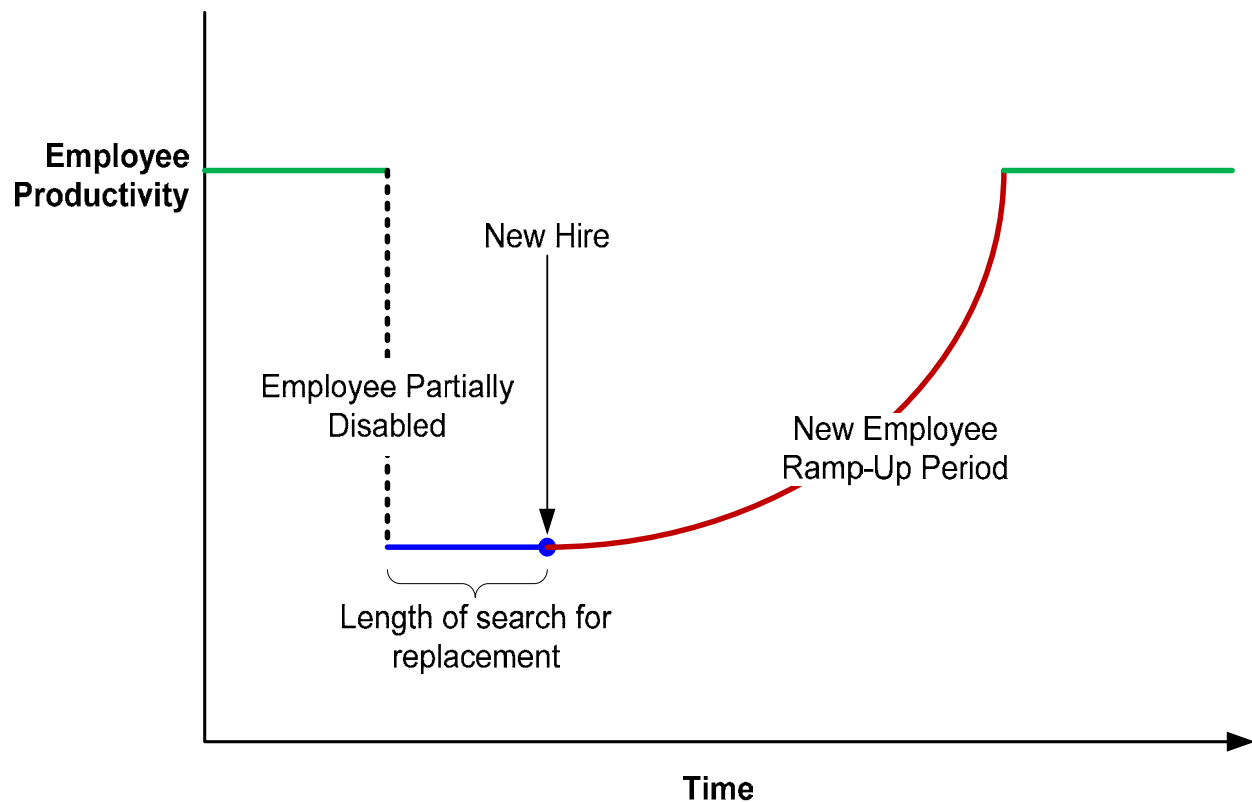
Where,

- $\Delta W_{[t-1,t]}^{a,g,i,k} \Big|_{Lost}$ Represents the change in production equivalent wages, over the period t-1 to t, for individuals of age a, gender g, in industry i.
- $w_{t-1}^{a,g,i}$ Represents the annual wages per person of age a, gender g, in industry i.
- $I_{[t-1,t]}^{a,g,i,j \rightarrow k}$ Represents the number of people (or incidence) who moved from disease state j to state k between over the period t-1 and t.
- $(d^k - d^j)$ Represents the change in the disability severity over the period t-1 to t.

- $D_{[t-1,t]}^{a,g,i,k}$ Represents deaths over the period t-1 to t for people with disease k.
- $(1 - d^k)$ adjusts the number of deaths to account for the period of time that the individual worked before dieing.

Associated with the hiring of new employees are what Arthur Treadway (1971) called the internal cost of reduced efficiency. This cost represents the lost output that occurs as a result of adjusting labour⁷⁷ and can be illustrated by way of the diagram below. (Each cost described here will be elaborated on in more detail below)

Exhibit 11 Productivity Impacts from Partial Employee Disability



As seen in Exhibit 12 the productivity of a disabled employee immediately drops when disability is incurred.⁷⁸ The employee (and the firm) continues to operate at this lower level of productivity while the firm seeks new employees to compensate for the partially disabled employee. This search period is represented by the blue line in the above diagram and is associated with “The Disability Lost Productivity of time to replace disabled employees” (search costs) in Exhibit 12.

The end of the blue line segment marks the point in time when a firm finds a new employee. The new employee (and the firm as a whole) works at a lower level of productivity until he/she receives adequate

⁷⁷ For a discussion of the structure of these costs see Hamermesh and Pfann (1996)

⁷⁸ This type of lost productivity can be measured through employee surveys for example see the Stanford Presenteeism scale. (Koopman et al (2002))

training. This period is represented by the red line segment and is associated with “The Disability lost productivity due to ramp up.” Once training is complete the firm will have completely compensated for the employees lost productivity due to disability. This return of lost productivity is represented by the return to the green line segment in the diagram.

The disability cost of finding a new employee: This cost represents the time and energy spent, expressed in terms of production equivalent wages, when partially or completely replacing a disabled employee.⁷⁹ Given that productivity has fallen, a firm requires additional employees to keep output at a constant level. “The disability cost of finding a new employee” is the cost of finding and employing these people. This cost is represented by the following equation:

$$c^i = f^{hiring} \left[\sum_{d^k > d^j} \sum_{a,g} I_{[t-1,t]}^{a,g,i,j \rightarrow k} + \sum_k D_{[t-1,t]}^{a,g,i,k} \right] w_{t-1}^{a,g,i}$$

Here the firm’s time and energy spent replacing a disabled employee is represented by the hiring factor, f^{hiring} . This factor is multiplied by the wage bill that would result from completely replacing all newly disabled employees thus arriving at the actual replacement costs, c^i .

The Disability Lost Productivity of time to replace a disabled employee: This cost is associated with the fact that it takes time to hire a new employee. “Rather than meeting in centralized markets where employment and wages are determined by the intersection of supply and demand curves, workers and firms meet in a decentralized, one-on-one fashion, and engage in a costly process of trying to match up idiosyncratic preferences, skills, and needs.”⁸⁰ Since this process is not instantaneous the firm is forced to operate at a lower level of production until an adequate replacement is found. The length of time it takes to find an adequate replacement will depend on the occupation and various macroeconomic, industrial and geographic considerations. For instance, if the unemployment rate is low, finding an adequate replacement may take longer than if it were an “employer’s market”. Similarly, if the position is in a more remote location finding an adequate replacement may also take longer.

This cost is a measure of the lost output (expressed in production equivalent wages) resulting from a lower productivity level. This cost can be expressed by way of the following equation:

$$\Delta w_{[t-1,t]}^i |_{Lost} = f^{delay} \left[\sum_{d^k > d^j} \sum_{a,g} I_{[t-1,t]}^{a,g,i,j \rightarrow k} (d^k - d^j) + \sum_k (1 - d^k) D_{[t-1,t]}^{a,g,i,k} \right] w_{t-1}^{a,g,i}$$

Where, f^{delay} is the replacement delay factor which represents the time required to find a new employee (this takes a value between 0 and 1). This factor is then multiplied by severity adjusted wage

⁷⁹ Hamermesh (1989) presents a model where this cost can be either variable or fixed. Here we assume the cost varies with the number of people hired.

⁸⁰ Romer (2006)

bill of newly disabled employees to arrive at the cost of lost production, $\Delta w_t^i|_{Lost}$ associated with the delays in the hiring process.

The Disability lost productivity due to ramp up: This cost arises because a newly hired employee requires time and training to become as productive as his/her more experienced co-workers.⁸¹ In particular, this cost is the lost production (expressed in equivalent wage) that results from the reduced productivity of the firm, during the new employee training period. This cost can be obtained by multiplying the number of new employees needed by the severity adjusted wage rate and a ramp up coefficient.

$$\Delta w_{[t-1,t]}^i|_{Ramp\ Up} = f^{Ramp\ Up} \sum_{a,g,k} \Delta E^{a,g,i,k}|_{target} (1 - d^k) w_{t-1}^{a,g,i}$$

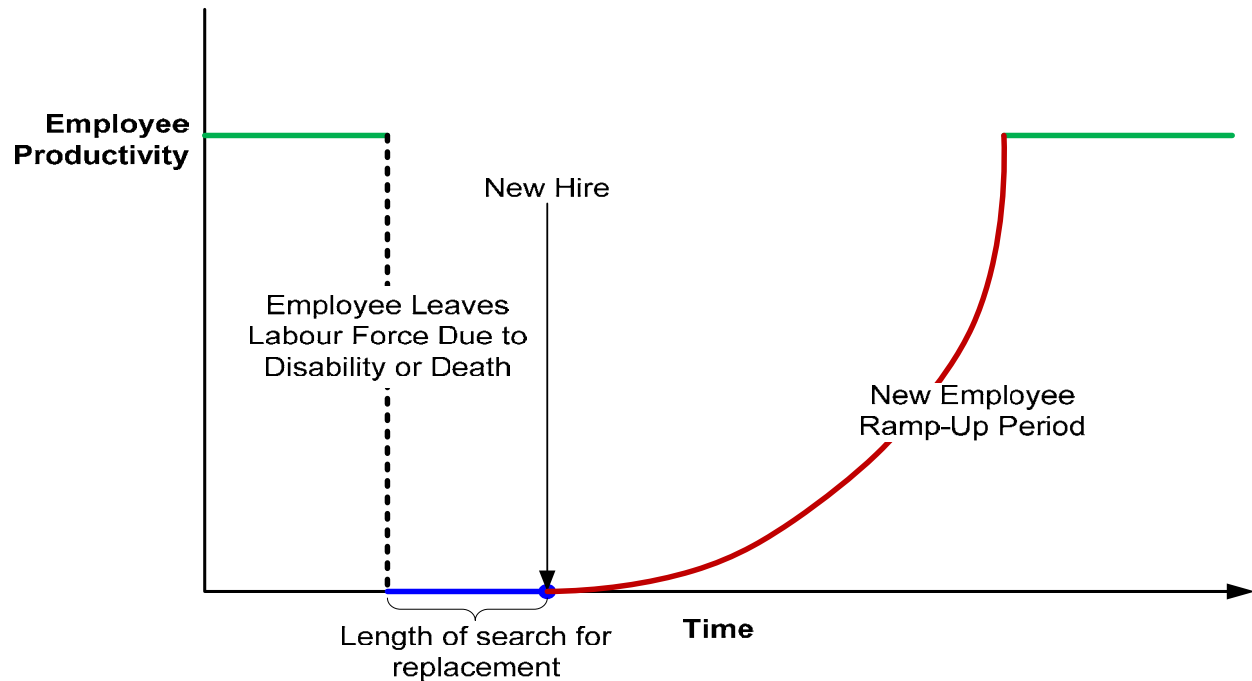
Where,

- $\Delta E^{a,g,i,k}|_{target}$ Represents the number of new employees the firm wants to hire to compensate for the change in disability for the period.
- $f^{Ramp\ Up}$ Represents the new employee ramp up function (this variable takes a value greater than one). This function adds additional cost to the firm over the wages paid to the new employees (to compensate for their initial lower productivity level).

The last two costs discussed vary with the nature of the disability. Two different situations and the related search and ramp up cost associated with each situation are discussed below.

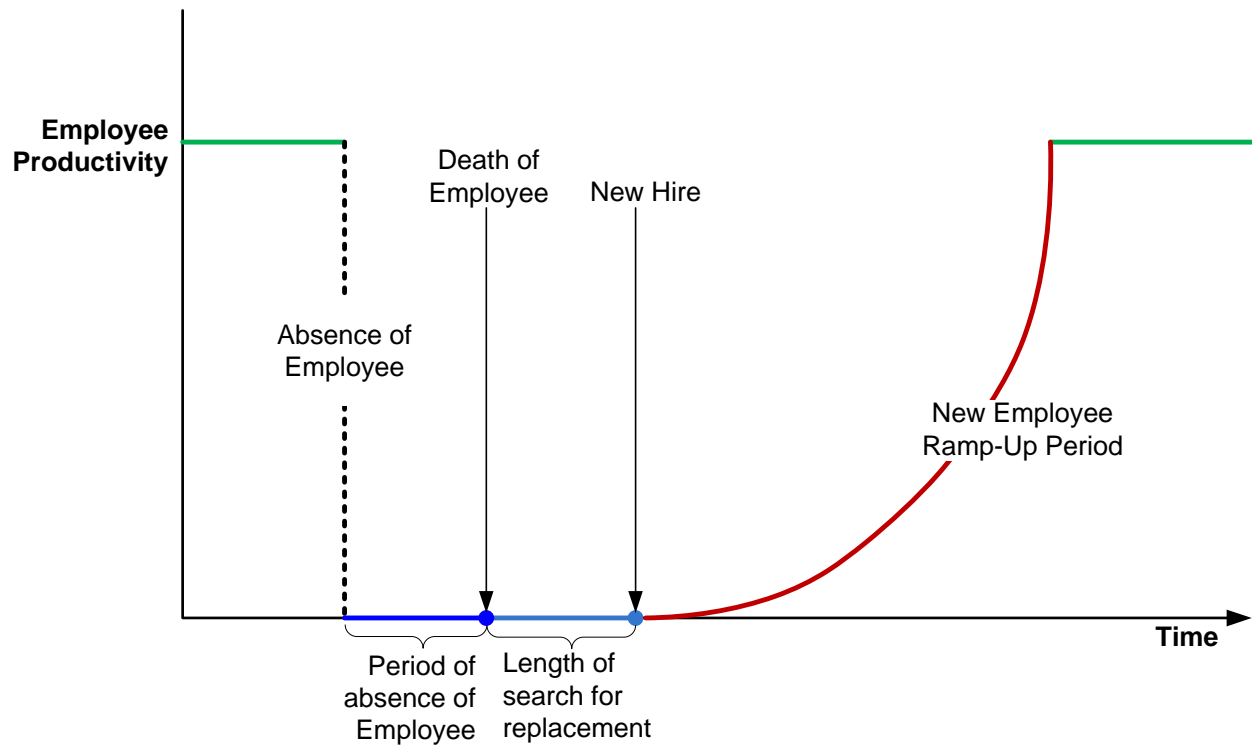
The first variation, which is conceptually illustrated in Exhibit 13, is the productivity impacts from employee retirement due to disability or death.

⁸¹ This cost is based on the distinction between general and firm specific human capital originally presented by Becker (1964). Firm specific human capital is the skills and knowledge unique to an individual firm's production process. These skills tend to be acquired through on the job training and take time to accumulate. Alternatively, this cost could be interpreted using the learning by doing theory originally present by Arrow (1962). Arrow's theory is based on observation that productivity increases with output, as individuals and firms learn the most efficient methods of production through experience. Arrow (1962)

Exhibit 12 Productivity Impacts from Employee Retirement Due to Disability or Death

When an employee dies or retires the individual's productivity immediately drops to zero as this employee is no longer contributing to the firms' productive capacity. The productivity for this employee remains at zero until the employer can find an adequate replacement. As the firm transitions from the initial drop in productivity to the eventual return to full productive capacity it absorbs the associated search and ramp-up cost described above.

The second situation is the productivity impacts of an employee with an absence prior to retirement or death. In this situation an employee contracts a disease, is forced to leave work, remains ill for a period of time, then dies or completely retires as a result of his/her disability. This situation is represented in the Exhibit 14.

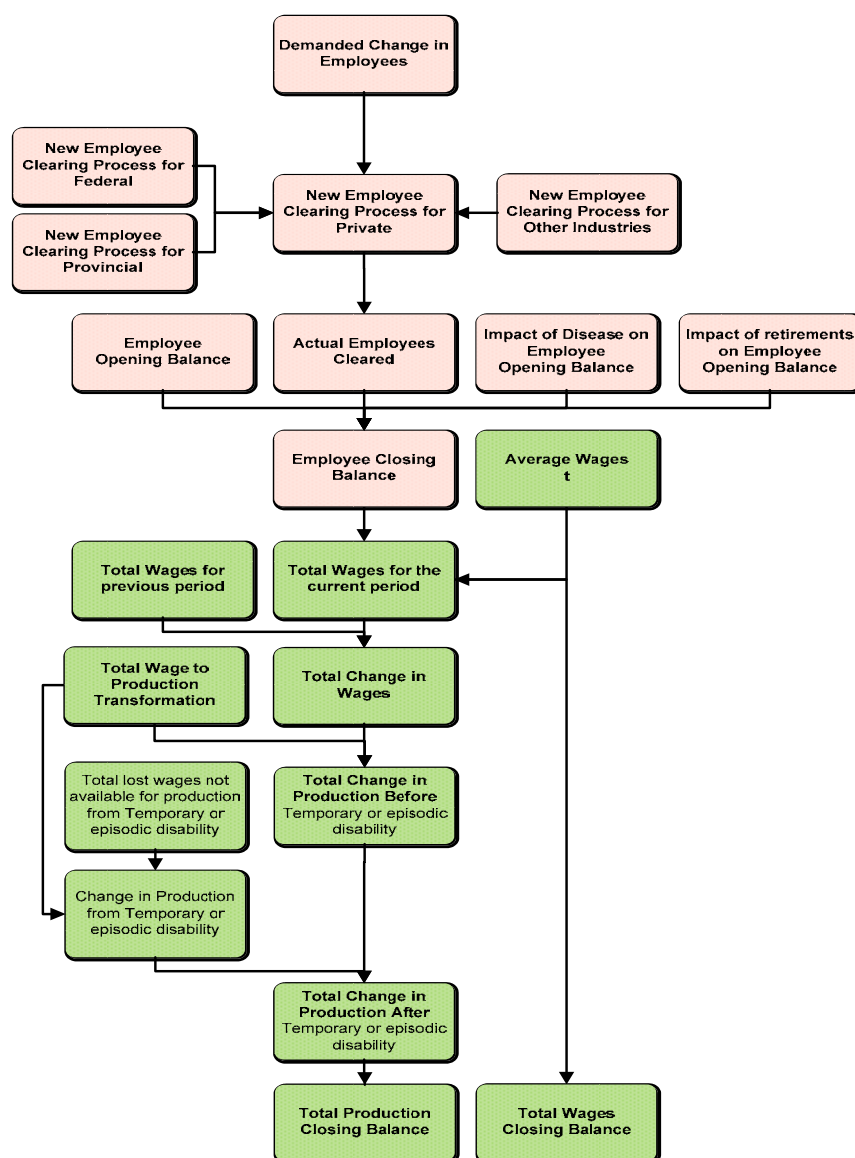
Exhibit 13 Productivity Impacts from Employee Absence Prior to Retirement Death

This situation is identical to the previous except for length of time that the firm operates without replacing the disabled employee. In this case, as in the last, when an employee contracts an illness he/she completely leaves the firm. The employer expects the absent employee to return once he/she has recovered. However, instead of recovering the absent employee dies or retires as a result of his/her disability. The firm must now begin the search to find a replacement employee. The employer takes the usual amount of time to find a new employee and incurs the search and ramp up costs of lost productivity associated with finding and hiring a new employee.

Private Sector Labour Clearing and Production Realization⁸²

Once production forecasts have been made and all costs have been considered, the firm attempts to produce its optimal level of output. However, imperfections exist in the labour market that prevents the firm from actually obtaining the quantity of labour required to produce the equilibrium level of output.⁸³ Exhibit 15 conceptually illustrates the process that results in actual production differing from expected.

Exhibit 14 Private Sector Labour Clearing and Production Realization



⁸² This section is based on the macroeconomic models of costly adjustment (also known as incomplete adjustment), for examples see: Brayton and Tinsley (1996), Sargent (1978), and Kennan (1979)

⁸³ This is the distinctive characteristic of the friction cost method (Koopmanschap et al. 1993) and incomplete adjustment models.

Deviations from the expected amount of labour employed occur because the firm is in competition with other industries, the federal government and provincial governments for new employees. The number of employees cleared represents the number of new employees the firm was able to hire. This value combined with the firms' existing employees minus the impact that disability due to disease and employee retirement had on the original employees gives the employee closing balance. The employee closing balance is the number of employees that the firm has available for production in the current period and provides a constraint on the amount the firm can produce.

From the employee closing balance the firms total wage bill can be calculated. This is represented by the equation below:

$$W_t^i = \sum_{k,g,i} w_t^{a,g,i} (1 - d^k) E_t^{a,g,i,k}$$

The change in the total wage bill is given by:

$$\Delta W_t^i = W_t^i - W_{t-1}^i$$

The change in the total wage bill can be converted into the change in total output for the period using the equation below:

$$\Delta \Pi_t^i = \frac{\Delta W_t^i}{f^{Wage\ to\ production\ Ratio}}$$

Where, $f^{Wage\ to\ production\ Ratio}$, is the wage per unit of output and is represented by the equation below:

$$f^{Wage\ to\ production\ Ratio} = \frac{W_t}{\Pi_t}$$

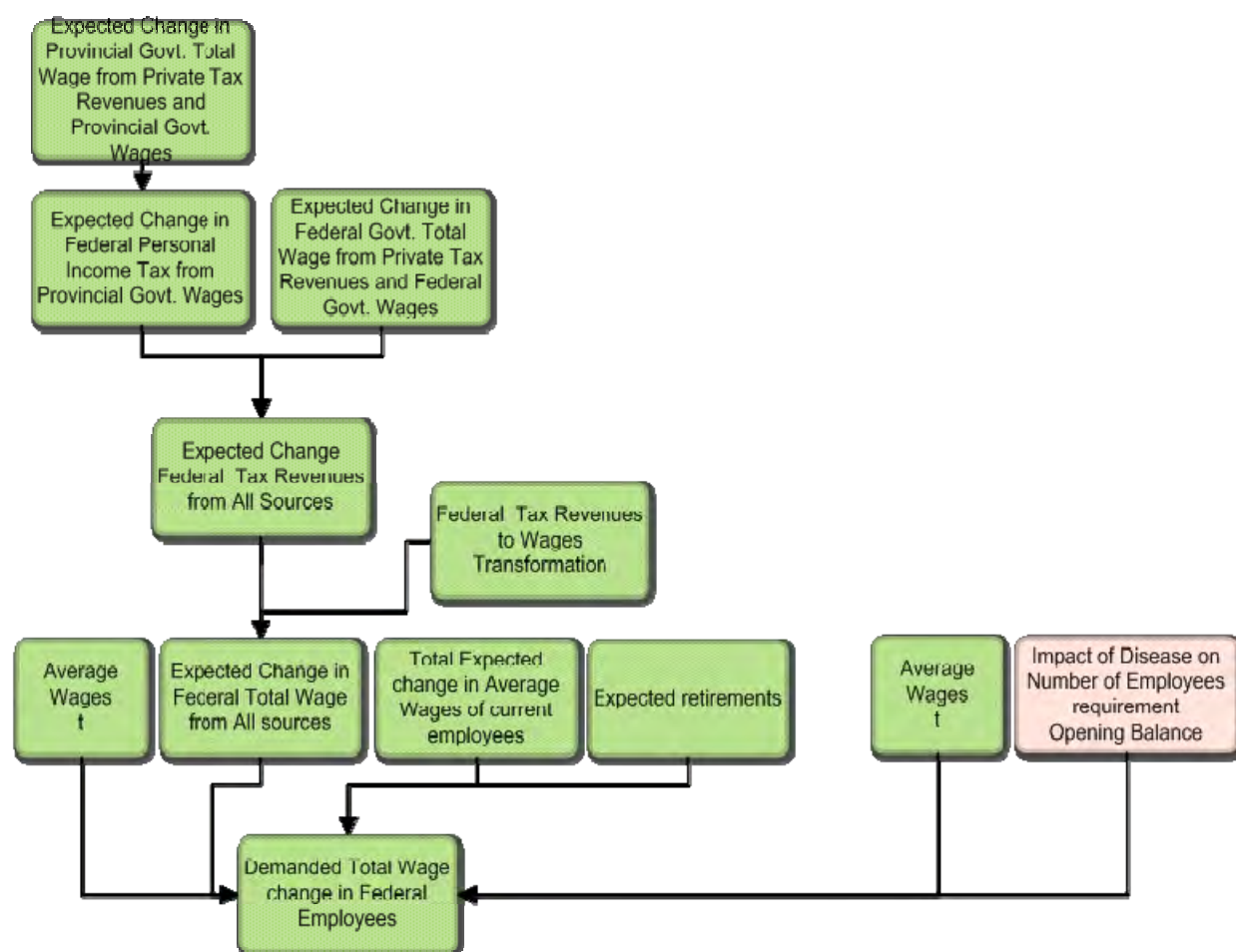
Public Sector Expectations and the Realization of Expectations

Governments are included in the economic model as they affect private production, demand for labour and pay health care costs. Within the Life at Risk[®] economic framework governments collect personal income taxes, corporate income taxes and consumption taxes. The model assumes that the government will always attempt to run a balanced budget. However, if a surplus or deficit should arise the government will adjust its tax rates, in the following period, in an attempt to correct for the previous period's surplus or deficit.

Public Sector Taxation Revenue and Labour Expectations

Exhibit 16 conceptually illustrates how a government forms expectations regarding its tax revenue and wage bill for the current period:

Exhibit 15 S&L: Public Sector Taxation Revenue and Labour Expectations



Expected Total Taxation Revenues

Broadly speaking, the government receives tax revenue from two sources: Wages from public sector employees and tax revenue from private sector sources. Like the private sector the government forms expectations regarding its revenue for the period.

The first expectation involves the government's forecast of the tax revenue that it expects to receive from taxing public sector (provincial and federal) employee wages. This can be expressed by way of the following equation:

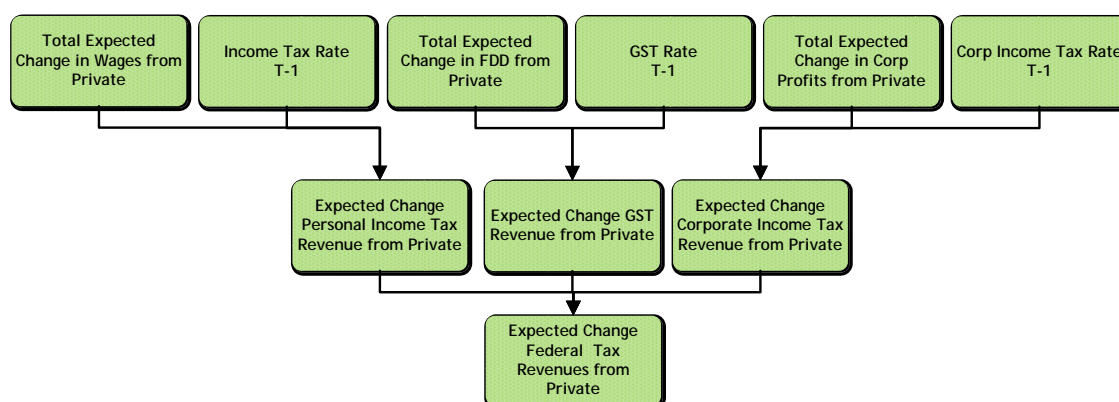
$$\Delta \tilde{R}_{[t-1,t]}^g \Big|_{government} = r_{t-1}^{g,income} \sum_{j \in Governments} \Delta \tilde{W}_{[t-1,t]}^j$$

Where,

- $r_{t-1}^{g,income}$ Represents the governments' income tax rate in period t-1.
- $\Delta \tilde{W}_{[t-1,t]}^j$ Represents the expected change in public sector wages.

Next, forecasts of the tax revenue expected to be received from private sectors sources are made. Private tax revenue comes from a variety of sources, which are conceptually illustrated in Exhibit 17. Each source of private sector revenue will be discussed in more detail below.

Exhibit 16 S&L: Expected Private Taxation Revenues



Income tax revenue: In forming an expectation regarding the change in personal income tax revenue the government must estimate the change in the total wage bill in the private sector. This expectation is assumed to be the same as the private sectors expected wage bill. This assumption implies either information sharing between the public and private sectors or that the government has perfect information regarding the variables that the private sector uses to forecast its wage bill. The wage bill is then multiplied by the governments' income tax rate for the period. Expected income tax revenue can be described by the equation below:

$$\Delta \tilde{R}_{[t-1,t]}^{g,income} = r_{t-1}^{g,income} \sum_{i \in Private} \Delta \tilde{W}_{[t-1,t]}^j$$

Where, $\Delta \tilde{W}_{[t-1,t]}^j$ represents the expected change in the private sector wage bill.

Corporate tax revenue: Forming an expectation of corporate tax revenue requires the government to form an expectation of the change in private sector corporate profits. Once again this value is assumed to be the same as the private sectors' corporate profit expectation which is a derivative of the production expectation. Expected corporate profits are multiplied by the corporate tax rate for the period resulting in the expected change in corporate tax revenue. This can be expressed by way of the following equation:

$$\Delta \tilde{R}_{[t-1,t]}^{g,corporate} = r_{t-1}^{g,corp} \sum_{i \in Private} \Delta \tilde{C}_{[t-1,t]}^j$$

Where,

$$\Delta \tilde{C}_{[t-1,t]}^j = \Delta \tilde{\pi}_t^i f_t^{Corporate Profit Factor}$$

And,

$$f_t^{Corporate Profit Factor} = \frac{\Delta C_t}{\Delta \Pi_t}$$

- $\tilde{C}_{[t-1,t]}^j$ Represents the expected change in corporate profits in industry i.
- $f_t^{Corporate Profit Factor}$ Represents the fraction production that contributes to corporate profits.

GST revenue from the private sector: The value of expected GST revenue is obtained by multiplying expected final domestic demand (or domestic consumption) by the GST rate for the period. To obtain this expectation the government assumes final domestic demand is a function of the expectation of private sector production. Expected final domestic demand is then multiplied by the government's GST rate for the period. When final domestic demand is greater than production, the economy is a net importer (implying the economy borrows to finance its consumption). If final domestic demand is less than production the economy is a net exporter (implying the economy lends to the rest of the world).

Expected GST revenue can be represented by the equation below:

$$\Delta \tilde{R}_{[t-1,t]}^{g,GST} = r_{t-1}^{g,GST} \sum_{i \in Private} \Delta \tilde{FD}_{[t-1,t]}^j$$

Where,

$$\Delta \widetilde{FD}_{[t-1,t]}^j = \Delta \widetilde{\Pi}_t^i f_t^{FDD}$$

And,

$$f_t^{FDD} = \frac{D_t}{\Pi_t}$$

- $\widetilde{FD}_{[t-1,t]}^j$ Represents the change in expected final domestic demand.
- f_t^{FDD} Represents the fraction of production consumed domestically.

The three sources of private sector revenue are summed to arrive at the government's expectation for the total expected change in revenue from private sources. This expectation is combined with the expected revenue from all public sector employees resulting in the "Expected Change in Tax Revenue from all Sources." This can be expressed by way of the following equation:

$$\Delta \widetilde{R}_{[t-1,t]}^g = \Delta \widetilde{R}^g|_{Private} + \Delta \widetilde{R}^g|_{government}$$

After the expected change in federal tax revenue has been calculated the value is converted from revenues to wages of government employees using the below formula:

$$\Delta \widetilde{W}_{[t-1,t]}^g = \Delta \widetilde{R}^g f_t^{\Delta Wage To \Delta Revenue} + \Delta W^g|_{Disability}$$

Where,

$$f_t^{\Delta Wage To \Delta Revenue} = \frac{\Delta W_t^g}{\Delta R_t^g}$$

All variables should be familiar from above except the wage to revenue function, $f_t^{\Delta Wage To \Delta Revenue}$. The wage to revenue function, $f_t^{\Delta Wage To \Delta Revenue}$ represents the fraction of tax revenue that is paid out to employees in wages, with the balance being contributed to public sector capital.

The government now has its expected change in total federal wages from all sources which is one factor that contributes to the total demanded wage change in federal employees.

Like the private sector, the government is required to adjust its wage expectations for the incidence of disability due to disease. In doing so the government uses the same information as the private sector to forecast the impact of disease. Once the number of employees affected by disability is determined this number is multiplied by the average wage rate to arrive that portion of the governments wage bill attributed to disability ($\Delta W^g|_{Disability}$). This value further contributes to the demanded total wage change in federal employees.

Finally, demanded total wage change in federal employees is adjusted for the expected wage increase of government employees and expected retirements.

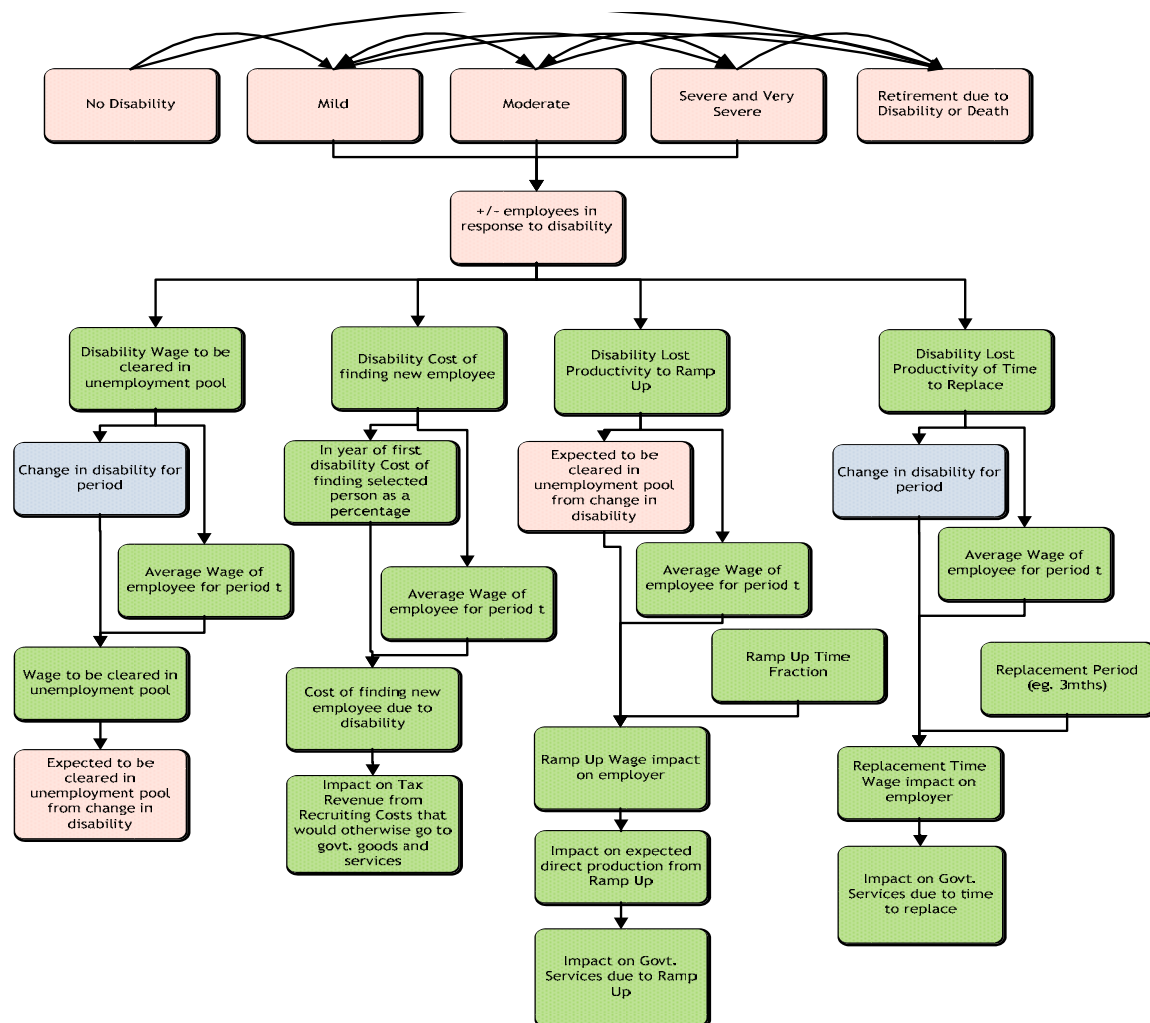
The government then takes the demanded total wage change in federal employees to the employment market in hopes of hiring the new employees it requires to meet its projected level of output (services).

Public Sector Response to Disability and Death

This section provides a description of how a government employer responds to disability in its workforce. Much of the public sectors' response to disability and death is similar to that of the private sector. The same replacement, search, and ramp up costs will be incurred in the public as in the private sector. For a more detailed explanation of these effects, refer to the section titled "Private Employer Response to Chronic Disability and Death".

There are important difference between the private sector and the public sectors response to disability. This section explores those differences by providing a more detailed account of the components that comprise the impact on tax revenue and government services resulting from a change in disability. The structure and logic diagram in Exhibit 18 conceptually illustrates how a government responds to changes in the prevalence of disease among its employees:

Exhibit 17 Public Sector Response to Disability and Death



As with private employers, the prevalence of disability (or disease) in the employment pool is comprised of:

- The previous year's prevalence of disability in the employment pool;
- Plus, incidence of new disability in the current year's employment pool;
- Plus, new employees entering the employment pool that have a disability;
- Minus, mortality from both disability and other causes, and employees with disability retiring from the employment pool.

Either a discrete or continuous disability scale can be used to account for disability among public sector employees. The structure and logic diagram above uses the same discrete scale that was described in the section on the private sector response to disability and death with disability being categorized into five stages (No Disability, Mild Disability, Moderate Disability, Severe and Very Severe Disability, Retirement due to Disability or Death).

In a similar fashion to the private sector, each period the government experiences either a positive or negative impact on its workforce from a change in the prevalence of disability. If the government experiences a negative impact from disability it incurs a variety of productivity related costs, which vary with the severity of the disability.⁸⁴ These costs ultimately result in either the need to raise further tax revenue to cover the costs of finding new employees or a fall in the level of services that can be provided by the government to the private sector.

A fall in the level of government services has adverse effects on the private sector. When disability affects the productivity of a government, and hence its ability to serve the community (e.g. maintenance of infrastructure, processing of regulation), then the productivity of private industry is impacted. This in turn impacts the expected future government tax revenues.

Given that productivity has fallen, a government now requires additional employees to keep output (services) at a constant level (or increase output in case of an increase in demand). The government, at this point, is required to hire new employees from the labour market in an attempt to compensate for the lost productivity of its current employees. Associated with the hiring of new employees are the productivity related costs described below.

The Disability Cost of Finding a New Employee: This cost represents the increase in the governments wage bill and also the time and energy spent (expressed in terms of equivalent wages) partially or completely replacing a disabled employee.⁸⁵ Such a cost is required to be funded by the government which therefore leads to an incremental growth in the demand for tax revenue. This cost can be represented by the equation below:

⁸⁴ The productivity related costs presented in this section are familiar to the Health and productivity management model presented in Goetzel et al (2002) and Druss et al (2002)

⁸⁵ Hamermesh (1989) presents a model where this cost can be either variable or fixed. Here we assume the cost varies with the number of people hired.

$$c^G = f^{hiring} \left[\sum_{d^k > d^j} \sum_{a,g} I_{[t-1,t]}^{a,g,G,j \rightarrow k} + \sum_k D_{[t-1,t]}^{a,g,G,k} \right] w_{t-1}^{a,g,G}$$

Where, the superscript G indicates a government variable.

The Disability Lost Productivity of Time to Replace a Disabled Employee: This cost is associated with the fact that it takes time to hire a new employee, and until that employee is hired the government is forced to operate at a lower service level. The “lost productivity of time to replace a disabled employee” can be determined using the equation below:

$$\Delta w_{[t-1,t]}^G|_{Lost} = f^{delay} \left[\sum_{d^k > d^j} \sum_{a,g} I_{[t-1,t]}^{a,g,G,j \rightarrow k} (d^k - d^j) + \sum_k (1 - d^k) D_{[t-1,t]}^{a,g,G,k} \right] w_{t-1}^{a,g,G}$$

Where, all variables are familiar from above.

The Disability Lost Productivity Due to Ramp Up: This cost arises because a newly hired employee requires time and training to become as productive as his/her more experienced co-workers. In particular, this cost is the lost government services (expressed in equivalent wage) that result from the reduced productivity of the government, during the new employee training period. As discussed above, reduced government services impact the private sector productivity which in turn impacts the governments expected future tax revenue. The cost of lost productivity can be obtained by multiplying the number of new employees by the wage rate and a ramp up coefficient; as seen in the below equation:

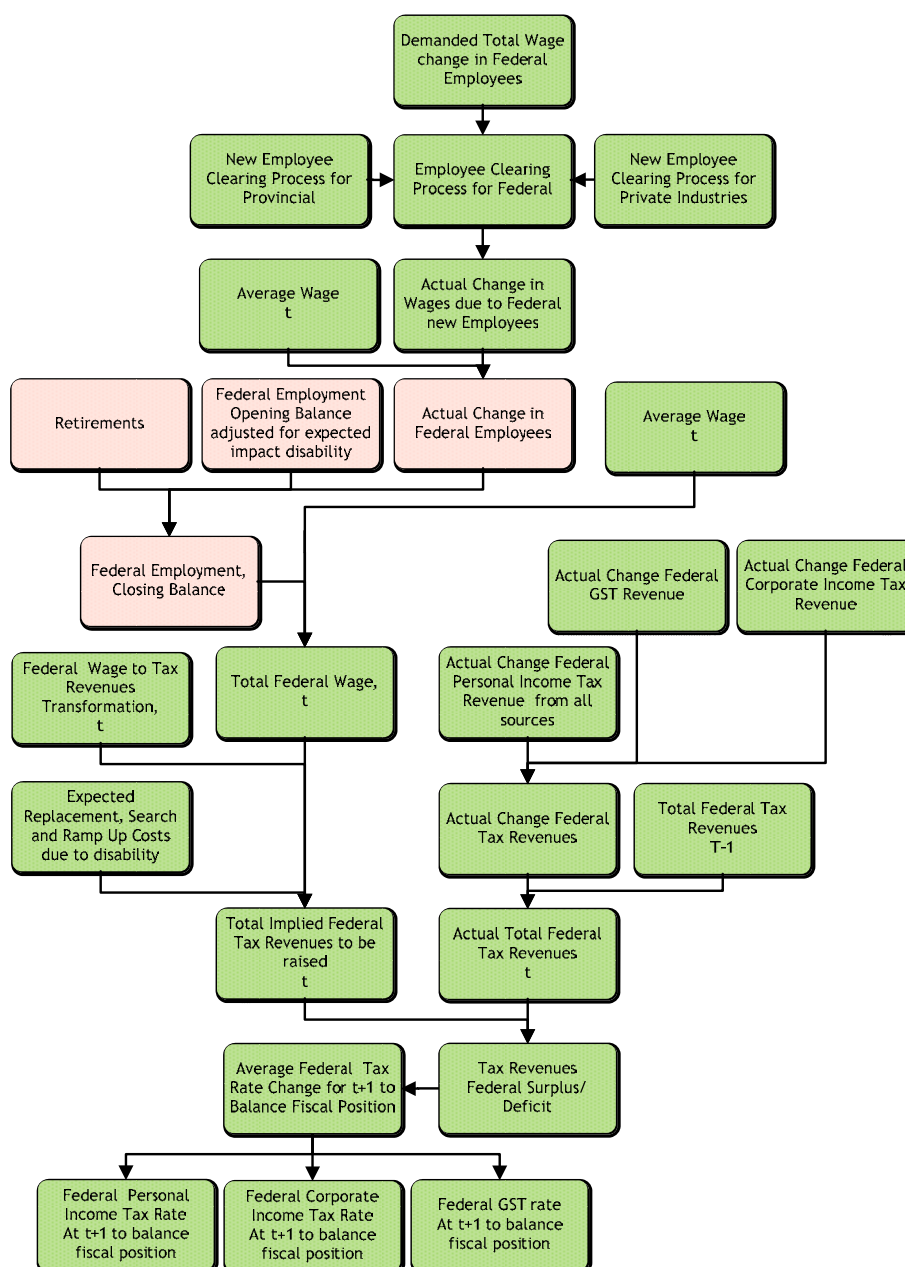
$$\Delta w_{[t-1,t]}^G|_{Ramp\ Up} = f^{Ramp\ Up} \sum_{a,g,k} \Delta E^{a,g,G,k}|_{target} (1 - d^k) w_{t-1}^{a,G,i}$$

Where, all variables are familiar from above.

Public Sector Clearing and Realization

As in the private sector the values that the public sector expects to occur often differ from their realized values.⁸⁶ The structure and logic diagram below conceptually illustrates how the public sector reacts to differences between expected and realized values.

Exhibit 18 S&L: Public Sector Labour Clearing and Realization



⁸⁶ This assumption is consistent with the costly adjustments models (Hamermesh (1989))

In the Life at risk economic framework imperfections exist in the labour market that prevents the government from actually obtaining the quantity of new employees it desires.⁸⁷ This results from the various imperfections that exist in the employment labour market. These imperfections in combination with the size of the unemployment pool may lead to differences between the demanded change in employees and the actual number of employees hired.

Once the actual number of new government employees is determined it is added to the current disability adjusted workforce of the government, then retirements are subtracted, to arrive at the government employment closing balance. Expected replacement, search and ramp up costs are also added to the wage bill as such costs are required to be covered by tax revenue. From this value the total government wage bill can be determined. The wage bill is converted from wages to implied tax revenues required to support the payment of such wages. The end result is the total tax revenues that the government requires to provide a uniform level of service while at the same time run a balanced budget. This is known as the “implied federal tax revenues to be raised” and is calculated as follows:

$$R_t^g|_{Implied} = \frac{W_t^g}{f_t^{wage\ to\ Revenue}} + \Delta \tilde{R}_{[t-1,t]}^g|_{disease}$$

At the end of the period private sector values (total wage bill, total output, final domestic demand, and corporate profits) have been determined and the government realizes its total tax revenue. This realized value is then compared to the implied federal tax revenues to be raised, to determine if the government has run a deficit or surplus for the period. This is represented by the equation below:

$$S_t^g = R_t^g - R_t^g|_{Implied}$$

Where,

- S_t^g Represents a government surplus or deficit (depending on its sign).
- R_t^g Represents realized tax revenues.

The government now adjusts its tax rates for the next period, in an attempt to correct for the deficit or surplus incurred in the current period. The equation below describes how tax revenue is allocated across the respective tax rates to compensate for the surplus/deficit described above⁸⁸:

$$-S_t^g = \alpha_t(W_{t+1}\delta r_t^{income} + C_{t+1}\delta r_t^{corporate} + FD_{t+1}\delta r_t^{GST})$$

Where,

$$\delta r_t^i = (\rho_t^i - 1)r_t^i$$

⁸⁷ This is the distinctive characteristic of the friction cost method. (Koopmanschap et al. 1993) and the costly adjustment models (Hamermesh (1989))

⁸⁸ α_t can be solved for by rearranging the below equation.

And,

$$\rho_t^i = \frac{r_{t+1}^i}{r_t^i}$$

Where,

- δ Represents the expected rate change for each respective tax rate.
- ρ_t^i Represents the tax policy function. This function is determined by examining historical changes in corporate, income and consumption taxes.

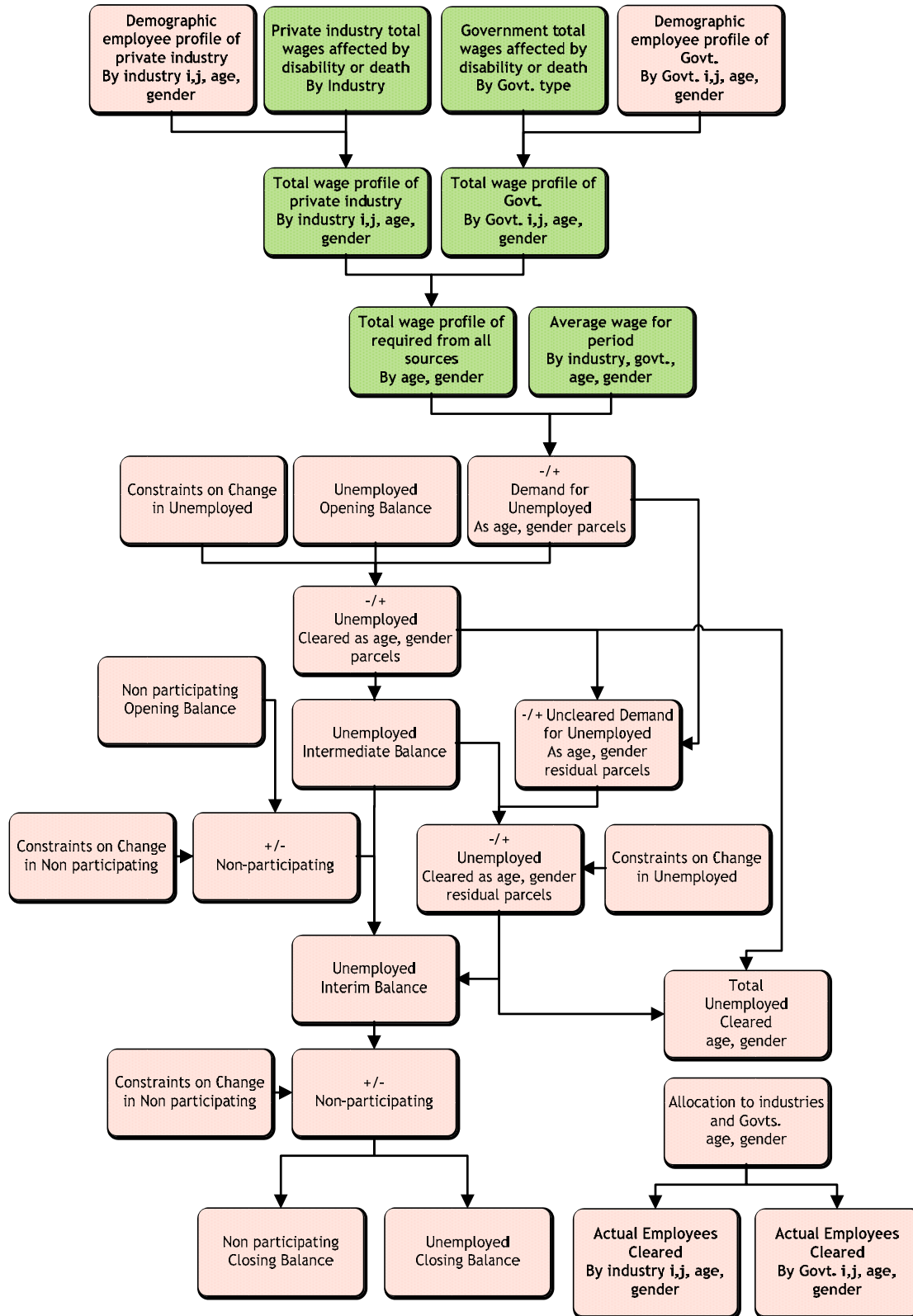
Labour Market Clearing of Demand

The presence of disease in an economy reduces the productive capacity of the labour force. How firms and governments react to this and how the labour market eventually clears will be the focus of this section. Employers, whether they are with the government or the private sector, seeking additional workers can obtain them from one of two sources: (1) hire an unemployed individual or (2) induce a non-participating individual to enter the unemployment pool.

As discussed above, in each period employers will experience either a positive or negative impact on their workforce from a change in the prevalence of disability. If an employer experiences a negative impact from the disability or death, they require additional employees to produce their desired level of output. Employers therefore are required to hire new employees from the labour market in an attempt to compensate for the lost productivity of their current employees.

The structure and logic diagram below conceptually illustrates an employer's experience with the labour market when seeking to satisfy his/her demand for new employees.

Exhibit 19 S&L: Labour Market Clearing of Labour Demand



For both private sector and government employers the process begins with the total new employee wage profile for each employer. The employee wage profile is a description of an employer's ideal employee and is comprised of distinct gender, age and industry experience characteristics of potential employees.⁸⁹ The new expected total employee wage profile is calculated as the employer's total wage bill, characterized by industry, age, and gender. This is given by the equation below:

$$\tilde{W}_{t+1}^i = \sum_{a,g,i} (1 - d^k) w_{t+1}^{a,g,i} E_{t+1}^{a,g,i,k}$$

Where all variables are familiar from above.

The model assumes that employers first look for new employees that have similar qualities to their current work force. For example, if the employer current work force is comprised of employees of age a and gender g then an employer will first look for people of this age and gender. These assumptions are consistent with searching and matching models of macroeconomics where workers and jobs are heterogeneous.^{90 91 92 93}

The total new employee wage profiles of all employers are summed, to arrive at the total aggregate demand for new employees, expressed in terms of wages. This value is given by the equation below:

$$W_{t+1}^i = \sum_{a,g,i} (1 - d^k) w_{t+1}^{a,g,i} (E_{t+1}^{a,g,i,k} + H_{Target}^{a,g,i,k})$$

Where,

- $H_{Target}^{a,g,i,k}$ Represents the target number of employees to be hired to meet demand in for the current period. This value is assumed to be determined thought profit maximization or cost minimization at the firm level.

The total aggregate demand for new employees in wage terms is then transformed into people equivalents using average wages by industry, age and gender.

However, the total aggregate demand for new employees in people terms is constrained by the extent that there are enough individuals in the unemployment pool. This part of the model proxies for the frictional nature of labour market. The labour force participation and unemployment rates are simulated using historically observed values of these variables. The model differentiates between 75 age groups and 2 genders. At each time t the random walk Monte Carlo simulation required about 10,000

⁸⁹ For examples of models that implement this assumption see the search and matching models presented in: Diamond (1982), Pissarides (1985), Mortensen (1986), Mortensen and Pissarides (1999)

⁹⁰ Diamond (1982)

⁹¹ Pissarides (1985)

⁹² Mortensen (1986)

⁹³ Mortensen and Pissarides (1999)

trials in order to reach an appropriate accuracy (slightly different for the various age groups). The above mentioned constraints are given by the below equations⁹⁴:

Labour Force Participation Rate:

$$\text{Max}(v_{projected}^{a,g}) \geq \frac{E^{a,g} + U^{a,g}}{p^{a,g}}$$

Unemployment Rate:

$$\text{Min}(\mu_{projected}^{a,g}) \leq \frac{U_t^{a,g}}{E_t^{a,g} + U_t^{a,g}} \leq \text{Max}(\mu_{projected}^{a,g})$$

Where,

- $v_{projected}^{a,g}$ Represents the projected labour market participation rate by age and gender.
- $\mu_{projected}^{a,g}$ Represents the projected unemployment rate by age and gender.
- $U_t^{a,g}$ Represents the number of unemployed at time t by age and gender.

Employers first hire all unemployed individual that match their specific demographic employee profile. However, there may not be enough unemployed individuals that match this profile to satisfy aggregate demand. The maximum number of employees that a firm is able to hire is constrained by the equation below:

$$H_{Max}^{a,g} = U_t^{a,g} - (U_t^{a,g} + \sum_i E_t^{a,g,i})\mu_{projected\ min}^{a,g}$$

Where,

- $\mu_{min}^{a,g}$ Represents the projected minimum level of unemployment that could potentially prevail in the economy.

The aggregate actual number of employees hired is given by the below condition:

$$H_{actual}^{a,g} = \text{Min} \left[\sum_i H_{target}^{a,g,i}, H_{max}^{a,g} \right]$$

At this point the unemployment pool has been transformed into an unemployed intermediate balance leaving a residual un-cleared demand for new employees. The unemployment pool is now comprised of individuals that don't fit an employer's demographic employee profile. Employers are now assumed to relax their demographic requirement in an attempt to clear the unfulfilled demand for new employees. The extent to which the unfulfilled demand is met is determined by the historical constraints on age and

⁹⁴ The US Federal uses a method similar in their MPS model to constrain coefficients on capital and energy intensities. Brayton and Tinsley (1996),

gender in the workforce and on the historical changes in the unemployment pool (movements from the non-participating pool into the unemployment pool). The part of the residual un-cleared demand for new employees that can be cleared by the unemployed intermediate balance gives rise to an unemployed interim balance. The unemployed interim balance is then adjusted for movement from non-participating into the unemployment pool to yield the year end non-participating and unemployment pool balances.

The total demand for new employees cleared by the unemployment pool by age and gender is then allocated to the original demands by private sector and government employers for new employees. New employees are allocated to each industry according to the portion of total new employees demanded by that industry. This then yields actual new employees available to each private sector (by industry, age, gender) and government employer (by government type, age, gender). This is represented by the equation below:

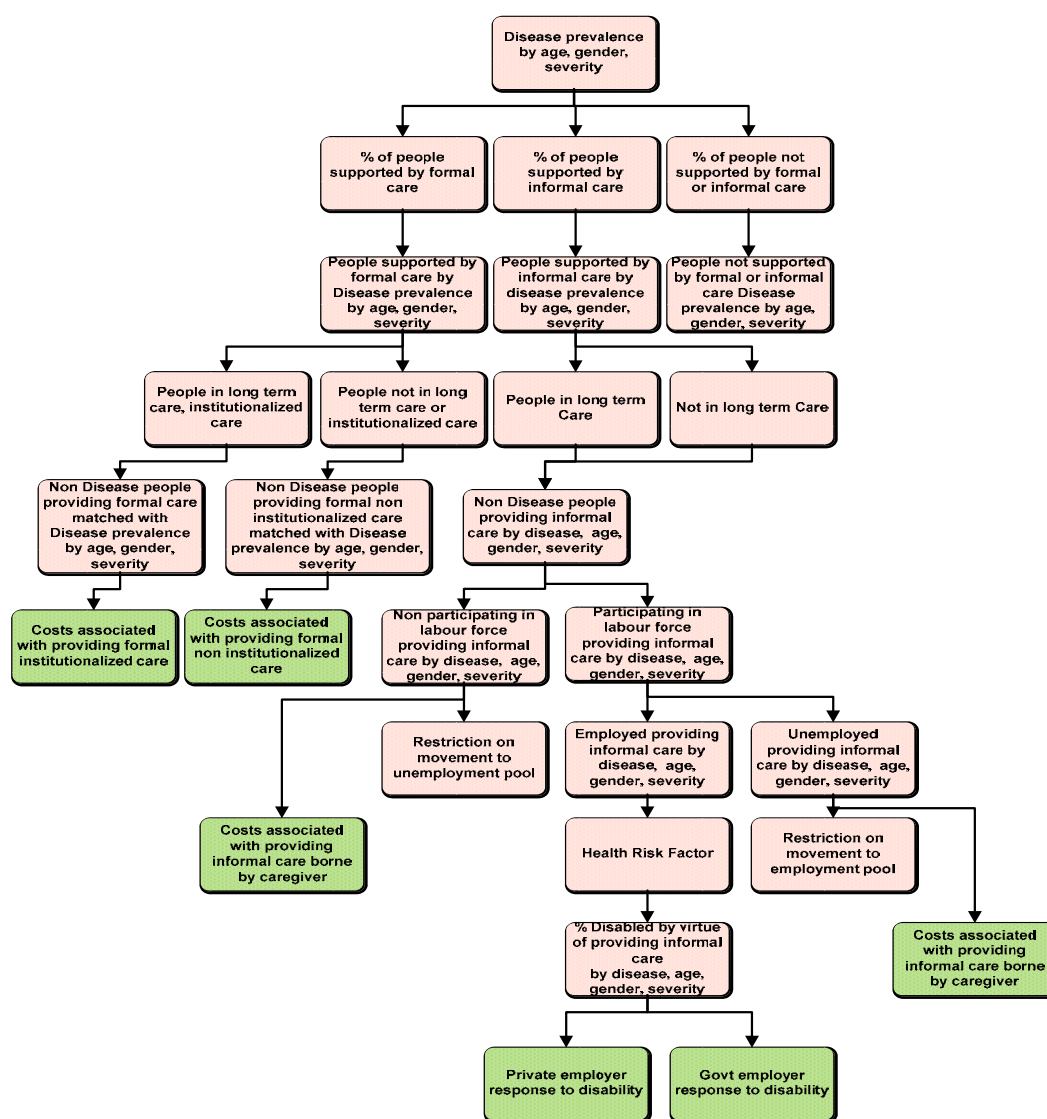
$$H_{actual}^{a,g,i} = \frac{H_{target}^{a,g,i}}{\sum_i H_{target}^{a,g,i}} H_{actual}^{a,g}$$

Section 4: Health Specific Modules

Implications of Caregivers

Effects of disability extend beyond those directly suffering from an ailment. The impact can be experienced by patient's families, caregivers, the healthcare system and society as a whole. A severe disability requiring involvement of either formal or informal care givers is bound to raise certain costs. The structure and logic diagram below conceptually illustrates the allocation of the costs associated with providing both formal and informal care:

Exhibit 20 S&L: Implications of Caregivers



The disabled population can be supported in one of three ways:

- **By formal caregivers:** These caregivers include doctors and nurses in Long term care facilities and attendants in retirement homes.
- **By informal caregivers:** These caregivers include relatives and friends of the disabled.
- **By neither:** No formal or informal care.

The number of people receiving formal care can be categorized into patients in institutionalized care facilities and those that pay for care services in their private residences. Direct healthcare costs are associated with both categories of formal care. These costs accrue from the wages of the healthcare professionals providing the support.

The second way a severely disabled individual can receive support is by way of an informal caregiver. Informal care is often provided by a family member or close friend of the care recipient. Individuals receiving informal care can be categorized by those in a long term care facility and those that receive care in their place of residence. Informal caregivers of patients in long term care are those that have an intimate connection with the patient and who volunteer their time to provide care.

Individuals providing informal care can be categorized by those that are participating in the labour force and those that are not. Those not in the labour force, and who face barriers to moving into the unemployment pool, carry an opportunity cost associated with providing informal care. This opportunity cost is defined as the potential income that could be earned by the support providers were they able to participate in the labour force.

Informal caregivers that are participating in the labour force can be further divided into those that are employed and unemployed. Unemployed caregivers that face restriction to moving from the unemployment pool to the employment pool face an opportunity cost similar to those not participating in the labour force. Restrictions on entry to the labour force can arise for a variety of reasons; for example, an informal caregiver may be forced to look for a position with flexible hours or close to their place of residence in order to provide adequate care for the care recipient. In this scenario the opportunity cost is defined as the potential income that could be earned by the support providers were they able to transition from the unemployment to the employment pool.

Employed caregivers are exposed to certain health risk factors associated with providing informal care.⁹⁵ These health risk factors, if realized, can result in decreased productivity and subpar work quality. This reduced productivity, whether it's from depression or fatigue, results in lost output and is a cost borne by the firm/government that employs the caregiver. This cost (expressed in production equivalent wages) can be represented by the following equation:

⁹⁵ Depression and fatigue is well documented in the literature on informal caregivers. For an example regarding informal caregivers of Alzheimer patients see (Mittelman, et al. 2004)

$$W_t^{a,g,i,c} \Big|_{Lost} = \sum_c (1 - d^c) E_t^{a,g,i,c} w_t^{a,g,i}$$

Where, d^c represents the disability factor associated with providing informal care.

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ISBN 978-0-9733522-4-5

Suggested citation

Smetanin, P., Kobak, P., Briante, C., Stiff, D., Sherman, G., and Ahmad, S. Rising Tide: The Impact of Dementia in Canada 2008 to 2038. RiskAnalytica, 2009.

This report and the analysis it contains was prepared by RiskAnalytica using its Life at Risk® simulation platform.