

# The Life and Economic Impact of Major Mental Illnesses in Canada

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Prepared on Behalf of the Mental Health Commission of Canada by:



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## Life at Risk Analysis of The Impact of Mental Illness in Canada

This report was prepared by RiskAnalytica on behalf of the Mental Health Commission of Canada. The RiskAnalytica team members who contributed to this report are: Paul Smetanin, Carla Briante, David Stiff, Sheeba Ahmad and Minhal Khan. The assumptions and calculations underlying RiskAnalytica's Life at Risk simulation platform were prepared by RiskAnalytica as part of this study. The use and interpretation of the methodologies, data, assumptions and simulation outcomes is entirely that of the authors.

Data sources, advice and recommended literature sources that were relevant to the research were provided by the staff of the Mental Health Commission of Canada as well as a panel of subject-matter experts, according to their areas of expertise. The views presented in this report are not necessarily those of the expert panel.

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## EXECUTIVE SUMMARY

### INTRODUCTION AND SCOPE

#### **The Challenge of Mental Illness**

Mental illness is a behavioural or psychological syndrome that significantly interferes with an individual's thought processing abilities, social abilities, emotions and behaviour (Mental Disorders, WHO). Depending on the type of mental illness, the severity of the illness may vary from mild to severe and contribute to disability and health care service use. This study estimated that 1 in 5 Canadians are affected annually by mood disorders, anxiety disorders, schizophrenia, attention deficit/hyperactive disorders (ADHD), conduct disorders, oppositional defiant disorders (ODD), substance use disorders or dementia. Not only does mental illness impact individuals but it also places a significant impact on families, communities and the health care system. In 2011, this study conservatively estimated that the cost of mental illness was \$42.3 billion in direct costs and \$6.3 billion in indirect costs. Over the next 30 years, the life and economic consequences of mental illness are expected to be magnified due to the increase in the expected number of people living with mental illness as a result of the aging and growth of Canada's population over the next 30 years. Within a generation, it is estimated that more than 8.9 million Canadians will be living in a mental illness.

#### **Study Objective**

The objective of this study was to estimate the health and economic impact of major mental illnesses in Canada, beginning in 2011 and annually over the next three decades. For the purposes of this study the major mental illnesses included: mood disorders, anxiety disorders, schizophrenia, substance use disorders, ADHD, conduct disorders, ODD and cognitive impairment including dementia. Using RiskAnalytica's Life at Risk simulation platform, measures of incidence, prevalence and mortality were simulated for the total Canadian population (ages 9 and over) to project the impact of major mental illnesses over a 30-year time horizon. The outcomes, assuming a steady-state prevalence were then linked to estimates of health service use and workplace productivity to forecast the economic impact of mental illness now and into the future.

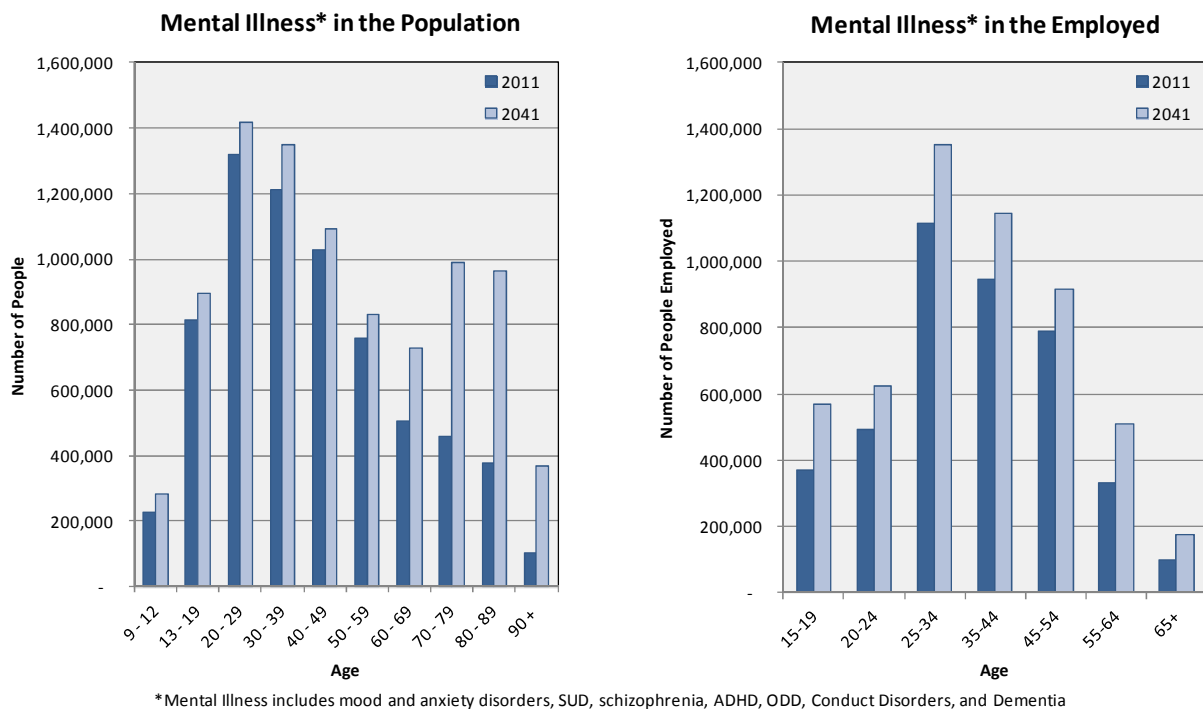
Throughout this study, an independent panel of recognized experts in mental health and illness including epidemiologists, health researchers, mental health data analysts, clinicians, psychiatrists and

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economists were consulted to review and assess the reasonableness of the model inputs and assumptions, model structure, and model outputs and conclusions to ensure that the model is consistent with observed data.

### CURRENT AND FUTURE IMPACT OF MENTAL ILLNESS IN CANADA: MODEL RESULTS

**Figure 1** Estimated Number of People with Mental Illness in the Canadian Population and Employed Population



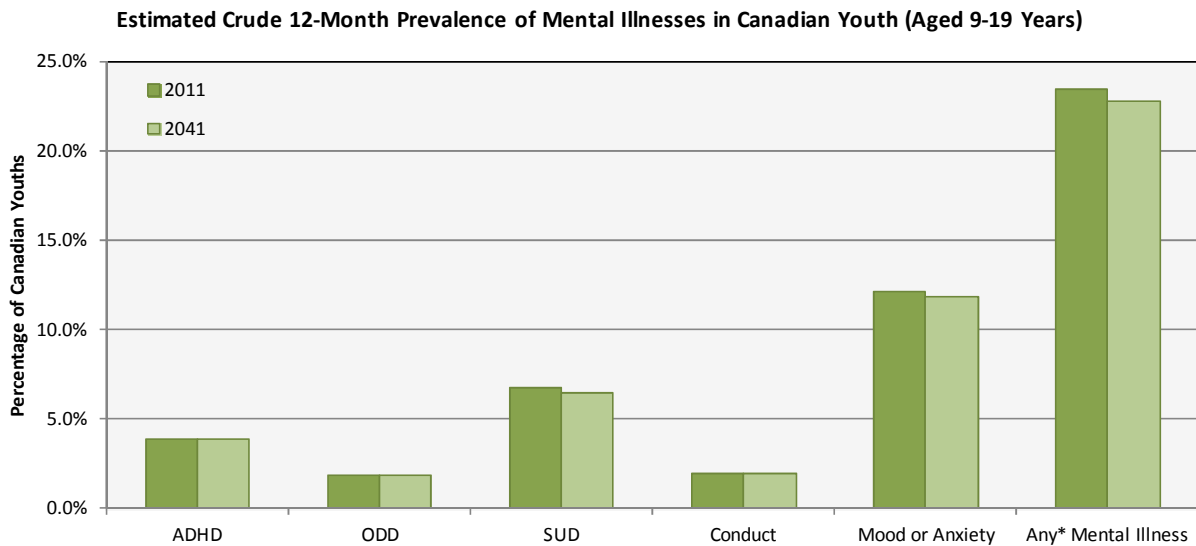
### 12-Month Prevalence

Our model estimated that there are over 6.7 million Canadians currently living with a mental illness, accounting for approximately 19.8% of the total population. By 2041, we forecast that there will be over 8.9 million people living with a mental illness in Canada (1.3 times the current estimate) or approximately 20.5% of the total population. Given the steady state prevalence assumptions applied in our model, this increase is primarily driven by Canada's projected population growth and aging over the next 30 years. Over the next generation the Canadian population projections from our model are expected to increase from 34.5 million in 2011 to 43.4 million in 2041, a 26.4% increase. In addition, the

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proportion of the population over the age of 60 is estimated to increase from 20.4% in 2011 to 30.3% in 2041.

**Figure 2** Estimated Percentage of Canadian Youth with Mental Illness in 2011 and 2041



Any\*- Includes ADHD, ODD, SUD, conduct disorders, mood disorders and anxiety disorders

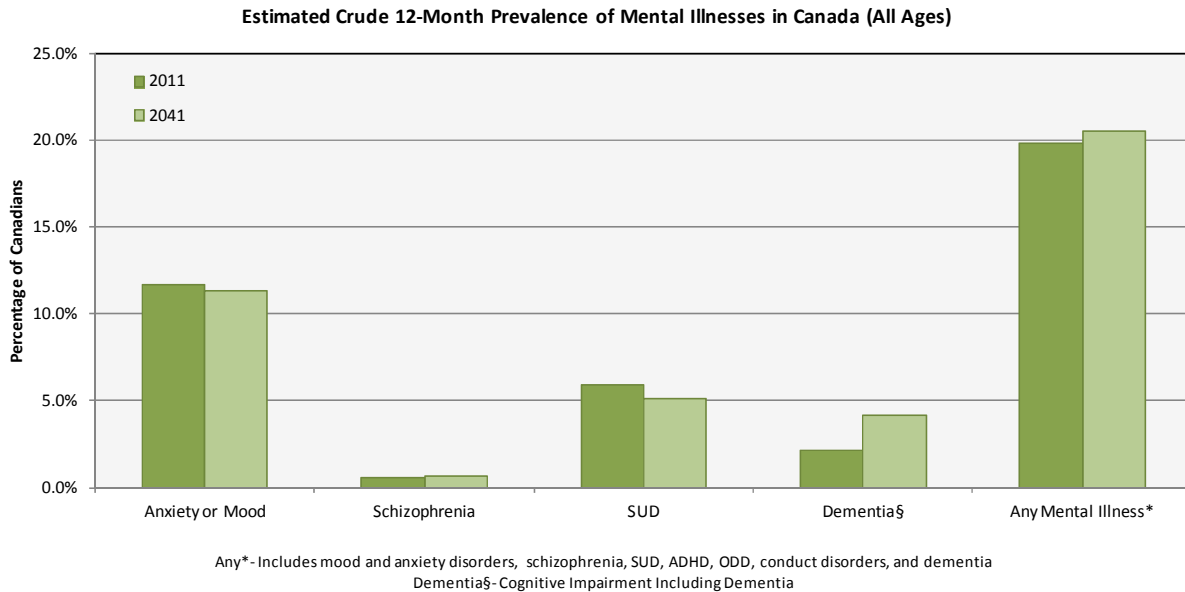
The number of Canadian youth living with a mental illness was estimated to be over 1.0 million in 2011. By 2041, it is estimated that there will be almost 1.2 million children and adolescents between the ages of 9 and 19 living with a mental illness in Canada. Further research has shown that these children are at a considerable risk of having the same mental illness or developing a new mental illness in adulthood. Our model further quantifies these risks and related societal costs across the lifespan from childhood through to adulthood.

The number of people living with mental illness is expected to increase by 31% over the next 30 years, reaching in excess of 8.9 million prevalent cases. Of these almost 1.2 million are expected to be children and adolescents between the ages of 9 and 19. This increase is driven by Canada's population growth and aging over the next 30 years.



## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 3** Estimated Percentage of Canadians with Mental Illness in 2011 and 2041



Mood and anxiety disorders are the most common mental illnesses among Canadians, with approximately 4.0 million Canadians living with either a mood or anxiety disorder in 2011 (including children and adolescents). By 2041, the number of people living with a mood or anxiety disorder is estimated to reach over 4.9 million Canadians. As a consequence of the aging population, the proportion of people in Canada with cognitive impairment including dementia will rise significantly. While the absolute number of people with any mental illness is shown to increase over time, the shifting age distribution causes the population prevalence of some illnesses to increase while others decrease. For diseases which primarily affect younger age-groups such as mood and anxiety disorders and SUDs, the aging of the population causes a decrease in the percentage of the total population with these illnesses. In contrast, there is a significant increase in the population prevalence of illnesses that affect older age-groups as the proportion of people in these age-groups rises.

### Economic Burden

In our analysis mental illness was estimated to cost the Canadian economy over \$42.3 billion dollars in 2011 in direct costs. Of this, \$21.3 billion are direct costs to the health care system<sup>1</sup> including

<sup>1</sup> This is equivalent to 10.6% of the estimated \$200.5 billion spent on health care in Canada in 2011 (Canadian Institute of Health Information, 2011). This is slightly higher than estimates from 2003/04, where provinces spent an average of 6.0% of

hospitalizations, physician visits, medication, and care and support staff. The total direct cost estimate of \$42.3 billion is likely an underestimate because these costs do not include costs to the justice system, social service and education systems, costs for child and youth services, informal care giving costs or costs attributable to losses in health-related quality of life. The present value of the cumulative direct costs over the next 30 years is expected to exceed \$2.3 trillion dollars. In 2011, the annual direct costs of all mental illnesses excluding dementia, \$22.6 billion dollars, were shown to exceed the direct costs of dementia<sup>2</sup> which were estimated to be \$19.7 billion dollars or 47% of the total direct costs. However, within one generation, as the number of people living with dementia increases, the costs of dementia are shown to exceed the costs of all other mental illnesses. By 2041, dementia is expected to account for 64% of the total direct costs of mental illness in Canada or \$185.4 billion in annual future value terms; whereas the costs in 2041 for all mental illnesses excluding dementia were estimated to be \$105.6 billion in annual future value terms.

When examining the costs associated with health care use for each illness, schizophrenia was shown to have the highest physician, hospitalization, prescription drug and psychiatrist costs. Although the prevalence of schizophrenia is low (<1.0% of the population), the severity of the illness contributes to higher health care service use and higher costs per prevalent case than any other mental illness.

Approximately 2 of every 9 workers (or 21.4% of the working population) are estimated to suffer from a mental illness that potentially affects their work productivity. The number of people with mental illnesses excluding dementia peaks in the middle of people's working years, which significantly impacts the productivity of the labour force. Mental illness in the workplace translates to an annual wage based productivity impact of over \$6.3 billion dollars.

## CONCLUSIONS AND FUTURE DIRECTIONS

The Life at Risk simulation platform estimated the baseline impact of major mental illnesses in Canada. By 2041, the number of Canadians living with mental illness is expected to reach over 8.9 million prevalent cases, or 20.5% of the total population. This will place a significant burden on Canada's

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total health spending on mental health though those estimates exclude dementia. Provincial variations ranged from as low as 4.4% in Saskatchewan to as high as 8% in British Columbia (Jacobs *et al.* 2007)

<sup>2</sup> Note that dementia also includes cognitive impairment.

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economy with the annual economic impact of over \$48.6 billion dollars in 2011 and with the present values of the cumulative cost over the next 30 years exceeding \$2.5 trillion.

Many of the results presented in this study are considered by experts to likely be *underestimates* of the current and future impact of mental illness in Canada. As a result of project scope and data availability the results do not include all mental illness types or all costs incurred as a result of mental illness such as costs to the social service, education and justice systems, costs for the provision of services for children and youth as well as costs to informal care givers who provide support and care for those with mental illness and costs related to losses in health-related quality of life. The next phase of this study will use the 30-year baseline assessment to model the impact of policy and service interventions on reducing the impact of mental illness in Canada.

## STRUCTURE OF THE REPORT

This report is divided into four sections:

- **Section 1** provides details on the background, purpose and objectives of the study;
- **Section 2** highlights the general approach to the analysis, the subject-matter expert review of the approach and outcomes, and provides details on the Life at Risk methodology and model assumptions as well as the input data and data assumptions used in the analysis;
- **Section 3** summarizes the results of the base model, establishing a 30 year annual baseline estimate of major mental illnesses in Canada; and
- **Section 4** summarizes the major findings and conclusions as well as potential research questions that were identified over the course of this study.

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## 1 INTRODUCTION AND BACKGROUND

### 1.1 WHAT IS MENTAL ILLNESS?

A mental illness or disorder is a diagnosable illness that significantly interferes with an individual's thought processing abilities, social abilities, emotions and behaviour (Mental Disorders, WHO). There are many different types of illnesses under the broad category of mental illness. This analysis has been as inclusive as possible with regards to condition coverage given the available data; however, it has not been possible to include all mental illnesses for the purposes of this study. The disorders under review within the scope of this analysis are divided into the following categories:

- Mood disorders: major depressive disorder, bipolar disorder and dysthymia;
- Anxiety disorders: generalized anxiety disorder, panic disorder, simple phobia, agoraphobia and social phobia;
- Psychotic disorders: schizophrenia;
- Disorders of childhood and adolescence: mood disorders, anxiety disorders, conduct disorder (CD), attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD);
- Cognitive impairment including dementia: cognitive impairment, vascular dementia, Alzheimer's disease, organic psychotic conditions; and
- Substance use disorders (SUDs): alcohol abuse and/or dependence, and drug abuse and/or dependence.

### 1.2 OVERVIEW OF ENGAGEMENT SCOPE

#### **Purpose and Objectives**

The purpose and objectives of this study were to estimate the current and future health and economic impacts of major mental illnesses on Canadian society over the next 30 years. To achieve these objectives RiskAnalytica's Life at Risk simulation platform was used to generate a base model of the current and future life and economic outcomes associated with major mental illness in Canada including: mood disorders, anxiety disorders, schizophrenia, disorders of childhood and adolescence, cognitive impairment including dementia, and substance use disorders.

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Using data inputs from a wide range of sources, the base model estimates the current impact of major mental illnesses and forecasts it over a 30-year time horizon. This base model represents the status quo for each mental illness type, where measures of health (incidence, prevalence and mortality) and economics (direct and indirect costs attributable to each illness) can be computed. It is important to note that the model assumes that the baseline prevalence and incidence of mental illness will remain constant over time it is further assumed that health service use and productivity will remain constant over the simulated time period. As a result, the projections are driven primarily by changes in population demographics. Based on current knowledge, this is considered to be a reasonable assumption for the majority of mental illnesses considered in this study, however the estimates presented are considered conservative if the incidence of one or more disorders increases or liberal if decreases in incidence are observed.

The base model takes into account some key risk factors and protective factors such as the healthy immigrant effect, comorbidity among mental illnesses, comorbidity between mental illnesses and two chronic diseases (type II diabetes and heart disease) and the increased risk of mental illness in adulthood given a childhood or adolescent illness. Each is described in further detail in Section 2.

### **Out of Scope Components of and Limitations to the Current Model**

This study only considered the life and economic burden for the major illnesses listed in Section 1.1. The impacts of other mental illnesses (such as eating disorders, personality disorders, and other additions such as gambling) were not included as a result of data limitations and time constraints. However these disorders are less common within the population and tend to co-occur with the major mental illnesses included in this study. As a result the impact of omitting these illnesses on the overall findings is considered to be minimal.

In addition, each mental illness was modeled as a distinct diagnostic category and the severity of illness and subclinical illnesses were not taking into consideration within this analysis. In reality the symptoms of each illness can occur across a continuum from mild to severe. At the mild end of the spectrum, diagnostic criteria may not be met, but mild cases may be at risk of future illness that meets diagnostic criteria, especially among children and youth (Galanter and Patel, 2005). In other situations, despite meeting diagnostic criteria, individuals may cope well and the impact of their illness in terms of suffering, disability, health care service use, and workplace productivity may be minimal (WHO, 2003). It



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is important to note that the costs and health care service utilization rates presented within this report were not adjusted for severity of illness and the probability of health service use based on illness severity.

Similarly, there are many known risk factors for mental illnesses that have not been included such as socioeconomic status, adverse childhood events and genetic factors. Due to data and time constraints, the model only included age, sex, type II diabetes, heart disease, immigrant status, and previous or concurrent mental illness as risk factors. Finally, it was not possible to include a full range of outcomes for some disorder. In particular, for children and youth disorders, outcomes such as leaving school early, teen pregnancy and parenting, domestic violence, injury, vehicle collision, fatality rates and legal system involvement (Egger *et al.* 2003; Rowe *et al.* 2004) were not considered.

The total costs presented in this report could not be specifically and directly attributed to a particular mental illness type or illness severity. In addition, the current model does not include costs for the justice system, education system, the provision of informal care, and the use of excess health services for conditions other than those provided for the main condition. These additional costs may comprise a substantial proportion of the total economic burden of mental illness. The utilization rate analysis for direct costs associated with mental illness was limited to the utilization and costs data available in Canada which is a subset of the total direct costs and mental illnesses included in the study.

The indirect costs associated with mental illness were limited to adult mental illness types and did not consider the lost opportunity costs for informal caregivers for time off work to care for the elderly, children and adolescents, or those with severe mental illness.

Finally, this study presents the impact of mental illness in Canada from a national perspective and does not take into consideration differences in specific population groups such as First Nations, Inuit and Métis (FNIM) or specific jurisdictions such as provinces and territories, in terms of epidemiological risk, health equity and access, and health services and resources available.

While this study considered many data sources, major challenges to producing an optimal model were substantial limitations in the type, age, availability, relevancy and quality of datasets in Canada. The data gaps and limitations are outlined in detail, and assumptions used to address data limitations were discussed and approved by the SME panel and considered to provide a reasonable approximation based

on current knowledge. While acknowledging data limitations and uncertainties, the Life at Risk model has allowed, for the first time, connections among data sets for a reasonable and comprehensive picture of the impact of mental illness in Canada. Please refer to Sections 2.8 and 4.2 for further discussion on data and study limitations respectively.

### 1.3 OVERVIEW OF MENTAL ILLNESSES

#### 1.3.1 EPIDEMIOLOGY OF MOOD DISORDERS

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##### ***Definitions and Diagnosis***

Mood disorders are a set of disorders that include major depressive disorders, bipolar disorder, dysthymia, cyclothymic disorder, bipolar disorder not otherwise specified, substance-induced mood disorder, mood disorders not otherwise specified, etc.; and are characterized by mood disturbances (DSM-IV-TR). These disorders are constructs developed through inference, hypothesis, deduction, and conjecture (Waraich *et al.*, 2004). Many individuals who suffer from these conditions transition between types of episodes at different times during their lifetime, making it difficult to determine the onset and cessation of episodes. Keeping these challenges in mind, this report focuses on mood disorders that are most common in the general population and which have been most extensively examined in epidemiological studies, namely: major depressive disorder, bipolar disorder and dysthymia.

Major depressive disorder (MDD) is a clinical syndrome characterized by the occurrence of major depressive episodes that cannot otherwise be accounted for by other specified disorders. These major depressive episodes consist of a time period lasting for 2 weeks or more in which the individual experiences consistent loss of pleasure and interest in usual activities or consistent feelings of sadness or depression (DSM-IV-TR). An individual is diagnosed with MDD when these feelings are combined with several other symptoms such as feeling hopeless, worthless or discouraged; having sleep disturbances; feeling fatigued or lethargic; having appetite disturbances; having difficulty concentrating; or having thoughts of death or suicide (DSM-IV-TR; Davison and Neale, 1997). It is one of the oldest, most recognized medical disorders, having been clearly described in medical texts dating back to ancient Greece (Fava and Kendler, 2000). By comparison, dysthymia has been defined as a chronically depressed mood occurring most days for extensive periods (two years or longer) with short, if any, symptom-free periods. Other symptoms of depression can also be present but tend to be less severe and insufficient to

meet the criteria for major depression (Bland, 1997). People with dysthymia may also experience one or more episodes of major depression during their lifetimes (NIMH).

Diagnosis of bipolar disorder in the DSM-IV TR requires that there must have been an occurrence of manic episodes, mixed episodes or hypomanic episodes often appearing in combination with major depressive episodes (DSM-IV-TR). There are two types of bipolar disorders: Bipolar I disorder and Bipolar II disorder.

*Bipolar I Disorder:*

Bipolar I disorder involves the occurrence of manic episodes which at times are also combined with symptoms of depression (mixed episode). It is diagnosed when the individual displays symptoms such as easily diverted attention, needing considerably less sleep than normal, vastly increased self-esteem, racing thoughts, highly increased level of activity, and involvement in pleasurable activities such as hyper-sexual activity, extreme spending, high-risk investments, reckless driving, impulsive travelling or other activities that are likely to result in severe consequences (Davison and Neale, 1997; DSM-IV-TR).

*Bipolar II Disorder:*

Bipolar II disorder is characterized by the recurrence of major depressive episodes as well as at least one hypomanic episode. A hypomanic episode consists of a period in which a person experiences either an abnormally elevated mood or an irritable mood that lasts for 4 or more days (DSM-IV-TR). Nonetheless, a hypomanic episode differs from a manic episode in that it is not severe enough to impair social interactions or the fulfillment of daily occupational responsibilities nor does it require hospitalization (DSM-IV-TR). The period of abnormal mood in a hypomanic episode must also be accompanied with three or more of: increased grandiosity, reduced sleep, being highly talkative, having racing thoughts or flight of ideas, being easily distracted, increased goal-directed activities, and increased involvement in pleasurable activities that are highly likely to have serious consequences (DSM-IV-TR). An individual with Bipolar II disorder experiences cycling mood changes that range from extreme highs to extreme lows (DSM-IV-TR). An individual is diagnosed with Bipolar II disorder only when the symptoms cause significant impairment to functioning in occupational, social or other settings (Davison and Neale, 1997).

Epidemiological understanding of mood disorders has come a long way in the past decades with revisions of the DSM and the ICD-10 diagnostic criteria as well as standardized interview instruments

such as Schedule for Affective disorders and Schizophrenia (SADS) (Depression, WHO), Diagnostic Interview Schedule (DIS) (Robins *et al.*, 1981), and the Composite International Diagnostic Interview (CIDI) (Robins *et al.*, 1988). Antidepressant medications and brief, structured forms of psychotherapy such as cognitive behavioural therapy (CBT) can be effective for 60 to 80 % of those affected and can be delivered in primary care (Depression, WHO).

### 1.3.2 EPIDEMIOLOGY OF ANXIETY DISORDERS

---

#### ***Definitions and Diagnosis***

Anxiety disorders involve a state of distressing chronic but fluctuating nervousness that is unsuitably severe for the person's circumstances (Starcevic, 2005). Having some anxiety is adaptive and can help people improve their functioning and help an individual be appropriately cautious in potentially dangerous situations. However, when anxiety occurs at inappropriate times, occurs frequently, or is so intense and long-lasting that it interferes with a person's normal activities, it is considered a disorder (Starcevic, 2005). Anxiety disorders are more common than any other class of psychiatric disorder. However, they are often not recognized and consequently not treated (Starcevic, 2005). Left untreated, chronic, maladaptive anxiety can contribute to or interfere with treatment of some physical disorders (Davison and Neale, 1997).

Specifically, generalized anxiety disorder (GAD) consists of excessive, usually daily, nervousness and worry (lasting 6 months or longer) about many activities or events (Starcevic, 2005; DSM-IV-TR). Phobias involve persistent, unrealistic, intense anxiety about and fear of certain situations, circumstances, or objects (DSM-IV-TR).

Deciding when anxiety is so dominant or severe that it constitutes a disorder depends on several variables and physicians' points of view may differ when making a diagnosis. Physicians must first determine -- by history, physical examination, and appropriate laboratory tests -- whether anxiety is due to a physical disorder or a drug (Davison and Neale, 1997). They must also determine whether anxiety is better accounted for by another mental illness. An anxiety disorder exists and requires treatment if anxiety is very distressing and it interferes with functioning.

Diagnosis of a specific anxiety disorder is based on its characteristic symptoms and signs. Clinicians usually use specific criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition

Text Revision (DSM-IV-TR), which describes the specific symptoms and requires exclusion of other causes of symptoms.

A family history of anxiety disorders (except acute and post-traumatic stress disorders) helps in making the diagnosis because some patients appear to inherit a predisposition to the same anxiety disorders that their relatives have, as well as a general susceptibility to other anxiety disorders (Eapen *et al.*, 2004).

### 1.3.3 EPIDEMIOLOGY OF SCHIZOPHRENIA

---

#### ***Definitions and Diagnosis***

Schizophrenia is a mental illness characterized by symptoms such as loss of contact with reality (psychosis), hallucinations (usually, hearing voices), firmly held false beliefs (delusions), abnormal thinking, a restricted range of emotions (flattened affect), disorganized speech, and disturbed work and social functioning (DSM-IV-TR; Blanchard and Cohen, 2006). Other symptoms may include reduction in facial and vocal expressions, diminished motivation and interest, and decreased social interactions (Blanchard and Cohen, 2006).

No definitive test exists to diagnose schizophrenia. However, there are a number of a symptom assessment tools for diagnosing schizophrenia (Blanchard and Cohen, 2006). A physician makes the diagnosis based on a comprehensive assessment of a person's history and symptoms. Schizophrenia is diagnosed when symptoms persist for at least 6 months and cause significant deterioration in work, school, or social functioning (DSM-IV-TR). Information from family members, friends, or teachers is often important in establishing its onset.

Laboratory tests are often done to rule out substance abuse or an underlying medical, neurologic, or hormonal disorder that can have features of psychosis (DSM-IV-TR). Examples of such disorders include brain tumours, temporal lobe epilepsy, thyroid disorders, autoimmune disorders, Huntington's disease, liver disorders, and side effects of drugs (DSM-IV-TR).

People with schizophrenia have brain abnormalities that may be seen on computed tomography (CT) or magnetic resonance imaging (MRI) scans (Pearlson and Marsh, 1999). However, these abnormalities are not specific enough for a definitive diagnosis of schizophrenia.

#### 1.3.4 EPIDEMIOLOGY OF CHILDHOOD AND ADOLESCENT DISORDERS

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This study included six broad categories of childhood and adolescent mental illnesses consisting of: mood disorders, anxiety disorders, CD, ODD, ADHD as well as SUD. Frequently, children and adolescents have subclinical symptoms and problems that cut across diagnostic boundaries. For instance, children and adolescents vary in temperament. Whether a child is behaving like a typical child or has a disorder is determined by the presence of impairment and the degree of distress related to the symptoms (Martin and Volkmar, 2007). Subclinical psychiatric problems have also been shown to cause distress and are associated with later psychiatric problems (Copeland *et al.*, 2011).

Diagnosis of mental complaints or symptoms in children and adolescents differs from that in adults in three distinct ways:

- Developmental context is critically important in childhood. Behaviours that are not indicative of a disorder at a young age may indicate a serious mental illness at an older age.
- Children exist in the context of a family system, and that system has a profound effect on children's symptoms and behaviours; children living in a family troubled by domestic violence and substance abuse may superficially appear to have one or more mental disorders.
- Children often do not have the cognitive and linguistic sophistication needed to accurately describe their symptoms, and begin their assessment or treatment. Thus, evaluation tends to rely heavily on observations of other people, such as parents and teachers that are supplemented by child/adolescent self-reporting (Martin and Volkmar, 2007).

In many cases, developmental and behavioural problems such as poor academic progress, delays in language acquisition, and deficits in social skills are difficult to distinguish from those due to a mental disorder. In such cases, formal developmental and neuropsychological testing is often used as part of the evaluation process.

##### 1.3.4.1 CHILDHOOD/ADOLESCENT DEPRESSIVE DISORDERS

###### *Definitions and Diagnosis*

Depressive disorders in children and adolescents are characterized by a pervasive and abnormal mood state that consists of sadness or irritability and that is severe or persistent enough to interfere with

functioning or cause considerable distress (Martin and Volkmar, 2007). Decreased interest or pleasure in activities may be as apparent as or even more apparent than mood abnormalities (Lyon and Morgan-Judge, 2000). Physical symptoms associated with depressive disorders among children and adolescents include dizziness, feeling lethargic, malaise, aches and pains, loss of energy, loss of appetite, and psychomotor agitation (Goodyer, 1996).

#### 1.3.4.2 CHILDHOOD/ADOLESCENT ANXIETY DISORDERS

##### *Definitions and Diagnosis*

Childhood and adolescent anxiety disorders include a range of disorders such as social phobia, generalized anxiety, separation anxiety, specific phobia and obsessive compulsive disorder (OCD). While some anxiety is a normal aspect of development, if manifestations of anxiety become so exaggerated that they greatly impair functioning or cause clinically significant distress, a diagnosis of an anxiety disorder is expected in the child (Childhood Anxiety, Anxiety Disorders Association of Canada, 2007). Once a clinical diagnosis is made a thorough psychosocial history is usually provided to confirm diagnosis. Physical symptoms that anxiety causes in children can often complicate the evaluation process (Childhood Anxiety, Anxiety Disorders Association of Canada, 2007). Some of the physical symptoms exhibited by children with anxiety disorders are crying, dizziness, sleep difficulties, headaches, muscle tension, shortness of breath, choking sensation, and stomach aches (Childhood Anxiety, Anxiety Disorders Association of Canada, 2007; Martin and Volkmar, 2007). Because these are common with other physiological conditions, it can be very complicated to distinguish anxiety disorders from other physiological illnesses (Martin and Volkmar, 2007).

#### 1.3.4.3 CONDUCT DISORDER

##### *Definitions and Diagnosis*

CD consists of a recurrent or persistent pattern of behaviour that violates the rights of others or violates major age-appropriate societal norms or rules (DSM-IV-TR). The DSM-IV-TR further divides this disorder into subtypes based upon onset, either in childhood or adolescence. CD consists of 15 conduct symptoms and is diagnosed in children or adolescents who have demonstrated at least three conduct

symptoms that fall within each of four behaviours (listed below) in the previous 12 months plus at least one conduct symptom in the previous six months (DSM-IV-TR):

1. Aggression to people and animals;
  - Conduct symptoms: Often bullies, threatens, or intimidates others; often initiates physical fights; has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun); has been physically cruel to people; has been physically cruel to animals; has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery); or has forced someone into sexual activity.
2. Destruction of property;
  - Conduct symptoms: Has deliberately engaged in fire setting with the intention of causing serious damage; or has deliberately destroyed others' property (other than by fire setting).
3. Deceitfulness or theft;
  - Conduct symptoms: Has broken into someone else's house, building, or car; often lies to obtain goods or favours or to avoid obligations (i.e., "cons" others); or has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery).
4. Serious violations of rules:
  - Conduct symptoms: Often stays out at night despite parental prohibitions, beginning before age 13 years; has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period); or is often truant from school, beginning before age 13 years;

#### 1.3.4.4 OPPOSITIONAL DEFIANT DISORDER

##### *Definitions and Diagnosis*

ODD is defined by repeated acts of disobedience and having a defiant behaviour towards any authoritative figure which persists for at least six months. ODD is diagnosed when four of the following behaviours also occur frequently:

- Actively refusing to comply with requests or following rules set by adults;



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- Losing temper;
- Arguing with adults;
- Deliberately doing things to annoy others;
- Being angry or resentful;
- Being spiteful or vindictive;
- Blaming others for their own mistakes; or
- Easily being annoyed by others (DSM-IV-TR).

### 1.3.4.5 ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

#### *Definitions and Diagnosis*

Developmental disorders such as ADHD are neurologically based conditions that can interfere with the acquisition, retention, or application of specific skills or sets of information. They may involve dysfunction in attention, memory, perception, language, problem solving, or social interactions (DSM-IV-TR).

Specifically, ADHD is a syndrome of inattention, hyperactivity, and impulsivity. According to the DSM-IV-TR, there are three types of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, and combined. Diagnosis of ADHD is clinical and based on comprehensive medical, developmental, educational, and psychological evaluations. The DSM-IV-TR diagnostic criteria include nine symptoms and signs of inattention, six of hyperactivity, and three of impulsivity. Diagnosis using these criteria requires that symptoms and signs occur in at least two situations (e.g. home and school) and be present before the age of seven (DSM-IV-TR).

### 1.3.4.6 ADOLESCENT SUBSTANCE USE DISORDER (SUD)

#### *Definitions and Diagnosis*

Definitions of SUD vary widely, but in general, SUD refers to the repeated and consistent use of either alcohol or other drugs by an individual. Although the DSM-IV-TR does not distinguish between adults and adolescents in terms of the diagnosis and treatment of SUD, several studies have pointed out the limitations of using the DSM-IV-TR criteria for SUD diagnosis in adolescents, one of which being that the criteria may not allow clear differentiation between dependence and abuse (Deas *et al.*, 2005).

### 1.3.5 EPIDEMIOLOGY OF DEMENTIA

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#### ***Definitions and Diagnosis***

Dementia is a syndrome caused by a number of disorders that affect the brain. 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 conditions (Alzheimer's disease facts and figures, 2009). The most common forms of dementia are Alzheimer's disease (AD) and vascular dementia (VaD). 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 behaviour. For example: AD, Pick's disease and Creutzfeldt-Jakob Disease (CJD) (Butters *et al.*, 1998).
- **Subcortical dementia** - dementia that affects parts of the brain below the cortex; these cause changes in emotions, movement and memory. For example: Huntington's disease, Parkinson's and HIV-associated dementias (Cummings and Benson, 1984; Von Giesen *et al.*, 2005).
- **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 CJD.

Definitive diagnosis for dementia requires a post-mortem 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 validity (Blacker *et al.*, 1994). The NINCDS - ADRDA criteria require that the presence of cognitive impairment and a suspected dementia syndrome be confirmed by neuropsychological testing for a clinical diagnosis of possible or probable AD; while

histopathologic confirmation (microscopic examination of brain tissue) is required for a definitive diagnosis (McKhann *et al.*, 1984). 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.

### 1.3.6 EPIDEMIOLOGY OF SUBSTANCE USE DISORDERS

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There are several, slightly varying definitions of SUDs and the concepts that aid in defining these disorders can include tolerance or dependence (psychological and physical) (DSM-IV-TR). Tolerance may be described as the need to progressively increase a drug dose to produce the effect originally achieved with smaller doses. Alternatively, psychological dependence includes feelings of satisfaction and a desire to repeat the drug experience or to avoid the discontent of not having it (DSM-IV-TR). Physical dependence is manifested by a withdrawal (abstinence) syndrome, in which untoward physical effects occur when the drug is stopped or when its effect is counteracted by a specific antagonist (DSM-IV-TR). It is important to note that the diagnostic criteria listed in DSM-IV-TR for SUDs are applicable to adults only and not to adolescents. Although adolescents may seem similar to adults in terms of their abilities and physical size, they lag in the levels of social, emotional and cognitive growth as they continue to develop physically (American Academy of Child and Adolescent Psychiatry, 2005). Adolescents tend to be experimental in order to form their identity and during adolescence they may try using different substances. Furthermore, unlike adults, adolescents usually do not have well-defined individual and societal roles that they are responsible to fulfill (American Academy of Child and Adolescent Psychiatry, 2005). Therefore, impairment due to substance use of an adolescent cannot be determined for DSM-IV-TR diagnosis since impairment refers to the inability of an individual to fulfill their major individual and societal roles (American Academy of Child and Adolescent Psychiatry, 2005).

#### 1.3.6.1 ALCOHOL ABUSE AND DEPENDENCE

##### *Definitions and Diagnosis for Adults*

Alcohol abuse refers to a maladaptive pattern of episodic drinking that results in failure to fulfill obligations, drinking in physically hazardous situations (e.g. driving, boating), legal problems, or social and interpersonal problems without evidence of dependence (DSM-IV-TR).

Alcohol abuse requires the recognition of fewer symptoms for diagnosis when compared to the diagnostic criteria for alcohol dependence suggesting that alcohol abuse may be less severe than alcohol dependence (Davison and Neale, 1997). Alcohol dependence refers to frequent consumption of large amounts of alcohol with  $\geq 3$  of the following:

- Tolerance
- Withdrawal symptoms
- Drinking larger amounts than intended
- Persistent desire to reduce use without success
- Substantial time spent obtaining, drinking, or recovering from alcohol
- Sacrifice of other life events for drinking
- Continued use despite physical or psychological problems

Thus, alcohol abuse is only diagnosed when alcohol dependence is ruled out (DSM-IV-TR). Individuals who abuse alcohol tend to continue heavy alcohol consumption even when knowing that this can result in significant social and interpersonal problems for them.

Alcoholism is often used as an equivalent term for alcohol dependence, especially when drinking results in significant toxicity and tissue damage.

### 1.3.6.2 DRUG ABUSE AND DEPENDENCE

#### *Definitions and Diagnosis for Adults*

Similar to alcohol, drug use can result in two different disorders: drug abuse or drug dependence (DSM-IV-TR). Drug abuse has no universally accepted definition and can be broadly explained as the use of illegal drugs, or the misuse of prescription or over-the-counter drugs (DSM-IV-TR). Nonetheless, this definition does not apply to the use of nicotine or caffeine. Drug dependence (or addiction) on the other hand can be explained as the compulsive use of a substance, despite its negative or dangerous effects (DSM-IV-TR). However, a physical dependence on a substance is not always part of the definition of addiction. Some drugs do not cause addiction but they can cause physical dependence. Other drugs cause psychological dependence, without leading to physical dependence, for example cocaine. Tolerance to a drug, needing a higher dose to attain the same effect, is usually part of addiction (DSM-IV-TR). Drug abuse may involve the following:

## Life at Risk Analysis of The Impact of Mental Illness in Canada

- Using drugs, usually illegal drugs, recreationally (not for medical reasons);
- Using mind-altering drugs to relieve medical problems or symptoms without a health care practitioner's recommendation; or
- Using drugs because of a strong psychological or physical compulsion to use them.

Drug abuse is diagnosed when one of the following conditions is met due to the repeated use of a drug:

- Failing to fulfill major responsibilities either at work or home;
- Consistently having interpersonal and social problems;
- Exposing self to potentially dangerous situations such as driving or operating machinery; and
- Getting into legal problems such as traffic violations or disorderly conduct (DSM-IV-TR).

For an individual to be diagnosed with drug abuse, the drug-related problem must persist or be repeated for at least 12 months (DSM-IV-TR). The criteria for drug abuse do not include withdrawal, tolerance or a pattern of compulsive use. If the individual meets any of these excluded criteria, a diagnosis of drug dependence is made, hence drug dependence is considered to be a more severe substance-related mental disorder compared to drug abuse (DSM-IV-TR).

### 1.4 COMORBID CONDITIONS

Comorbidity refers to the concurrent presence of more than one diagnosable illness in an individual. Comorbidity can involve multiple mental illnesses, multiple chronic diseases or a combination of both. Studies have shown that people with mental illness, for example major depression, are at a higher risk for developing other mental disorders as well as physical illnesses such as OCD, panic disorder, alcohol dependence or abuse, heart disease and other circulatory problems (Weissman *et al.*, 1996). On the other hand, other studies have shown the presence of major depression in patients with migraine headaches, chronic obstructive pulmonary disease (COPD), and ulcers (Fiest *et al.*, 2011); panic disorder in patients with asthma or other respiratory diseases (Goodwin *et al.*, 2003); a high prevalence of panic disorder and depression among patients with chronic heart failure (CHF) (Muller-Tasch *et al.*, 2008); and a high rate of SUD in patients with schizophrenia and bipolar disorder (Regier *et al.* 1990; Jaworski *et al.*, 2011).

The current model includes both comorbidity among mental illnesses– (more specifically referred to as co-occurring disorders) – as well as comorbidities between mental illness and one or both of the two chronic diseases in adults that we were able to measure: type II diabetes and heart disease.

Comorbidities can either be unidirectional or bidirectional. Unidirectional comorbidities (one-way path) refer to illnesses which, when developed in an individual, increase the likelihood of another disease developing. For instance, studies have shown that patients with schizophrenia are at higher risk for the development of type II diabetes either due to the medications given for schizophrenia treatment, behaviours related to lifestyle, smoking, or a combination of these and other factors (Lin and Shuldiner, 2010; Curkendall *et al.*, 2004; Henderson *et al.*, 2006). In bidirectional comorbidities (two-way path), this effect occurs both ways hence, the development of one disease can increase the likelihood of the other disease developing and vice versa. It is thought that depression and heart disease exhibit the two-way path since depression has been shown to lead to heart disease (possibly due to the negative impact that depression has on homeostasis of the circulatory system) and patients with heart disease may also develop depression due to stressors and biochemical changes associated with the deterioration of their physical health (Fiest *et al.*, 2011).

This two-way causal path is represented in the model as a two-way interaction (see Section 2.7.2 for further details). For the purposes of the analysis, the following definitions of type II diabetes and heart disease were used:

- **Type II Diabetes Mellitus** - is a disorder that results in high blood glucose levels due to progressive insulin secretion deficiency and insulin resistance (Fuentes and Rios, 2009). The disorder is a result of interactions between genetic and environmental factors such as decreased physical activity, and higher levels of obesity (Fuentes and Rios, 2009). It accounts for 90% of all cases of diabetes (Egede and Simpson, 2003).
- **Heart Disease** - is a term that encompasses several diseases involving the heart and related circulatory vessels which reduce or prevent normal functioning. For the purposes of this study, the term heart disease is used to refer to myocardial infarction (MI), congestive heart failure (CHF), angina, heart attack and damage to either heart vessels or heart muscles through atherosclerosis (Chow *et al.*, 2005).

### **Epidemiology of Co-occurring Mental Illnesses**

Around half of the people diagnosed with a mental illness have more than one mental illness (Newman *et al.*, 1998). For the purposes of this analysis, comorbidities among the following mental illnesses were included: anxiety disorders, mood disorders, schizophrenia, childhood and adolescent disorders, dementia, and substance use disorders.

People with comorbid mental illnesses not only show more severe symptoms and longer lasting illness, but they also have higher rates of service use. One major risk factor for many comorbid mental illnesses is childhood trauma. The most prevalent comorbidity is anxiety comorbid with mood disorder, found more commonly in women. Many studies have shown that a substantial proportion of individuals who report symptoms consistent with a given DSM mental disorder also have symptoms consistent with one or more other disorders. For example, according to the National Comorbidity Survey Replication conducted in the United States, approximately 45% of people aged 18 years or older that are diagnosed with a DSM-IV mental disorder have more than one mental disorder (Kessler *et al.*, 2005).

Comorbidities also occur with mental disorders other than the ones discussed thus far. For instance, SUD has also been shown to co-occur at rates of up to 50% with schizophrenia (Duva *et al.*, 2010). Additionally, a high rate of SUD (up to 60 percent) is observed in patients who have also been diagnosed with bipolar disorder (Jaworski *et al.*, 2011). Other comorbidities within the bipolar disorder patient population include social phobia, which is found in around 10% this population, obsessive compulsive disorder which is common in 21% and panic disorder which has been reported in up to 25% of this patient population (Cassano *et al.*, 2000). Dementia is commonly noted in older patient populations of bipolar disorder (Brooks *et al.*, 2006). Patients with dementia can also be diagnosed with MDD. However, the recognition and diagnosis of MDD in this patient group is difficult due to communication problems (Verkaik *et al.*, 2009). SUD is also commonly found to be comorbid with anxiety disorders and mood disorders (de Graaf *et al.*, 2002).

Comorbidities are not only found in adults with mental illness but also in children and adolescents. There is a huge interest in comorbidities among children and adolescents as they are commonly observed within the community as well as clinical settings. Although little is known about comorbidities in younger age groups, results from the Oregon Adolescent Depression Project (OADP) showed that 70% of adolescent patients with anxiety disorders are also diagnosed with one additional mental illness

(Lewinsohn *et al.*, 1997). Similar to the comorbidity prevalence seen in adults, major depressive disorder was found to be most comorbid with anxiety disorders, with more than 50% of adolescent patients with anxiety disorders also having major depressive disorder. Alcohol abuse or dependence was reported to be comorbid with anxiety disorders in 11% of the adolescent patients. Externalizing disorders such as ADHD, ODD and CD on the other hand were also reported to be comorbid with anxiety disorders; however, their co-occurrence is often not as significant as alcohol abuse or major depressive disorder. Additional significant comorbidities noted from OADP results are: alcohol abuse/dependence with overanxious disorder, ODD with OCD, ADHD with simple phobia, and bipolar disorder with anxiety disorders which is more prevalent in males (Lewinsohn *et al.*, 1997).

Similarly, Joshi *et al.* (2010) found that approximately 21% of adolescents that had bipolar disorder also had OCD. Comorbidities are also found in adolescents and children with schizophrenia. Schizophrenia that begins in childhood is continuous within the individual as they grow older. The most common comorbidities in children with schizophrenia were ODD and ADHD. Depression is also often comorbid with schizophrenia and can affect 33% of the childhood schizophrenic patient population while anxiety can affect 22% of children with schizophrenia (Ross *et al.*, 2006). Thus a large number of comorbidities exist among the mental illnesses being discussed and these different comorbidities present themselves in children and adolescents as well adults.

### **Epidemiology of Mood Disorders Comorbid with Type II Diabetes Mellitus**

The link between type II diabetes and mood disorders has been documented since 1919. However, several well-characterized studies have been successful in showing that type II diabetes and mood disorders do co-occur at high rates (Mcintyre *et al.*, 2005). Studies have shown that 10% of patients with type II diabetes have major depression and patients with diabetes are twice as likely to develop depression when compared with people without diabetes (Egede and Simpson, 2003). The addition of major depression along with diabetes increases the complexity of the disease management plans and people inflicted with comorbidities often report lower health-related quality of life (QOL) (Egede and Ellis, 2010).

The etiology of this comorbidity is currently not well-defined; however, there are a few mechanisms that explain the relationship between type II diabetes and mood disorders such as major depression. Depression can result from the biochemical changes an individual with diabetes experiences either due



to the disease itself or its treatment. Depression may also result from the psychosocial burden experienced from living with diabetes. Along with these mechanisms, it is also proposed that depression predisposes individuals to type II diabetes due to the similarities in risk factors (Egede and Simpson, 2003). Therefore, mood disorders, in particular major depression can increase the risk of an individual developing type II diabetes, and type II diabetes can increase the risk of developing mood disorders (Egede and Ellis, 2010).

The high rate of comorbidity among these two illnesses is often due to the similar risk factors they share. The onset of type II diabetes significantly increases with age, genetic predisposition, obesity, and a lifestyle lacking physical activity. Many medications used in treating mood disorders have been documented to result in weight gain for patients. For example, Monoamine Oxidase Inhibitors (MAOIs) such as Tranylcypromine have shown to significantly decrease plasma glucose levels resulting in hypoglycemia (McIntyre *et al.*, 2005). Tricyclic antidepressants (TCAs) have also been shown to affect glucose homeostasis through blocking the reabsorption of norepinephrine and dopamine. Thus, people with mood disorders undergoing therapy have a much higher risk of clinically significant weight gain which increases their risk for type II diabetes (McIntyre *et al.*, 2005).

### **Epidemiology of Mood Disorders Comorbid with Heart Disease**

As previously mentioned, heart disease is a broad term that encompasses many chronic illnesses that affect the heart and inhibit its proper function. Mood disorders, in particular major depression, are seen in 20% to 40% of patients with cardiovascular disease (CVD); this percentage is likely to be much higher since mood disorders are often under-recognized in this patient population (Celano and Huffman, 2011). People with CVD have shown to have 2- to 3-fold higher rates of major depression when compared to the general population. The increased prevalence of mood disorder, specifically major depression, in CVD patients negatively impacts their cardiovascular outcomes, psychiatric outcomes, and recovery after a cardiac event, while it also results in increased hospitalizations and costs to the health care system. Symptoms associated with major depression are linked to the development and progression of several heart diseases and increases the risk of mortality in these patients by more than 2-fold (Celano and Huffman, 2011).

There are several physiological and behavioural factors that may contribute to the relationship between heart disease and mood disorders. Inflammation has been shown to play a role in the development of

various heart diseases as well as increasing the risk of cardiovascular mortality. Inflammatory cytokines<sup>3</sup> such as C-reactive protein (CRP) and interleukin-6 (IL-6) that contribute to heart disease are also found to increase in concentration in patients with depression, perhaps suggesting one biological connection between depression and CVD progression and cardiac outcomes (Celano and Huffman, 2011).

Depression has also been shown to have an impact on endothelial function and platelet activity in individuals with heart disease. It has been shown that individuals with depression have hyperactive platelets that are more sensitive to serotonin, making the platelets more susceptible to aggregation and in turn facilitating the progression of heart disease, in particular atherosclerosis (Celano and Huffman, 2011).

Many behavioural factors are also involved in the comorbidity of heart disease with mood disorders. As mentioned earlier, individuals with mood disorders are prone to weight gain. Significant weight gain resulting in obesity increases the chances of an individual with a mood disorder to develop heart disease (Celano and Huffman, 2011). Therefore, comorbidity can occur in both directions: individuals with heart disease have a chance of developing mood disorders and individuals with mood disorders are at risk for heart disease. Individuals with depression are less likely to complete cardiac rehabilitation programs, adhere to their medications, and maintain a healthy lifestyle through regular physical exercises and healthy eating. The safety profile of antipsychotic drugs in terms of their effect on the cardiovascular system becomes crucial when designing a treatment plan for such patients (Celano and Huffman, 2011).

### **Epidemiology of Anxiety Disorders Comorbid with Type II Diabetes Mellitus**

The link between anxiety disorders and type II diabetes remains unclear as few studies have looked into this relationship and the majority of studies have focused on the relationship between depression and type II diabetes. The most common anxiety disorder found in patients with type II diabetes is generalized anxiety disorder (GAD), which has been observed to increase the severity of the chronic illness (Grigsby *et al.*, 2002). Anxiety disorders can impact disease management, hyperglycemic control resulting in vascular complications, higher risk of mortality and increased healthcare expenditures (Fisher *et al.*, 2008). A non-interventional, longitudinal study conducted by Fisher *et al.* (2008) has

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<sup>3</sup> Inflammatory cytokines are substances produced by the immune cells to enhance the inflammatory response within the body when under threat; these cytokines play an important role in the inflammation process.

reported high rates of anxiety disorders in type II diabetics compared to the rates seen in the general population. They also observed that 50% of type II diabetics that were diagnosed with GAD also had major depression (Fisher *et al.*, 2008). The few studies that focused on studying the relationship between anxiety disorders and type II diabetes have come to different conclusions regarding the relationship between these two illnesses, highlighting the need for further in-depth studies to better understand this comorbidity.

### **Epidemiology of Anxiety Disorders Comorbid with Heart Disease**

The World Mental Health (WMH) surveys have established a strong link between anxiety disorders and CVD (Fiedorowicz *et al.*, 2011). Physiological mechanisms that are involved in the development of heart disease, in particular coronary artery disease CAD are also related to anxiety disorders (Frasure-Smith and Lesperance, 2008). Anxiety disorders such as GAD are linked to autonomic dysfunction, increased platelet activity, dysregulation, inflammation, coagulation and increased catecholamine levels<sup>4</sup> all of which lead to the development and progression of various heart diseases. Furthermore, GAD is associated with poor CHD outcomes possibly either due to the increased catecholamine levels or the possibility that the comorbid patients are more likely to avoid regular medical care and be non-compliant with their medication regimen (Martens *et al.*, 2010).

Explanations of the association between anxiety disorders and heart disease range from genetic interactions and growth patterns of an individual to behavioural factors (Martens *et al.*, 2010). Although the relationship between heart disease and anxiety is still under heavy investigation, anxiety has been shown to be a strong independent risk factor itself for CHD through several recent studies suggesting that diagnosing anxiety in an individual can act as a warning sign for increased risk of developing heart disease in the future (Roest *et al.*, 2010). GAD in particular can be an important modifiable risk factor in individuals with heart disease as it is common and can be treated. Other risk factors that may be involved in the development of this comorbidity are avoiding medical care, chronic depression, arterial stiffness, reduced physical activity, sedentary lifestyle and family history of heart disease (Roest *et al.*,

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<sup>4</sup> Catecholamines are hormones that are produced by the adrenal glands and released when the body is under physical or emotional stress.

2010; Fiedorowicz *et al.*, 2011; Seldenrijk *et al.*, 2011). Avoiding medical care may result in no treatment intervention, thus decreasing the chances of disease prevention (Martens *et al.*, 2010).

Anxiety disorders are also found to be strongly associated with increased arterial stiffness which is indicated by a higher central augmentation index. Arterial stiffness has been shown to increase with the duration and severity of anxiety disorders, which then reduces the overall health of the vasculature through a number of proposed mechanisms including an increased concentration of inflammatory cytokines (Seldenrijk *et al.*, 2011). Thus, early effective treatment of anxiety disorders may reduce the risk of developing heart disease later on in life (Seldenrijk *et al.*, 2011).

### **Epidemiology of Schizophrenia Comorbid with Type II Diabetes Mellitus**

A study by Curkendall *et al.* (2004) demonstrated a higher prevalence of type II diabetes among patients with schizophrenia compared to those without schizophrenia or other mental illness and those not on antipsychotic medication. It has been established that the high prevalence of type II diabetes within this population is related to the effects of prescribed antipsychotic medications (Irvin *et al.*, 2009).

Environmental factors, genetic variants and their interactions play an important role in the development of this comorbidity (Lin and Shuldiner, 2010). Although the general nature and fundamental interactions between genetic and environmental factors that contribute to type II diabetes comorbid with schizophrenia are unknown, several mechanisms of how type II diabetes develops in individuals with schizophrenia have been proposed. Generally individuals with schizophrenia are more likely to experience social isolation, leading to a more sedentary lifestyle, unhealthy eating habits and subsequent weight gain. Thus weight gain is possibly an important factor that leads into type II diabetes development (Curkendall *et al.*, 2004). The comorbidity then emerges when these environmental risk factors are coupled with antipsychotic drugs or genetic predisposition to type II diabetes (Lin and Shuldiner, 2010).

Genome-wide linkage and association studies have discovered genes that play an important role in the development of schizophrenia. Genes for glycogen synthase kinase 3 (GSK-3), dopamine receptor D2 (DRD2), and tyrosine hydroxylase (TH) are under vigorous investigation as they may be responsible for the comorbidity of schizophrenia and diabetes (Lin and Shuldiner, 2010). Genetic factors have been

recognized and are being further investigated to better understand the relationship between schizophrenia and diabetes.

### **Epidemiology of Schizophrenia Comorbid with Heart Disease**

Heart disease is also highly prevalent in the schizophrenic patient population. As shown in the population-based study by Curkendall *et al.* (2004), the prevalence of cardiovascular disease is significantly higher in patients with schizophrenia when compared to patients without schizophrenia or other mental illness and those not on antipsychotic medications. Both morbidity as well as mortality due to heart disease is highly prevalent in those with schizophrenia. The increased likelihood of developing cardiovascular disease is seen in both females and males suggesting that sex does not play a protective role in the formation of this comorbidity (Bresee *et al.*, 2010).

The high prevalence of heart disease in this patient population is largely due to the increased cardiovascular risk factors (Hennekens *et al.*, 2005). Higher blood cholesterol levels, hypertension, cigarette smoking, type II diabetes, other metabolic syndromes, and obesity either due to the atypical antipsychotic drugs administered to individuals or their sedentary, unhealthy lifestyle are all risk factors that increase the chances of developing heart disease in someone with schizophrenia (Hennekens *et al.*, 2005).

## **1.5 CONTINUITY OF MENTAL ILLNESSES FROM CHILDHOOD AND ADOLESCENT TO ADULTHOOD**

Mental illnesses can emerge at any point in an individual's lifetime during childhood, adolescence or adulthood. Those who develop a mental illness during either childhood or adolescence are often at a greater risk of developing another mental illness in subsequent developmental stages. More than half of adult psychiatric patients report having had a mental disorder either in their childhood or adolescence (Kessler *et al.*, 2005).

### **1.5.1 CHILDHOOD TO ADOLESCENT**

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Some of the most common mental illnesses that can manifest in a person during childhood are depression, anxiety, CD, ADHD and ODD. When the same illness persists to the next developmental period, the process are called 'homotypic continuity', and when another illness is seen in the next developmental period, the process is referred to as 'heterotypic continuity' (Orvaschel *et al.*, 1995).

### ***Homotypic Continuity***

Homotypic continuity refers to mental illnesses that are unaffected as the individual ages, thus the characteristics of such disorders is maintained and the mental illness is more likely to remain continuous (Goldberg and Goodyer, 2005). For example, anxiety in childhood tends to remain consistent and continues on to develop into adolescent anxiety as the child ages. Depression in childhood also shows homotypic continuity since it generally evolves into adolescent depression or can often develop into other mood disorders. Childhood anxiety is often associated with higher rates of major depression or other anxiety disorders in adolescence (Goodwin *et al.*, 2004; Keenan *et al.*, 2009; Caspi *et al.*, 1996; Costello *et al.*, 2003). Similarly childhood CD, ADHD and ODD if not treated, can continue to manifest into adolescence.

### ***Heterotypic Continuity***

Heterotypic continuity refers to mental illnesses that are modified by maturation processes resulting in clinically significant differences in signs and symptoms seen in the individual. The risk of a mental illness continues to persist, however, as the individual matures, one mental illness can develop into another (Goldberg and Goodyer, 2005). For instance, anxiety disorders in childhood, in particular GAD, have been shown to increase the risk of CD later in adolescence (Bittner *et al.*, 2007). Heterotypic continuities are also seen in childhood ADHD that later develops into adolescent ODD (Costello *et al.*, 2003). Children with CD or anxiety have also been reported to continue into adolescent substance abuse (Costello *et al.*, 2003).

## 1.5.2 ADOLESCENT TO ADULT

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In adolescence, the most common mental illnesses are depression, other mood disorders, anxiety, CD, ADHD, ODD, schizophrenia, other psychotic disorders, and SUD. Some mental illnesses such as depression and CD may have developed earlier in life while other illnesses such as schizophrenia and SUD begin to emerge in late adolescence or early adulthood (Os and Kapur, 2009). Similar to childhood mental illnesses, adolescent disorders also exhibit homotypic and heterotypic continuity.

### ***Homotypic Continuity***

Depression and other mood disorders tend to be homotypic when adolescents become adults. Studies such as Canals *et al.* (2002) have found that approximately 30% to 70% of adolescents diagnosed with MDD go on to develop major depressive disorder in adulthood (Rutter *et al.*, 2006; Fergusson and Woodward, 2002). This value increases to up to 80% for adolescents who are not diagnosed with major depression but exhibit depressive symptomology (Canals *et al.*, 2002). Similarly, anxiety manifested either in childhood or adolescence is homotypic and can develop into adult anxiety if not treated. Although schizophrenia often develops in late-adolescence or early-adulthood, it can also develop in childhood and continue on into adulthood (Rutter *et al.*, 2006). Adolescent SUD can also develop into adult SUD as the individual matures (Rao *et al.*, 2000).

### ***Heterotypic Continuity***

Externalizing disorders such as CD, ADHD and ODD, typically show heterotypic continuity. The Dunedin Multidisciplinary Health and Development Study (DMHDS) has shown that people who are diagnosed with CD in late-childhood or early-adolescence have an increased risk of developing any other psychiatric disorder in adulthood including schizophrenia, SUD and other internalizing as well as externalizing disorders (Rutter *et al.*, 2006). The Great Smoky Mountains Study (GSMS) has shown that people who are diagnosed with ODD in adolescence have an increased risk of developing GAD, panic disorder, and depression in adulthood (Copeland *et al.*, 2009). An association between cannabis use and schizophrenia has been implicated (Andréasson *et al.*, 1987). Beginning the use of cannabis at an early age and a long duration of cannabis use has been found to increase the risk of psychosis in adults. People who start cannabis use at around the age of 15 double their risk of developing non-affective psychosis in young adulthood (McGrath *et al.*, 2010; Fergusson *et al.*, 2003; Casadio *et al.*, 2011). Arseneault *et al.* (2002) along with several other studies also reported similar findings suggesting that cannabis use among adolescents significantly increases the risk of schizophrenia in adulthood, further solidifying the link between cannabis use and schizophrenia.

Adolescent bipolar disorder also exhibits heterotypic continuity as adolescents with bipolar disorder have a high risk of developing SUD, specifically alcohol abuse in adulthood (Merikangas *et al.*, 2008; Behrendt *et al.*, 2011; Swendsen *et al.*, 2010).

A better understanding of mental illness transitions between childhood, adolescence and adulthood is critical for early intervention, prevention and appropriate management of mental illnesses throughout one's lifetime.

## 1.6 ECONOMIC DISABILITY

The nature of the workplace in recent decades has changed dramatically. Employees are increasingly expected to perform optimally in high stress, unstable situations which can be very demanding psychologically. Canadian data on workplace disability due to mental illnesses is limited; however, a study by Wang *et al.* published in 2006 has shed some light on the prevalence of mental illness in the working population and its possible consequences. The authors found that in Alberta over 20% of the population aged 18 to 64 years has some form of work disability as a result of a mood, anxiety or substance use disorder. Mental illnesses are known to contribute to disability at the workplace as measured by work-days missed by the employees (absenteeism), lower productivity and performance while working (presenteeism) and costs associated with employee assistance programs. All contribute to an overall economic burden that translates into economic loss (Wang *et al.*, 2006).

A survey conducted by the Canadian Mental Health Association reported that around 25% of employees find their work as a major source of anxiety and stress (Canadian Mental Health Association COMPAS Survey, 2001). The level of disability caused by each mental illness included in the study was shown to depend on the severity, time of duration and other comorbidities. For instance, individuals with schizophrenia show high disability compared to other mental illnesses (World Health Organization, 2001).

Mental illness negatively impacts economic productivity in two main ways:

- It reduces the performance of the workforce; and
- It excludes many people from paid work thus reducing skills available.

In a study by Wang *et al.* (2006), researchers found that more than 20% of the workers experience some form of disability which includes daily communication, understanding, and self-care. Substantial disabilities in activities that directly impact daily work translate into lower performance and productivity. In addition, many skilled individuals seeking work are unable to find employment due to the severity of their disability. Economic disability has also been found to be much more pronounced in



those with schizophrenia worldwide. A study by Marwaha *et al.* (2007) that describes the international employment patterns for people with schizophrenia found that only 12.9% of individuals with schizophrenia in the United Kingdom were employed while 30.3% of those with schizophrenia in Germany were employed. The study concluded that a large portion of the population with schizophrenia worldwide is reliant on disability benefits or social assistance (Marwaha *et al.*, 2007).

A study by Kouzis and Eaton (1994) found that 44% of working individuals with DIS/DSM-III diagnosed depressive disorders and panic disorders reported a disability day while 40% of working individuals with schizophrenia reported a disability day. If workplace activities continue to become more complex and competitive, and the psychological pressure on employees continues to increase, the impact of mental illness in the workplace will continue to grow. In order to maintain high performance of workers, employers are encouraged to develop strategies for protecting the mental health of their workers and for ensuring early intervention and effective treatment (Wang *et al.*, 2006).

### 1.7 RISK OF MORTALITY

Mortality rates vary among different mental illnesses but generally increase for people with co-occurring mental illnesses or mental illnesses that are comorbid with chronic diseases. Cardiovascular disease on its own is the leading cause of death in Canada, which equates to 30% of all deaths as of 2006 (Statistics Canada, CANISM Table 102-0529, 2010). Type II diabetes is also one of the leading causes of death in Canada (Conference Board of Canada, 2009). An increased risk of mortality is also reported for individuals with major depression, schizophrenia, and SUD (Harris and Barraclough, 1998).

In particular, people with schizophrenia are at a higher risk of cardiovascular mortality than the general population since more than two-thirds of those with schizophrenia die of coronary heart disease, reducing their life expectancy by 20% (Hennekens *et al.*, 2005). Mortality rates from CHD are 90% higher in those with schizophrenia (Hennekens *et al.*, 2005) than in the population without schizophrenia. The higher risk may pertain to the antipsychotic drugs given to schizophrenia patients or unhealthy lifestyles that may lack physical activity (Curkendall *et al.*, 2004). Type II diabetes is another major cause of mortality within this patient population. Genetic and environmental factors as well as some treatment medications are known to be responsible for the development and progression of type II diabetes in individuals with schizophrenia; these factors may also potentially be responsible for the high mortality rates observed (Lin and Shuldiner, 2010).

SUD in general has shown to drastically increase the risk of mortality. Since the 1980s, mortality due to substance abuse has more than doubled (National Institute of Drug Abuse). Every year in Canada, 47,000 deaths are linked to substance abuse which accounts for 21% of all deaths (Regulation of Psychoactive Substances in Canada, 2007). The mortality rate for individuals with various mood disorders is often 2 to 3 times higher compared to the general population (Public Health Agency of Canada, 2002). A major portion of these high mortality rates consists of suicides.

Impact of anxiety disorders on mortality rates within the cardiovascular disease patient population is still debated as some studies show an association while others do not. However, there is growing evidence that anxiety disorders are a risk factor for heart disease (Roest *et al.*, 2010). Overall, unnatural and premature deaths are very common in individuals with a mental disorder, especially in those with schizophrenia, SUD and major depression. The risk of mortality is further increased if the individual has co-occurring mental illnesses or has a mental illness comorbid with a chronic disease.

### **Suicide**

People with mental illness have a higher risk of attempting suicide as well as dying from suicide, although the risk varies with type of mental illness. People with SUD have the highest risk of attempting suicide and completing suicide followed by those with major depression and schizophrenia (Bertolote *et al.*, 2003). A study conducted in the United States determined that more than 54% of patients with SUD attempt suicide in 2006 while lifetime suicide ideation rates are as high as 80% (Pompili M, 2009). On average, 15% of patients with major depressive disorder die by suicide (Angst *et al.*, 1999). Studies from around the world have demonstrated that people with schizophrenia are 10 to 20 times more likely to commit suicide compared to the general population (Hennekens *et al.*, 2005), which equates to 10% to 13% of that group (Pompili *et al.*, 2007). Approximately 90% of individuals who die by suicide have been shown to have had a diagnosable mental illness at some prior to their death (Mann, 2002). In Canada, suicide is one of the leading causes of death in youth and young adults (Langlois and Morrison, 2002).

The social and economic isolation suffered by mental illness patients, in particular patients with schizophrenia, may lead to the higher suicide rates observed, implying the need for people with mental illness to be provided with a strong framework of social support throughout their treatment (Taylor *et al.*, 2004). Thus the recognition, diagnosis and treatment of mental disorders are important in reducing mortality due to suicide.

## 1.8 MENTAL ILLNESS AND HOMELESSNESS

Homelessness is an issue faced by many people with mental illness throughout Canada. Mental and physical illnesses are commonly found in these populations; however, it is often difficult to track health conditions in this group (The Street Health Report, 2007). A report prepared by Parliamentary Information and Research Service (2004) estimated that 66% of homeless individuals in Toronto had been diagnosed with a mental illness at some point in their life (excluding substance abuse) while 86% of the homeless individuals in Toronto alone have a lifetime diagnosis of either mental illness or substance abuse. The annual prevalence of mental illness in the homeless population is difficult to determine and varies with estimates ranging from as low as 25% (Smith *et al.*, 1992) to a 33% (Patterson *et al.*, 2007) and up to 50% (Adams *et al.*, 1996) depending on the definitions of mental illness and homelessness. Furthermore, The Street Health Report (2007) suggests that homeless women tend to suffer more from mental illness than men, with 55% of women surveyed reporting a mental health diagnosis compared to 28% of men. Approximately 68% of homeless women in Toronto who were surveyed reported experiencing serious depression, 64% reported experiencing anxiety and 12% had attempted suicide in the past year.

Due to the lack of adequate housing and access to health care, many homeless people or those at risk of homelessness go undiagnosed and/or do not receive medical treatment for their mental illness. With the growing Canadian population, the issues of inadequate housing and homelessness are also expected to grow in magnitude.

## 2 SUMMARY OF APPROACH TO MODELING MENTAL ILLNESS IN CANADA

### 2.1 OVERVIEW OF APPROACH

#### 2.1.1 DATA COLLECTION

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An electronic search and review of the published scientific literature, government databases, reports and documents was conducted for available Canadian and international data on prevalence, incidence, mortality, health care utilization, health costs and economic disability of mental illness, as per the parameters required for the analysis within the Life at Risk model. The search was divided into sections based on diagnostic categories of mental illness, and subsets of these categories.

An initial search of broad category headings was conducted for mood disorders, anxiety disorders, childhood and adolescent disorders, psychotic disorders and dementia to identify all possible relevant studies published in English. The search was further split into Canadian sources and international sources.

PsychINFO and MedLine electronic databases were searched and supplemented with Socioabs and others and included studies and articles from 1972 up until January, 2011. For each database, the search procedure included the name of the disorder and key search words (epidemiology, incidence, mortality, prevalence, longitudinal studies, cohorts, prospective studies, relative risk, odds ratios, and comorbidity etc.). Government websites (e.g. Public Health Agency of Canada, Health Canada, etc.) were also searched to identify Government reports and a search was also conducted using meta-search engines (e.g., Google).

Once key articles relevant to the model scope and Life at Risk input data requirements were identified, a manual search of the reference list of each article was conducted, in order to ensure that the yield was comprehensive. In addition suggestions for literature sources were requested from subject matter experts at various points throughout the data collection process. The expert panel as well as staff from the MHCC further contributed various journal articles, reports and datasets from administrative databases and research studies.

Section 2.7 describes the input data used for each of the model components. A complete summary of the input data used including the data source, description, data limitations, rationale for use and

examples of other sources considered is provided in *Appendix B: Review and Validation of Base Model Assumptions and Outcomes*.

An independent panel of recognized epidemiologists, researchers and clinicians in the field of mental health was consulted throughout this project to assist with gathering key data and to provide expert validation of the epidemiological inputs, modeling approach, assumptions and life and economic model outcomes. Expert working groups were assembled for key aspects of the project including prevalence, comorbid chronic disease, economic disability, and healthcare utilization and costs. In addition, individual experts were consulted for specific topic areas such as homelessness and housing. In the case of risk transitions across the age span from childhood through to adulthood, a special expert working group that included the lead investigators from three international longitudinal cohort studies, in addition to Canadian experts, was assembled for consultation. Feedback on the appropriate population-based data sources and assumptions from the expert panel was incorporated into the base model to generate the mental illness prevalence simulation results as well as the direct and indirect economic costs of mental illness in Canada over a 30 year timeframe. Subsequently, the expert panel reviewed the reasonableness of the simulation outputs given the approach and assumptions applied.

The following sections summarize the approach, methods and assumptions for each of the Life at Risk model components.

## 2.2 OVERVIEW OF METHODOLOGY: LIFE AT RISK

RiskAnalytica's Life at Risk platform was used for all simulations for this study. The Life at Risk platform provides a flexible means to simulate demographic-based disease models, efficiently store and access input data and results, and manage intervention scenarios. The platform mathematically combines the numeric estimates of aspects like the frequency of illness, the health services used, and the effect in the workplace, with information on the characteristics (such as age and sex) of a whole population and its economy. The approach allows one to forecast what might happen in a total population, using powerful computer technology that allows the integration and use of many and multiple sources of data within a single comprehensive model. One of the most important benefits of building such a model is the subsequent ability to change some of the numeric estimates (representing some policy or service intervention) to examine what would happen in the whole population overall and over time.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

At its core, the Life at Risk modelling environment divides a population into a set of unique, non-overlapping population cells. For example, at a minimum, the population is divided by age and sex. The population can then be further divided into health states and those exposed to or not exposed to risk factors. The division of the population cells can continue until the required level of specificity is achieved. Each division of the population by a new property adds a new axis to the population divisions. Once the population is divided, the rate at which people can flow between cells is defined. For example, people can transition from a younger age-group to an older age-group or from a healthy state to a “sick” state. The transition rate between cells may be constant or it may depend upon the source population, the destination population, or external rate factors. In addition to the transitions between population cells, some processes allow a flow of people from outside the model into the population (e.g. birth or immigration), and others can remove people from the system (e.g. death or emigration).

The combined system of population cells and transition rates define a set of coupled differential equations which allows Life at Risk to evolve the system from the present day into the future. The complete state of the population can be stored at any time throughout the simulation time frame, typically at the end of each simulated year. Once the population is modelled, it can be used as the input to secondary calculations. In particular, the labour force dynamics and macroeconomic properties of the population can be calculated.

A powerful feature of the Life at Risk environment is its ability to estimate unknown historical quantities based upon the model structure and known historical data. For example, if the relative risk of incidence for a disease is unknown between two population groups, the Life at Risk platform can determine what the relative risk must be to match the total disease incidence assuming that it is known. These unknown parameters are referred to as calibration parameters.

The flexibility of the platform allows Life at Risk to simulate a wide variety of models with complicated risk factor dependence and perform detailed scenario comparisons.

### 2.3 DEMOGRAPHIC AND DISEASE MODEL

In order to completely define the model, the full set of possible population states and the transition rates between each state must be defined.

### 2.3.1 POPULATION STATES

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The population in this study was initially divided by demographic characteristics consisting of:

- Age;
- Sex; and
- Immigration status (immigrant or non-immigrant).

The population groups were then further subdivided by possible disease states. Both mental illness and chronic diseases (heart disease and type II diabetes) are included in the model and are modelled in exactly the same manner. The exact set of potential disease states depends upon age. Table 1 shows the full list of mental and chronic illnesses for each age category. The bottom row shows the total number of population groups in each age category including age, sex, immigration status and diseases. Since no population-based data on illnesses below the age of 9 years was available, the current model is based on an artificial assumption that children less than 9 years of age are always healthy with no mental illness or chronic disease. Children ages 9 to 12 (inclusive) can have up to 5 mental illnesses, with each defined as active, in remission, or never having had the disease. Note that the model also considers comorbidities among all illnesses. Adolescents have the same 5 illnesses as children plus substance use disorders. In addition, to account for increased risk of adolescent illness for those who have had a childhood illness, the adolescent population groups are also divided by previous illness status.

For adults, mental illnesses and chronic illnesses include mood disorders, anxiety disorders, schizophrenia, cognitive impairment including dementia, heart disease and type II diabetes. It is assumed that adults do not have ADHD, ODD or CD due to a lack of available estimates or data in the scope of the current project. Similar to adolescents, the adult population is also subdivided by previous adolescent illness status.

**Table 1** The population states associated with disease

<b>Childhood Conditions (Age 9-12)</b>	<b>Adolescent Conditions (Age 13-19)</b>	<b>Adult Conditions (Age 20+)</b>
Mood Disorders (Active, Remission, Never)	Mood Disorders (Active, Remission, Never)	Mood Disorders (Active, Remission, Never)
Anxiety Disorders (Active, Remission, Never)	Anxiety Disorders (Active, Remission, Never)	Anxiety Disorders (Active, Remission, Never)
	SUD (Active, Remission, Never)	SUD (Active, Remission, Never)
ADHD (Active, Remission, Never)	ADHD (Active, Remission, Never)	
ODD (Active, Remission, Never)	ODD (Active, Remission, Never)	
Conduct Disorders (Active, Remission, Never)	Conduct Disorders (Active, Remission, Never)	
	Childhood Mood (Yes, Never)	Adolescent Mood (Yes, Never)
	Childhood Anxiety (Yes, Never)	Adolescent Anxiety (Yes, Never)
	Childhood ADHD (Yes, Never)	Adolescent ADHD (Yes, Never)
	Childhood ODD (Yes, Never)	Adolescent ODD (Yes, Never)
	Childhood Conduct Disorders (Yes, Never)	Adolescent Conduct Disorders (Yes, Never)
		Adolescent SUD (Yes, Never)
		Schizophrenia (Active, Remission, Never)
		Dementia (Active, Never)
		Heart Disease (Active, Never)
		Type II Diabetes (Active, Never)
Number of Model Cells: 3,888	Number of Model Cells: 746,496	Number of Model Cells: 11,778,048

While the number of population states is large relative to the population of Canada, it is important to note that the majority of the population resides in relatively few cells and these cells are responsible for driving the dynamics of the model. For example, while the model can track an individual who has every condition in the model active at the same time, the likelihood of that occurring is negligibly small. However, for completeness, these states are included in the model.



### 2.3.2 POPULATION TRANSITIONS

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After the population states have been defined, the rate at which people move between the various states is defined. Ideally, all transition rates would be available from the literature or specific datasets. For example, if estimates from literature provided the average rate at which 20 year old males who have SUD and a history of ADHD get anxiety, that rate could be used directly in the model. Studies that collect information prospectively over time for a given total population (cohort studies) are necessary to produce such estimates. In practice, estimates from these types of studies are not available for most components of the model, or the transition rate estimates are available do not always align with the population states. To account for the misalignment between the available data and model requirements, some assumptions and auxiliary data are required to determine a complete set of transition rates and the model uses sophisticated mathematical calculations to combine them into a plausible picture. The model incorporates three categories of transition rates that reflect the impact of changes in demographics, disease, and immigration in the Canadian population

#### **Demographic Transitions**

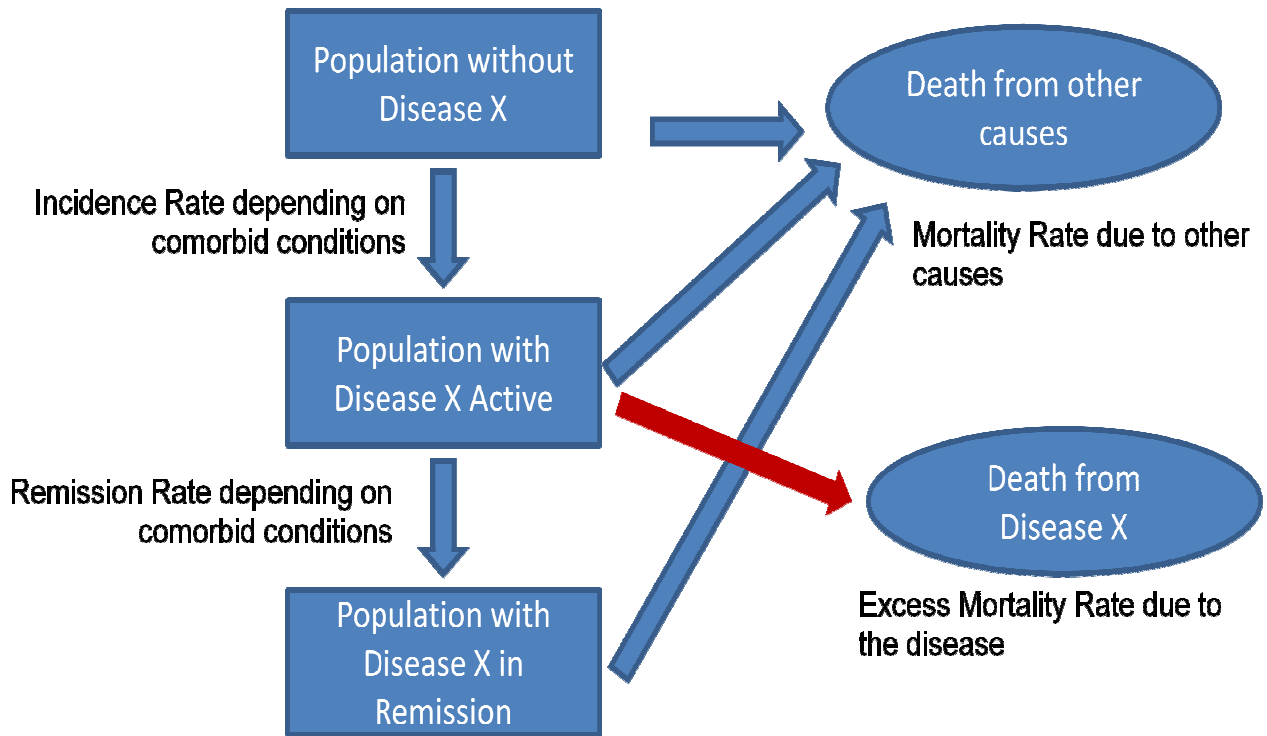
Population demographics are driven by four key processes: births, deaths, migration and aging. The birth, death and migration rates used in the Life at Risk platform are estimated from Statistics Canada Canadian Socio-Economic Information Management System (CANSIM) database. The complete list of data tables used can be found in Section 2.7 with additional details in Appendix B. Historically the all-cause mortality is decreasing as life expectancy increases and this trend is extrapolated into the future. Birth rates in the model also follow historical trends. Since migration rates tend to depend on government policy the average historical rates are used. The resulting demographic projection aligns closely with Statistics Canada's own moderate growth scenario projections. For a complete list of equations and further technical details please refer to Appendix B.

#### **Disease Incidence, Remission and Mortality**

The transitions between health states are driven by incidence and remission. The incidence and remission rates depend not only upon each disease in question, but upon any risk factors. Figure 4 schematically outlines the possible transitions associated with a single illness. This would apply to both mental and chronic illnesses, though for chronic diseases and cognitive impairment including dementia,

the remission rate is always assumed to be 0. Disease incidence is the transition from not having the disease to a state with the disease being active. Disease remission is the transition from the disease being active to being inactive.

**Figure 4** A Schematic Representation of the Progression of a Single Disease in the Model



Each disease transition can be factored into a baseline rate and relative risk factors. The baseline rate represents the incidence or remission rate that would occur once the risk factors included in the model are removed. Generally, relative risks for incidence are presented in pairs, such as the relative risk of mood disorders given heart disease. To combine the relative risks from multiple factors, the risks are combined such that the relative risks for each individual condition are maintained. For example, the relative risk of mood disorders given heart disease and previous adolescent anxiety is combined such that the average risk of mood disorders given heart disease independent of other conditions and the risk of mood disorders given previous adolescent anxiety independent of other conditions, are both maintained.

Each illness also can have a higher risk of death associated with it. As in the case for incidence and remission, the mortality rate can be factored into a baseline rate (blue arrows to Death states in Figure

4) and an increased relative risk of death given the illness (red arrow in Figure 4). In the context of mortality, the relative risk is between having the specific illness, and not having the illness. For multiple comorbid conditions, the excess risk of death is assumed to be the maximum excess risk of each illness individually.

The detailed equations used to model disease incidence, remission, and mortality can be found in Appendix C.

### **Healthy Immigrant Effect**

The prevalence of mental illness in the immigrant population is significantly lower than in those born in Canada based on CCHS data (Menezes *et al.*, 2011). Two factors are assumed to drive this difference:

1. Immigration screening reduces the prevalence of mental illness in the immigrating population;  
and
2. The incidence rate among immigrants is initially lower than those born in Canada but approaches that of native-born Canadians approximately 10 years after immigration.

This effect is included in the model by including immigration status as a risk factor for disease incidence (with a relative risk less than 1) and a bias in the immigrating population towards healthy adults. As CCHS data only includes individuals over 15 years old, and the average age in the Menezes *et al.* (2011) study was 44, it was assumed that the healthy immigrant effect only applied to adults, and not to adolescents or children. The Menezes *et al.* (2011) study did not include dementia so immigration effects are limited to anxiety, mood disorders, substance use disorders, and schizophrenia.

### **2.3.3 CALIBRATION**

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Since time series data or longitudinal trends for the prevalence of mental illness are unknown, the no-risk incidence and remission rates are calibrated to maintain constant age- and sex-specific prevalence of each illness simultaneously. For consistency, the same assumptions are applied to type II diabetes and heart disease. These no-risk rates are then used in the base model and in any future scenario analysis. The details of the calibration procedure can be found in Appendix C.2.3.

## 2.4 CHILDHOOD AND ADOLESCENT TRANSITION RISKS AND PREVALENCE

In order to ultimately model the impact of interventions targeted at young ages through the lifespan, it was necessary to make connections between disorders from childhood to adolescence and through to adulthood. Since no dataset currently exists to provide these estimates for Canadian children and youth, a meta-analysis of the transitional odds ratios (ORs) was undertaken from three longitudinal cohort studies in other countries. Leads for each of the Dunedin Multidisciplinary Health and Development Study (DMHDS), the Christchurch Health and Development Study (CHDS), and the Great Smoky Mountain Study (GSMS) were first engaged as subject matter experts and initial risk estimates were extracted from the published literature on their studies. When it was noted that many of the estimates were not comparable across published articles, the researchers agreed to re-run the relevant analyses in their datasets and provide us with tables of risk estimates for the disorders of interest (and comorbidities) for defined age groups. In particular, unadjusted ORs for the transitions between childhood (ages 9 to 12) and adolescent ages (12 to 18), and adolescent and adult illnesses (age 19 and above) were provided. Then the estimates, shown in Section 2.7.2, were submitted to meta-analysis pooling across the studies based on a random effects design used in Horwood *et al.* (2010). Specifically for each transition between early and later periods, the ORs of all available studies were first log-transformed before they were weighted and combined across the studies to obtain the overall effect size:

$$\hat{\beta} = \frac{\sum_i w_i \beta_i}{\sum_i w_i}$$

where  $\beta_i = \ln \text{OR}_i$  is the natural logarithm of OR of study  $i$ ,  $\hat{\beta}$  is the weighted average of  $\beta_i$  from each study, and  $w_i$  is the reciprocal of the sum of the within- and between- studies variances (DerSimonian and Laird, 1986):

$$w_i = (\Delta^2 + s_i^2)^{-1}$$

$\Delta^2$  is the between studies variance estimated using the Cochran's Q Statistic and  $s_i^2$  is the within study variance of  $\beta_i$ . The standard error of the estimated effect size  $\hat{\beta}$  is:

$$SE(\hat{\beta}) = \left( \sum_i w_i \right)^{-\frac{1}{2}}$$

The 95% CI of  $\hat{\beta}$  is then given by 95% CI =  $\exp(\hat{\beta} \pm 1.96SE)$

The Cochran's Q was also used to assess the non-homogeneity of the parameters across all studies. All Q values and ORs were considered significant when  $p < 0.05$ , but the total number of tests and possible spurious results attributable to multiple testing was considered by the experts in discussing and validating results.

The two developmental transitions, childhood to adolescence and adolescence to young adulthood, were analyzed separately. Unadjusted estimates, rather than adjusted estimates, were used as unadjusted estimates reflect how the transitions occur naturally in the population and in the model rather than trying to isolate causal pathways. The transitional unadjusted ORs from childhood to adolescence were available in both the GSMS and the DMHDS for the following childhood and adolescent disorders: mood, anxiety, CD, ADHD, ODD, SUD, and any (i.e. any one or more of the aforementioned illnesses). The adolescent to adult transitional unadjusted ORs were available in the GSMS, DMHDS, and CHDS, with each adolescent illness predicting the following adult disorders: mood, anxiety, SUD, and any one or more of the adult disorders.

The results of the meta-analysis are presented in Section 3.2.

The ORs from the meta-analysis were used to estimate the relative risks between the childhood, adolescent, and adult mental illnesses. In addition, the ORs provide constraints on the prevalence of childhood and adolescent conditions. If  $\Pr(K | J)$  is the probability of being diagnosed with illness K at an older age given illness J at a younger age, then the ORs are defined as:

$$OR_{J \rightarrow K} = \frac{\Pr(K | J) \Pr(\bar{K} | \bar{J})}{\Pr(\bar{K} | J) \Pr(K | \bar{J})}$$

where the bar indicates not having the illness. The relative risk is with respect to not having the younger condition. Therefore,

$$r_{J \rightarrow K} = \frac{\Pr(K | J)}{\Pr(K | \bar{J})} = (1 - \Pr(K | J))OR_{J \rightarrow K} + \Pr(K | J)$$

While the ORs are sex-independent the prevalence rates and probabilities are sex-dependent. It is assumed that the same ORs apply to males and females. Prevalence estimates for these conditions resulting from this analysis were then compared with prevalence values from other studies and reviews (shown in Table 9), including some Canadian cross-sectional survey data, and were considered to be reasonable by the experts.

## 2.5 DIRECT ECONOMIC COST MODEL

Prevalence-based cost estimates are used to estimate the direct economic costs. This method calculates total costs by associating an average cost per prevalent case. No distinction is made within the prevalent population about which individuals are driving the costs, or the specific costs of providing each unit of service. For example, if the total hospitalization cost for a given illness and the prevalence of the illness are known, the average hospitalization costs per prevalent case can be calculated. However there is no way to distinguish if the total hospitalization cost is driven by a low number of hospitalizations but high costs per hospitalization, or high hospitalization rates with low unit costs. The use of prevalence-based methods is driven by the limited availability of detailed service utilization rates for all direct cost categories in the model. However, for some services and illnesses, the utilization data are available allowing a more detailed examination of the differences between various mental illnesses.

As costs do change over time in both nominal and real terms, the effect of inflation and real cost increases are included in the direct cost model.

### 2.5.1 PREVALENCE-BASED TOTAL DIRECT COSTS

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The prevalence-based direct costs are estimated using the total prevalence of health state  $K$ ,  $P^K$  and the average per-prevalence cost service item  $i$ ,  $\mu_i^K$ . The total cost,  $T_i^K$ , is then:

$$T_i^K = \mu_i^K P^K$$

Note that in this case there is no attribution by age, sex or illness severity. In addition, the health  $K$  can be a combination of illnesses. In particular, as shown in Section 2.7.3, historical total costs data are only available for mental illnesses excluding dementia as an aggregate category allowing one to estimate the per case costs for those illnesses. For dementia, per prevalent case costs are available.

Given historical estimates of the total costs and prevalence rates, the average per prevalent cost can be calculated. Under the base model assumption, the average per prevalent case costs are assumed only to change due to inflation and real cost increases as described in Section 2.5.2. In the base model, there are no assumptions about changes in treatment or technology which may alter future costs.

The total prevalence-based direct costs are the sum of the direct costs due to dementia and the direct costs due to all other mental illness excluding dementia.

## 2.5.2 COST FACTORS

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Several economic factors, unrelated to the specifics of a disease, influence how costs will change in the future. In particular, in order to estimate the future nominal costs, the real rate of cost increases and the rate of inflation must be included. If  $c_0$  is the cost in current dollars, the nominal value  $t$  years in the future is then:

$$c_t^{FV} = c_0(1+r)^t(1+i)^t$$

where  $r$  is the real rate of increase,  $i$  is the inflation rate. The present values of the future costs are then discounted at the discount rate  $d$ :

$$c_t^{PV} = c_t^{FV}(1+d)^{-t}$$

Projected real rate of cost increases are adopted from the Conference Board of Canada (Conference Board of Canada, 2005), and can depend upon the type of cost being considered. For example, the real rate of increase in medication costs may differ from the real rate of increase in physician costs. In the base case, a future inflation rate of 2% is assumed. Real rates of increase range from 2.2% to 2.9% depending upon the cost category and are presented in Section 2.7.3. In the case that cost estimates come from earlier years, the historical inflation rate is used to bring costs up to 2011. Refer to Appendix C.3.1 for the historical inflation rate data source. In order to test the projected costs to the sensitivity of the adopted inflation and discount rates, costs are also calculated using an inflation rate of 4%, and discount rates of 0% and 5%.

### 2.5.3 HOMELESSNESS AND HOSPITALIZATIONS

The housing status of an individual affects both the likelihood of requiring services, and the costs associated with providing required services. Data do not exist for the full range of direct costs included in the full analysis presented in the previous section with the exception of hospitalizations. Therefore, based on the results from the full model, an analysis examining the connection between homelessness and hospitalizations, based on studies done in Toronto, was implemented. The data and assumptions used to estimate these values are shown in Section 2.7.3. Given the probabilities of homelessness, mental illness, and mental illness given homelessness, the hospitalization costs associated with homelessness can be estimated.

The probability of an individual being homeless given a mental illness can be estimated using:

$$\Pr(\text{Homeless} | \text{MI}) = \Pr(\text{MI} | \text{Homeless}) \frac{\Pr(\text{Homeless})}{\Pr(\text{MI})}$$

The total annual cost of hospitalizations,  $H$ , is the sum of the costs driven by the homeless population with mental illness,  $P_{\text{Homeless}}^{\text{MI}}$ , and the housed population with mental illness,  $P_{\text{Housed}}^{\text{MI}}$ ,

$$H = \mu_{\text{Homeless}} P_{\text{Homeless}}^{\text{MI}} + \mu_{\text{Housed}} P_{\text{Housed}}^{\text{MI}}$$

where  $\mu_{\text{Homeless}}$  and  $\mu_{\text{Housed}}$  are the average annual hospitalization costs for those homeless and housed respectively. Using  $\mu_{\text{Homeless}} = 1.65\mu_{\text{Housed}}$  which accounts for both the excess utilization rates and greater costs for homeless individuals, the total hospitalization costs for each group can be calculated.

## 2.6 INDIRECT ECONOMIC COST MODEL

The labour force dynamics and macro-economic impact analysis examines the impact of the disease on the labour force and estimates the indirect cost of disease in the economy through a frictional cost model. In a frictional cost model, each population state has an associated economic disability which indicates the fraction of time that a person in that cell is unable to work due to the illness. This economic disability reduces the productivity of an employee compared to a healthy individual resulting in an overall loss of economic production. The frictions induced in the economy due to having to hire and train a replacement when the disability of an individual increases, or an individual leaves the labour



force through early retirement or death affects the productivity of the economy. This productivity impact cascades through the economy affecting total wages paid, corporate profits, government tax revenue, total gross domestic product, and the demand for future employees. Lower levels of economic disability result in greater economic growth which is amplified through compounding effects where a more productive economy grows faster.

The impact of altering the economic disability associated with a disease, or by preventing disease entirely, can then be estimated. A key metric to measure the burden of a disease or the impacts of a scenario upon the economy is to look at its impact on total wages paid in the economy.

The magnitude of the economic disability for mental illness can be estimated from the full and partial disability days incurred by those with mental illness in the labour force. Based upon the number of days of worked missed, the economic disability relative to healthy individuals can be determined.

In order to estimate the impact of mental illness on the economy, all mental illnesses were removed from the population setting the prevalence and no-risk incidence rates after 2011 to zero. When mental illnesses are removed, the economy will respond with rapid growth as the productivity increased due to the reduced disability in the labour force. Note that the prevalence and no-risk incidence of type II diabetes and heart disease remained unaltered. The average change in total wages earned provides an estimate of the burden of the disease on the economy. Similarly, the impact of health interventions changes the total wages earned in the economy. Note that the impact on wages is not solely due to unearned wages because of the illness, but also reflects the compounding nature of productivity in the economy.

The annual indirect economic impact is estimated as the average of the present value of the cumulative economic impact over the course of the simulation. Further details of the macro-economic model can be found in Appendix C.3.

## 2.7 MODEL: DATA SOURCES AND ASSUMPTIONS

Sections 2.7.1 to 2.7.3 outline the input data sources used and key assumptions for population demographics, prevalence, incidence, mortality, risk factors, and direct and indirect costs. For further details on the data sources used and the rationale for use please refer to Table 39 in Appendix B.

### 2.7.1 POPULATION DEMOGRAPHICS

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The demographic data used to determine birth, death, and migration rates are from Statistics Canada and summarized in Table 2. The historical trends in births, deaths and migration are extrapolated to model the future population growth.

### 2.7.2 PREVALENCE, INCIDENCE AND MORTALITY

---

This section summarizes the input data sources and key assumptions for the prevalence, mortality and incidence of adult mental illnesses as well as inputs used for heart disease and type II diabetes.

The Ontario Health Survey Mental Health Supplement (OHS-MHS, 1990) was used in our model to estimate adult prevalence from ages 19 to 64. Trends based on administrative data for the population of Manitoba from the Manitoba Centre for Health Policy's report on *Patterns of Regional mental Illness Disorder Diagnoses and Service Use in Manitoba: A Population Based Study* (Martens *et al.*, 2004) report were used to estimate the prevalence for mood and anxiety disorders for ages greater than 65. Note that the Martens *et al.*, (2004) data include only 5-year prevalence which was assumed to be a good initial estimate of the lifetime prevalence. The model tracks 12-month prevalence and those who are in remission for each disease. The lifetime prevalence is the combination of those two categories. For schizophrenia only lifetime prevalence estimates were available and the split of the lifetime prevalence into 12-month prevalence and permanent remission was estimated based on the meta-analysis by Goldner *et al.* (2002). Age and sex dependent splits were not available so the same ratio was assumed for all ages and both sexes. For all mental illnesses, the lifetime prevalence rates were corrected for recall bias (Moffitt *et al.*, 2010) and incompleteness by requiring that the mortality-corrected lifetime prevalence rate monotonically increased with age. The excess risk of death for mental illness was assumed to be age and sex independent. The excess risk for death for type II diabetes depended upon sex only, while the excess risk due to heart disease depended upon age only. These assumptions were necessary because of the lack of finer resolution data.

**Table 2** Demographic Data Inputs

Variable	Description	CANSIM Table Number
Population	The population of Canada by age and sex	051-0001
Births	The number of births in Canada by sex	051-0013
Deaths	Number of deaths in Canada by age and sex	051-0002
Immigration	Immigration into Canada by age and sex	051-0012
Emigration	Emigration from Canada by age and sex	051-0012

Comorbidities among mental illnesses were estimated based on Martens *et al.* (2004). Since the Manitoba report does not include comorbidity data stratified by age or sex, the same age and sex independent comorbidity ratios were used.

As outlined in Section 1.4, there is a two-way interaction between mental illnesses and type II diabetes and heart disease. The relative risk estimates associated with this two-way interaction are outlined in the tables below. Table 4 provides the relative risk estimates used for the incidence of heart disease and type II diabetes associated with each of the adult mental illnesses in the model and Table 5 provides the relative risk estimates used for the incidence of mental illness given heart disease and type II diabetes. The relative risks reported in Rehm *et al.* (2010) are for alcohol abuse/dependence but since alcohol abuse/dependence accounts for more than 90% of all SUDs, it was assumed that the relative risk estimates would be a reasonable approximation for all SUD cases. For prevalent mood and anxiety disorders, it was assumed that the same relative risk of incidence would apply to both chronic diseases.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 3** Adult Input Data: Prevalence, Mortality, and Incidence

Illness	Prevalence Data Inputs	Mortality Risk		Incidence Data Inputs
		Data Inputs	Relative Risk of Mortality	
Adult Mood Disorders	OHS-MHS (1990)*	Harris and Barraclough (1998)	RR = 1.7	Bijl <i>et al.</i> (2002)
Adult Anxiety Disorders	OHS-MHS (1990)	Harris and Barraclough (1998)	RR = 3.4	Bijl <i>et al.</i> (2002)
Schizophrenia	Martens <i>et al.</i> (2004)** Goldner <i>et al.</i> (2002)	Harris and Barraclough (1998)	RR = 1.6	Bijl <i>et al.</i> (2002)
Adult SUD	Rehm <i>et al.</i> (2011) <sup>5</sup>	Harris and Barraclough (1998)	RR=2	Bijl <i>et al.</i> (2002)
Cognitive Impairment Including Dementia	Martens <i>et al.</i> (2004)	Harris and Barraclough (1998)	RR=2.2	Canadian Study of Health and Aging Working Group (2000)***
Heart Disease	Chow <i>et al.</i> (2004)	Statistics Canada CANSIM Table 102-0524	RR=3.22 for those less than 50, RR=1.86 for those older than 50	N/A
Type II Diabetes	NDSS	Statistics Canada 102-0524	RR=1.83 for females, RR=1.43 for males	NDSS****

\* OHS-MHS (1990): Ontario Health Survey Mental Health Supplement

\*\* Martens *et al.* (2004)- Manitoba Centre for Health Policy

\*\*\* Canadian Study of Health and Aging Working Group (2000): 1991 Canadian Study of Health and Aging

\*\*\*\*NDSS: National Diabetes Surveillance System

**Table 4** Relative Risk Estimates for Incidence of Heart Disease and Type II Diabetes Associated with Adult Mental Illnesses

Prevalent Mental Illness	Relative Risk of:	
	Heart Disease	Type II Diabetes
Adult Mood Disorders	Rugulies (2002): RR = 1.64	Relative risk estimate assumed to be 1.64
Adult Anxiety Disorders	Relative risk estimate assumed to be 1.64	Relative risk estimate assumed to be 1.64
Schizophrenia	Curkendall <i>et al.</i> (2004): RR = 1.2	Curkendall <i>et al.</i> (2004): RR = 1.8
Adult SUD	Rehm <i>et al.</i> (2010): RR=1.01	Rehm <i>et al.</i> (2010): RR=1.45
Cognitive Impairment Including Dementia	Assumed to be no excess risk	Assumed to be no excess risk

<sup>5</sup> Within the model SUDs are comprised of substance dependence and/or abuse of: alcohol, cannabis, opioids (heroin and non-medical prescription opioids), cocaine, amphetamine/methamphetamine, and sedatives/tranquillizers.

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**Table 5** Relative Risk Estimates for Incidence of Adult Mental Illness Associated with Heart Disease and Type II Diabetes

Prevalence Chronic Disease	Relative Risk of:				
	Adult Mood Disorders	Anxiety Disorders	Schizophrenia	Adult SUD	Cognitive Impairment Including Dementia
<b>Heart Disease</b>	Patten (2005): RR = 1.4	Assumed to be 1.4	Assumed to be 1	Assumed to be 1	Assumed to be 1
<b>Type II Diabetes</b>	Assumed to be 1.4	Assumed to be 1.4	Assumed to be 1	Assumed to be 1	Ahluoto <i>et al.</i> (2010): RR=1.77

**Table 6** Odds Ratio Estimates for Prevalence of Mental Illness Associated with Immigration Status from Menezes *et al.* (2011)

Chronic Disease	Adult Mood Disorders	Anxiety Disorders	Schizophrenia	Adult SUD	Cognitive Impairment Including Dementia	Childhood/Adolescent Disorders
<b>Immigrant Status</b>	OR= 0.760	OR= 0.667	OR= 0.538	OR= 0.472	Assumed to be 1	Assumed to be 1

Similarly, the relative risks of mood or anxiety disorders given heart disease or type II diabetes were assumed to be the same for both chronic diseases.

Menezes *et al.* (2011) provides the odds ratios, but not the relative risks, used to incorporate the healthy immigrant effect into the model. The prevalence of mental illness in a random cross-section of the population from the Canadian Community Health Survey (CCHS 1.2) was shown to be significantly less in the immigrant population compared to the non-immigrant population. This included all immigrants, regardless of length of time since immigration. Table 6 summarizes the reported ORs. For mental illnesses not included in the study, the odds ratio was assumed to be 1. In addition, since CCHS 1.2 only includes individuals greater than 15 years old, and the mean age in Menezes *et al.* (2011) was 44 years old, it was assumed that the immigration bias only applies to adults. No immigration bias was applied to children or adolescents, or seniors with dementia.

As described in Section 2.4, the relative risks for the incidence of mental illness given childhood or adolescent illness, were estimated from a meta-analysis of the pooled odds ratios from three longitudinal cohort studies (DMHDS, CHDS, and GSMS). Table 7 shows the cohort odds ratios for childhood to adolescent transitions and Table 8 shows the cohort odds ratios for adolescent to adult transitions. As a sensitivity test, the DMHDS childhood data was classified using both DSM and Top 5% criteria. The top 5% refers to those in the cohort who score in the top 5% of the alignment of symptoms

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to diagnostic criteria even though they may not satisfy all the criteria for a DSM diagnosis. The final analysis used the top 5% criteria data, based on expert opinion that the results from that analysis reflected more plausible risk estimates. The results of the meta-analysis and the resulting relative risks are presented in Section 3.2.

The results of the meta-analysis were used to constrain the prevalence of childhood and adolescent mental illnesses. Prevalence estimates, shown in Table 9, for childhood and adolescent mental illness were also used as additional constraints. In addition, Table 10 shows the average male to female prevalence ratios used to estimate the sex-dependent prevalence rates. The ratios are based on the CHDS (Fergusson *et al.*, 1993) and GSMS (Costello *et al.*, 2003) data, with the exception of conduct disorders and ODD which are from GSMS only. Note that the SUD data from Rehm *et al.* (2011) includes prevalence stratified by age-group and sex.

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**Table 7** Odds Ratios and 95% Confidence Intervals for Incidence of Adolescent Mental Illness Given Previous Childhood Mental Illness (A: GSMS, B1: DMHDS Top 5%, B2: DMHDS DSM)

Mental Illness	Adolescent Mood Disorders	Adolescent Anxiety Disorders	Adolescent CD
Childhood Mood Disorders	A: 6.64 (2.39-18.46) B1: 2.64 (1.4 - 5.1) B2: 1.57 (0.5-5.1)	A: 8.35 (2.58-26.98) B1: 1.98 (1.0 - 3.7) B2: 1.54 (0.5-4.8)	A: 3.92 (0.92-16.61) B1: 3.48 (1.8 – 6.6) B2: 16.8 (4.6-61.0)
Childhood Anxiety Disorders	A: 3.40 (1.44-8.02) B1: 2.91 (1.5 – 5.6) B2: 1.61 (0.9-3.0)	A: 4.81 (1.93-12.02) B1:2.60 (1.3 - 5.0) B2: 2.65 (1.5-4.6)	A: 3.03 (1.17-7.84) B1:1.97 (1.0 – 4.0) B2: 1.92 (1.1-3.5)
Childhood CD	A: 1.01 (0.40-2.53) B1: 1.46 (0.6 – 3.3) B2: 2.69 (1.2-6.1)	A: 0.70 (0.25-1.95) B1: 1.46 (0.7 – 3.2) B2: 1.78 (0.8-4.1)	A: 12.39 (5.33-28.78) B1: 4.04 (2.0 – 8.3) B2: 4.58 (2.1-10.1)
Childhood ADHD	A: 2.32 (0.58-9.22) B1: 1.98 (1.0-3.8) B2: 0.8 (0.4-1.7)	A: 1.14 (0.40-3.31) B1: 1.99 (1.1 - 3.8) B2: 1.24 (0.7-2.3)	A: 1.00 (0.35-2.86) B1: 3.20 (1.7 - 6.0) B2: 6.72 (3.8-12.0)
Childhood ODD	A: 4.00 (1.78-8.97) B1: 1.48 (0.7 - 3.0) B2: 1.54 (0.8-3.1)	A: 4.24 (1.52-11.89) B1: 1.76 (0.9 - 3.4) B2: 1.50 (0.8-2.9)	A: 3.50 (1.59-7.71) B1: 3.33 (1.8 - 6.3) B2: 3.79 (2.0-7.0)
	Adolescent ADHD	Adolescent ODD	Adolescent SUD
Childhood Mood Disorders	A: 8.92 (2.42-32.83) B1: 4.39 (1.7 - 11.3) B2: 13.97 (4.4-44.3)	A: 3.84 (1.61-9.13) B1: 5.34 (1.9 - 15.3) B2: 5.94 (1.2-28.7)	A: 3.16 (0.94-10.60) B1: 2.88 (1.5 - 5.6) B2: 4.03 (1.3-12.2)
Childhood Anxiety Disorders	A: 3.00 (0.85-10.52) B1: 7.31 (3.0 - 17.6) B2: 6.31 (2.8-13.6)	A: 1.71 (0.83-3.52) B1: 4.71 (1.5 - 14.8) B2: 3.79 (1.4-10.7)	A: 1.28 (0.47-3.52) B1: 1.47 (0.7 - 3.2) B2: 1.18 (0.6-2.3)
Childhood CD	A: 13.87 (5.23-36.77) B1: 7.97 (3.1 - 20.2) B2: 7.32 (2.7-19.5)	A: 4.04 (1.91-8.56) B1: 2.64 (0.6 – 11.9) B2: 5.43 (1.5-20.0)	A: 2.37 (1.15-4.88) B1: 1.87 (0.8-4.3) B2: 2.85 (1.2-6.7)
Childhood ADHD	A: 25.06 (9.06-69.33) B1: 11.18 (5.0 - 25.1) B2: 30.52 (14.2-65.7)	A: 5.26 (2.09-13.22) B1: 5.54 (1.9 - 15.8) B2: 5.19 (2.0-13.8)	A: 0.60 (0.21-1.68) B1: 2.70 (1.4 - 5.2) B2: 2.38 (1.3-4.4)
Childhood ODD	A: 4.99 (1.48-16.89) B1: 5.39 (2.2 - 13.3) B2: 7.23 (3.1-16.7)	A: 6.52 (3.34-12.73) B1: 2.90 (0.8 - 10.3) B2: 5.37 (1.9-15.3)	A: 1.78 (0.85-3.73) B1: 1.97 (1.0 - 4.0) B2: 3.04 (1.6-5.8)

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**Table 8** Odds Ratios and 95% Confidence Intervals for Incidence of Adult Mental Illness Given Previous Adolescent Mental Illness (A: GSMS, B: DMHDS, C: CHDS)

Mental Illness	Adult Mood Disorders	Adult Anxiety Disorders	Adult SUD
Adolescent Mood Disorders	A: 2.63 (1.04-6.68) B: 3.40 (2.5 – 4.7) C: 3.49 (2.63-4.64)	A: 8.14 (4.25-15.60) B: 2.62 (1.9 – 3.6) C: 2.90 (2.18-3.85)	A: 1.81 (0.99-3.30) B: 1.94 (1.4 – 2.7) C: 1.02 (0.78-1.33)
Adolescent Anxiety Disorders	A: 2.41 (0.91-6.35) B: 3.27 (2.4 – 4.4) C: 2.07 (1.58-2.70)	A: 6.16 (3.02-12.59) B: 4.28 (3.2 – 5.8) C: 3.15 (2.39-4.16)	A: 0.71 (0.35-1.45) B: 0.99 (0.7 – 1.3) C: 1.19 (0.92-1.55)
Adolescent CD	A: 3.10 (1.13-8.49) B: 1.33 (1.0 – 1.9) C: 2.09 (1.42-3.10)	A: 2.93 (1.38-6.24) B: 1.76 (1.3 – 2.5) C: 1.86 (1.26-2.75)	A: 2.29 (1.30-4.02) B: 5.66 (4.0 – 8.1) C: 5.61 (3.44-9.16)
Adolescent ADHD	A: 1.66 (0.47-5.86) B: 0.65 (0.3 – 1.4) C: 1.77 (1.06-2.94)	A: 1.51 (0.54-4.22) B: 2.69 (1.3 – 5.5) C: 2.59 (1.55 - 4.32)	A: 2.04 (0.86-4.86) B: 3.80 (1.9 – 7.6) C: 2.77 (1.58-4.84)
Adolescent ODD	A: 4.36 (2.02-9.44) B: 1.37 (0.6 – 3.1) C: 1.88 (1.32-2.68)	A: 6.12 (3.32-11.28) B: 2.83 (1.2 – 6.7) C: 1.97 (1.38-2.81)	A: 2.20 (1.31-3.70) B: 2.07 (0.9 – 4.7) C: 2.24 (1.55-3.24)
Adolescent SUD	A: 3.34 (1.36-8.19) B: 1.55 (1.1 – 2.2) C: 2.08 (1.58-2.75)	A: 2.47 (1.17-5.20) B: 1.82 (1.3 – 2.5) C: 1.51 (1.14-2.01)	A: 3.71 (2.10-6.58) B: 7.31 (5.1 – 10.6) C: 6.42 (4.65-8.87)

**Table 9** Summary of Childhood and Adolescent Mental Illness Prevalence Used as Constraints

Illness/Study	CHDS [Fergusson <i>et al.</i> 1993]	DMHDS [Kim-Cohen <i>et al.</i> 2003]	GSMS [Costello <i>et al.</i> 2003]	Waddell (2002)	QCMHS [Breton <i>et al.</i> 99]	Alberta [unpub. data from Svenson 2010]	CMHO Conduct Disorder Review, 2001	
<b>Estimator and sample</b>	Latent class estimates: self [S] and maternal [M] reports at 15 years	Fraction of cohort at 26 & first diagnosis < 18 years	Cumulative prevalence by 16 years	3 month prev., 9-16 yrs	Literature Review, requiring impairment, 4-17 years	Six-month prevalence, 6-14 years [avg. as in W02] [*]	Past-year treated prevalence, < 19 years	
<b>Mood disorders</b>	7.8%	13.4%	9.5% (±1.1%)	2.2% (1.6-3.0)	3.5% (1.0-7.1)	2.6%	6.3%	
<b>Anxiety disorders</b>	10.7%	19.9%	9.9% (±1.5%)	2.4% (1.8-3.1)	6.4% (4.2-9.2)	7.0% [**]	10.2%	
<b>Alcohol dependence or abuse</b>	5.2%	13.2% , 3.2%, 7.6% [d]	12.2% (±0.6%) [CAPA]	2.4% (1.8-3.1) [CAPA]	0.8% (0.5-1.3) [CAPA]		0.3% [d] 1.1%	
<b>ADHD</b>	2.8%		4.1% (±0.7%)	0.9% (0.6-1.2)	4.8% (2.7-7.3)	5.5%	10.7%	
<b>Conduct Disorder</b>	8.1%	S 3.2%(±1.1) M 3.3%(±1.1)	9.0% (±1.2%)	2.7% (2.1-3.5)	4.2% (2.4-6.5)	1.1%	3.2%	1.5%-3.4%
<b>ODD</b>		S 5.1%(±1.4) M 1.8%(±0.8)	11.3% (±1.0%)	2.7% (2.2-3.3)		2.8%		

[\*] Average of multiple informants: child, teacher (where available) and parent, with parental informant requiring impairment

[\*\*] Requiring impairment decreases anxiety prevalence by 50-70%; effects on other disorders are modest

[d] Dependence only, for alcohol, drug, and marijuana respectively



**Table 10** Average Male to Female Prevalence Ratio for Childhood and Adolescent Mental Illnesses

Mental Illness	Average Ratio of Male to Female Prevalence
Mood Disorders	0.44
Anxiety Disorders	0.45
Conduct Disorders	2.4
ADHD	6.7
ODD	1.3

### 2.7.3 DIRECT ECONOMIC COSTS

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As explained in Section 2.5, the direct economic costs can be calculated either using the prevalence-based methods or more detailed utilization-based methods. In this model, both approaches were used and reconciled mathematically where possible.

#### Prevalence-Based Costs

Table 11 provides the input data based on Jacobs *et al.* (2010) that were used for estimating the direct costs per prevalence case excluding cognitive impairment including dementia. These costs include both health care related costs, and non-health care related costs. The dark grey cells highlight where Jacobs *et al.* (2010) were unable to obtain provincial data. To gain a better estimate of the total cost, these values are estimated from the reported values on an average per capita basis. For example, employment support is only reported for PEI, Quebec, Manitoba, and British Columbia. The average per capita costs from each of these provinces was then applied to the missing provinces to estimate the costs. A sensitivity analysis of estimation, using maximum and minimum provincial per capita costs, and a comparison to other reported provincial costs was also completed and the results are provided in Appendix E.

As the direct costs from Jacobs *et al.* (2010) are in 2007 dollars, the costs are adjusted to account for inflation and real cost increases.

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**Table 11** Total Direct Cost Input Data by Service Type and Province in Millions (2007/2008) based upon Jacobs *et al.* (2010)

Services	NFLD	PEI	NS	NB	QC	ON	MB	SK	AB	BC	Total
Inpatient Total	\$58.79	\$16.00	\$67.35	\$82.46	\$737.20	\$1,067.29	\$135.79	\$65.79	\$359.73	\$327.98	\$2,918.37
Inpatient: General Hospitals	\$24.90	\$10.10	\$46.20	\$68.10	\$487.30	\$475.60	\$106.90	\$49.80	\$199.10	\$249.40	\$1,717.40
Inpatient: Psychiatric Hosp.	\$31.00	\$5.10	\$15.80	\$10.10	\$205.40	\$518.00	\$22.00	\$10.20	\$140.20	\$53.60	\$1,011.40
Long Term Care	\$2.89	\$0.80	\$5.35	\$4.26	\$44.50	\$73.69	\$6.89	\$5.79	\$20.43	\$24.98	\$189.57
Physician Total	\$14.80	\$4.80	\$19.90	\$23.20	\$248.80	\$787.20	\$38.90	\$30.60	\$199.60	\$204.98	\$1,572.78
GP – Fee for Service	\$1.10	\$0.90	\$0.30	\$4.20	\$51.20	\$181.20	\$3.10	\$8.30	\$46.90	\$29.00	\$326.20
Specialist – Fee for Service	\$5.20	\$0.70	\$7.30	\$5.80	\$83.90	\$320.60	\$23.90	\$8.60	\$87.10	\$95.80	\$638.90
Psychiatrist – Alt. Payments	\$8.50	\$3.20	\$12.30	\$13.20	\$113.70	\$285.40	\$11.90	\$13.70	\$65.60	\$80.18	\$607.68
Comm. and Social Services	\$87.31	\$26.09	\$96.84	\$105.62	\$1,252.77	\$1,930.96	\$179.71	\$186.00	\$509.17	\$595.31	\$4,969.78
Outpatient – ER Rooms	\$1.98	\$0.55	\$3.66	\$2.91	\$30.23	\$46.00	\$4.71	\$3.96	\$19.20	\$17.09	\$130.29
Community Mental Health	\$27.17	\$6.90	\$32.40	\$32.40	\$65.40	\$661.90	\$44.00	\$49.10	\$103.80	\$234.41	\$1,725.09
Supportive Housing	\$18.18	\$5.00	\$33.59	\$26.75	\$277.48	\$462.80	\$43.25	\$36.37	\$128.34	\$156.90	\$1,188.67
Employment Support	\$0.96	\$1.80	\$1.78	\$1.42	\$5.40	\$24.56	\$2.40	\$1.93	\$6.81	\$6.20	\$53.27
Other Support	\$17.22	\$4.74	\$31.81	\$25.33	\$262.76	\$506.70	\$40.95	\$34.44	\$121.52	\$80.00	\$1,125.47
Addictions Services	\$9.19	\$7.10	\$26.00	\$16.80	\$99.80	\$196.40	\$22.30	\$40.70	\$102.00	\$79.31	\$599.60
First Nations:	\$12.60	(total for NF, PE, NS, NB)			\$11.70	\$32.60	\$22.10	\$19.50	\$27.50	\$21.40	\$147.40
Pharmaceuticals	\$42.20	\$13.30	\$95.20	\$77.80	\$785.00	\$984.40	\$99.20	\$68.20	\$293.30	\$356.30	\$2,814.90
Public	\$15.90	\$4.40	\$38.10	\$26.00	\$391.70	\$443.00	\$46.90	\$35.80	\$133.70	\$140.00	\$1,275.50
Private	\$26.30	\$8.90	\$51.80	\$51.80	\$393.30	\$541.40	\$52.30	\$32.40	\$159.60	\$216.30	\$1,539.40
Other Services	\$28.05	\$8.41	\$50.46	\$39.58	\$413.64	\$792.18	\$65.64	\$70.31	\$255.13	\$239.45	\$1,962.84
Non-Profits	\$2.50	\$1.20	\$2.30	\$1.20	\$13.50	\$125.90	\$3.30	\$17.80	\$68.00	\$13.40	\$249.10
Other Housing	\$5.84	\$1.61	\$10.79	\$8.59	\$89.14	\$148.67	\$13.89	\$11.68	\$41.23	\$50.60	\$382.03
Educ. Mental Health Service	\$16.71	\$4.60	\$30.87	\$24.59	\$255.01	\$425.31	\$39.74	\$33.42	\$118.00	\$144.15	\$1,092.40
Employee Assistance Plans	\$3.00	\$1.00	\$6.50	\$5.20	\$56.00	\$92.30	\$8.70	\$7.40	\$27.90	\$31.30	\$239.30
Income Support	\$29.80	\$13.60	\$108.50	\$75.68	\$213.90	\$1,459.80	\$101.20	\$28.00	\$283.09	\$391.51	\$4,245.08
Canada Pension Plan – Disability	\$22.50	\$8.20	\$58.10	\$35.70	\$4.00	\$474.70	\$37.50	\$17.00	\$89.80	\$146.90	\$894.40
Workers Compensation	\$0.00	N/A	\$0.20	\$0.00	\$15.40	\$4.90	\$0.50	\$2.60	\$1.50	\$10.20	\$35.30
Provincial Income Support	\$7.30	\$5.40	\$50.20	\$39.98	\$194.50	\$980.20	\$63.20	\$8.40	\$191.79	\$234.41	\$1,775.38
Priv. Long Term Disability	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	\$1,300.00
Priv. Short Term Disability	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	\$240.00
<b>Total</b>	<b>\$260.95</b>	<b>\$82.19</b>	<b>\$438.24</b>	<b>\$404.34</b>	<b>\$3,651.31</b>	<b>\$7,021.83</b>	<b>\$620.44</b>	<b>\$448.90</b>	<b>\$1,900.02</b>	<b>\$2,115.54</b>	<b>\$18,483.75</b>

**Table 12** Annual rate of real cost for each cost category of Jacobs *et al.* (2010)

Category	Annual Rate of Real Increase (Conference Board of Canada, 2005)
Inpatient	2.8%
Physician	2.9%
Community and Social Services	2.8%
Pharmaceuticals	2.2%
Other Services	2.5%
Income Support	2.5%

### Prevalence-Based Cognitive Impairment including Dementia Costs

The average direct costs per prevalence case associated with cognitive impairment including dementia are summarized in Table 13. While the costs and assumptions were for dementia specifically, it was assumed that they would apply to both cognitive impairment and dementia. Direct costs were divided into three care categories: those who reside in LTC facilities, those who receive community-care support and services, and those who receive no formal care (Tranmer *et al.* 2003). 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.

It was assumed that there are only out-of-pocket expenses for those people living with dementia or cognitive impairment that are not using formal care services. For those who are in LTC or community care due to other causes but then develop dementia, it was assumed that the incremental costs attributable to dementia would be 6% of the costs in LTC (Wodchis *et al.* 2008), and 53% of the costs in community care (Shapiro and Tate, 1997).

Again, historical costs are adjusted to account for inflation and real costs increases to estimate the base 2011 values as described in Section 2.5.2.

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**Table 13** Direct Costs Associated with Cognitive Impairment including Dementia per Prevalent Case

Cost	Long Term Care	Community Care	No Formal Care	Source
Annual Costs of Medication (1996 dollars)	\$81.00	\$39.00	n/a	Hux <i>et al.</i> (1998)
Annual Long-Term Care Staff Costs (1991/1992 dollars)	\$19,228.60	\$16,164.27	n/a	Hollander <i>et al.</i> (2002)
Annual Support Staff Costs (1991/1992 dollars)	\$9,263.75	n/a	n/a	Hollander <i>et al.</i> (2002)
Annual Administrative Costs (1991/1992 dollars)	\$15,512.50	n/a	n/a	Hollander <i>et al.</i> (2002)
Annual Physician & Hospital Costs (1991/1992 dollars)	\$518.01	\$1,625.12	n/a	Hollander <i>et al.</i> (2002)
Annual Purchased Services (1991/1992 dollars)	n/a	\$947.39	n/a	Hollander <i>et al.</i> (2002)
Annual Facility User Fees (1991/1992 dollars)	\$11,849.81	n/a	n/a	Hollander <i>et al.</i> (2002)
Out-of- Pocket Expenses (1991/1992 dollars)	\$1,379.10	\$2,780.95	\$2,780.95	Hollander <i>et al.</i> (2002)

**Table 14** Annual rate of real cost for each cost category in Table 13

Cost	Annual Rate of Real Increase (Conference Board of Canada, 2005)
Annual Costs of Medication	2.2%
Annual Long-Term Care Staff Costs	2.5%
Annual Support Staff Costs	2.5%
Annual Administrative Costs	2.5%
Annual Physician & Hospital Costs	2.8%
Annual Purchased Services	2.5%
Annual Facility User Fees	2.5%
Out-of- Pocket Expenses	2.5%

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**Table 15** Utilization Data Inputs for Mood Disorders, Anxiety Disorders, Schizophrenia and SUD, rates per 1,000 Cases from Martens *et al.* (2004)

Mental Illness Type	Sex	Physician Visits for Mental Illness	Hospital Days for Mental Illness	Psychiatrist Visits for Mental Illness	Prescription Drug Use for All Cause	Excess Prescription Drug Use
Anxiety Disorder	Males	2,992.7	692.7	1,084.7	463.7	200.0
	Females	2,850.8	690.3	958.1	508.5	221.9
Mood Disorders	Males	1,945.3	752.4	742.4	482.3	218.6
	Females	1,913.4	596.4	653.1	490.2	203.6
SUD	Males	1,370.6	872.6	337.4	n/a <sup>6</sup>	n/a
	Females	1,591.7	714.1	415.5	n/a	n/a
Schizophrenia	Males	4,367.5	5530.1	2,275.5	671.0	407.3
	Females	4,946.6	5483.1	2,531.1	815.6	529.0

### Utilization Estimates and Costs

In order to estimate the relative costs of each mental illness, the total costs from Jacobs *et al.* (2010) were used in conjunction with the prevalence of mental illnesses and utilization rates, shown in Table 15, to calculate the effective unit costs. Utilization data were available for mood disorders, anxiety disorders, schizophrenia and SUD. Since data were not available for all service categories listed in the prevalence-based estimates, the utilization approach highlights the different service utilization patterns for physician (excluding psychiatrist) visits, psychiatrist visits, hospitalizations and prescription drug use for these illnesses only. All input data were from the Manitoba Centre for Health Policy administrative database, Martens *et al.* (2004). Note that prescription drug use for those with SUD was not available from Martens *et al.* (2004). Therefore, it was necessary to apply a very conservative assumption that there was no prescription drug use for those with SUD in the current model. Since there are prescription drugs used in SUDs, such as methadone therapy, medications to treat withdrawal, and newer anti-craving and alcohol-aversion medications, this assumption will underestimate the costs in the current model, until new data become available.

### Hospitalization and Housing

The data and assumptions used to estimate the proportion of total hospitalization costs driven by the homeless population with mental illness, summarized in Table 16, include:

<sup>6</sup> Note that prescription drug costs were not available for SUD from Manitoba report (Martens *et al.*, 2004) or from the Manitoba Centre for Health Policy data repository.

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- 0.5% of the total population is homeless (HRSDC, 2011). The age and sex distribution of the homeless population was assumed to be the same as the overall population.
- The probability of having a mental illness given homelessness was assumed to be 33%, a conservative estimate (Patterson *et al.*, 2007). The age and sex dependent prevalence of mental illness among the homeless population was assumed to be the same as the overall population.
- A homeless individual was assumed to use hospital services at 1.53 times the rate of housed individuals (Hwang, unpublished) but the study does not distinguish between those with mental illness and those without. It was assumed that this ratio would be a conservative estimate of the excess utilization rate for homeless individuals with mental illness.

The average cost per hospitalization for a homeless individual was 7.7% higher than for a housed individual (Hwang, 2011). While the study does divide hospitalization costs into psychiatric and non-psychiatric categories, the average mean costs for homeless and housed was used since the study does not distinguish between those with mental illness and those without. It is assumed that this cost ratio would be a conservative estimate of the excess costs for homeless individuals with mental illness.

**Table 16** Direct Cost Data Inputs for the Housing Sub Model

Source	Description	Value
HDSRC (2011)	Proportion of homeless people in Canada	0.5%
Patterson <i>et al.</i> (2007)	Proportion of homeless people with mental illness	33%
Hwang (2010, unpublished)	Hospital utilization among a homeless cohort and low income control group (relative health care utilization)	1.53
Hwang (2011)	Relative homeless to housed hospitalization costs	7.7%
Jacobs <i>et al.</i> (2010)	Total hospitalization costs in billions (See Table 11)	\$2,918

### 2.7.4 INDIRECT ECONOMIC COSTS

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#### General Economic Data Inputs

The base economic data are from Statistics Canada. Historical GDP, taxes and labour force statistics were used to calibrate the macroeconomic model. The data inputs are summarized in Table 17.

#### Economic Disability Associated with Mental Illnesses

Table 18 below summarizes the data inputs and assumptions for the indirect model. Total disability days were used to estimate absenteeism (missed days from work) and partial disability dates were used to estimate presenteeism, where the individual is present but not working to full capacity. The total and

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partial disability days from Dewa *et al.* (2007) were derived from self-report data from CCHS 1.2 and are the number of days within the last 2 weeks. The absenteeism data from Kouzis *et al.* (1994) comprises days missed from work in the past 3 months. Since Dewa *et al.* (2007) do not distinguish between specific mental illnesses; the indirect economic model operates on the four health states indicated in the table.

**Table 17** Historical GDP, Taxes and Labour Force Statistics

Variable	Description	CANSIM Table/Reference
GDP	Annual gross domestic product	384-001
Pre-tax Corporate Profits	Annual pre-tax profits for private corporations	384-001
Total Wages	Annual total wages	384-001
Real Average Wages	Real average wages (in 2006 dollars) by age and sex	202-0407
Labour force statistics	Employed, unemployed and non-labour by age and sex	282-0002
Government Employees	Public sector employment by age and sex	282-0008
Government Accounts	Government expenses and revenue	384-0004
Labour force disability	Total disability in the labour force from all illnesses	MacKenzie (2008)

**Table 18** Odds Ratio Input Data Sources for Estimating Economic Disability for Adults with Mental Illness

Mental Illness	Total Disability Days	Partial Disability Days
Any mental illness or combination of mental illnesses (except schizophrenia) with no chronic disease	Dewa <i>et al.</i> (2007): OR = 2.06	Dewa <i>et al.</i> (2007): OR = 1.65
Any mental illness or combination of mental illnesses (except schizophrenia) with a chronic disease	Dewa <i>et al.</i> (2007): OR = 3.70	Dewa <i>et al.</i> (2007): OR = 3.88
Chronic disease with no mental illness (Heart Disease and Type II Diabetes)	Dewa <i>et al.</i> (2007): OR = 2.11	Dewa <i>et al.</i> (2007): OR = 2.24
Schizophrenia with or without a chronic disease	Kouzis <i>et al.</i> (1994): OR = 17.8	N/A

## 2.8 MODEL: DATA LIMITATIONS

### 2.8.1 MODEL: DATA GAPS AND LIMITATIONS

A key challenge to modeling the impact of illness resides in the lack of or availability of quality data. With data gaps or limitations, assumptions are applied to provide a reasonable approximation of this impact. A variety of sources were used to evaluate the impact of mental illness in Canada, including national and regional survey data, provincial administrative (billings) data, international cohort data, and a variety of literature sources, each with its own strengths and weaknesses. For example, data obtained from provincial billings only include patients who have sought care and been diagnosed with a particular illness and as a result these data will not capture either those with an illness who have not sought care or who have sought care but not been diagnosed as having that particular illness. On the other hand, billings data for a specific region provide a reasonable estimate for who is using the health care system

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as it currently operates; however, these data do not fully capture the need health care services for all those with mental illness. While it is important to acknowledge the data limitations, strengths, weaknesses and uncertainties, the sources used and the assumptions employed in the Life at Risk model provide for a reasonable, valid and comprehensive estimate of the impact of mental illness in Canada. In addition, the process of searching and reviewing existing data and sources provided for a systematic assessment of the gaps and limitations that exist within Canada's mental health data. The table below documents the key data gaps, key limitations and the justification for their use for each of the input sources outlined in Section 2.7. For further discussion on the data sources used, limitations, their justification and rationale for use and examples of other sources considered, please refer to Appendix B.



**Table 19** Model Data Inputs and Key Limitations

Adult Prevalence		
Data Source and Description	Key Data Limitations	Rational For Use
<p>OHS-MHS (1990)</p> <ul style="list-style-type: none"> <li>Mood Disorders (major depression, dysthymia, bipolar disorder)</li> <li>Anxiety Disorders (social phobia, simple phobia, panic disorder, agoraphobia, generalized anxiety disorder)</li> </ul>	<ul style="list-style-type: none"> <li>Data are 20 + years old</li> <li>Ontario only, other provinces will differ</li> <li>Ages 15-64 only</li> <li>Excludes:                             <ul style="list-style-type: none"> <li>Panic disorder<sup>7</sup></li> <li>Schizophrenia</li> <li>Antisocial personality disorder</li> <li>Ethnicity</li> <li>Severity of illness</li> <li>Institutionalized populations</li> <li>Homeless populations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Internally consistent dataset for mood and anxiety</li> <li>Data available by age-group and sex</li> <li>Comorbidity among MI: mood, anxiety and SUD</li> <li>Employment data for those with mood and anxiety</li> <li>Provides 12 month and lifetime prevalence for accounting purposes</li> <li>Rates were similar to the CCHS 1.2 for disorders common to each study</li> <li>SME recommended</li> </ul>
<p>Martens <i>et al.</i> (2004)</p> <ul style="list-style-type: none"> <li>Schizophrenia</li> <li>Cognitive impairment including dementia</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba only, other provinces may differ</li> <li>Treated prevalence</li> <li>Ages 55+ only (for dementia)</li> <li>Dementia may include cognitive impairment coded as dementia by physician</li> <li>Diagnostic coding varies by province</li> <li>Excludes: Young onset dementia, Severity of illness, Ethnicity</li> </ul>	<ul style="list-style-type: none"> <li>Comorbidity among MI: dementia, schizophrenia, SUD, anxiety</li> <li>SME recommended for dementia, schizophrenia</li> <li>If dementia data are capturing cognitive impairment this may provide a more complete picture of the economic burden</li> </ul>
<p>Rehm <i>et al.</i> (2011)</p> <ul style="list-style-type: none"> <li>Consistently estimated epidemiologic indicators for SUD in Canada</li> <li>SUD defined as substance abuse and/or dependence</li> <li>Includes: alcohol, cocaine, heroin, non-medical prescription opioid, cannabis, amphetamine/methamphetamine</li> </ul>	<ul style="list-style-type: none"> <li>Combination of international and Canadian data</li> <li>Excludes:                             <ul style="list-style-type: none"> <li>Prescription drug and over the counter drug abuse/dependence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> <li>Custom analysis for this project</li> <li>Consistently estimated by incorporating prevalence, incidence, duration, remission, relative risk and mortality for those with SUD matched to general population by age, sex and case fatality within the same statistical disease model</li> </ul>
<p>Goldner <i>et al.</i> (2002)</p> <ul style="list-style-type: none"> <li>Systematic literature review of prevalence of schizophrenic disorders</li> </ul>	<ul style="list-style-type: none"> <li>Included international systematic review of literature with each study varying in methodology and estimates</li> <li>Excludes:                             <ul style="list-style-type: none"> <li>Age and sex stratification</li> <li>Severity of illness</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Used to estimate the 12-month and lifetime prevalence ratios to split the MB prevalence rates</li> <li>SMEs recommended using international data to supplement the MB data</li> </ul>

<sup>7</sup> Note that the OHS-MHS collected data on panic disorders but it was not included in the data extraction for the Life at Risk model due to the small sample sizes.

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Adult Incidence		
Data Source and Description	Key Data Limitations	Rational For Use
Bijl <i>et al.</i> (2002) <ul style="list-style-type: none"> <li>Mood</li> <li>Anxiety</li> <li>SUD</li> <li>Schizophrenia</li> </ul>	<ul style="list-style-type: none"> <li>International data may not be representative of Canada</li> <li>Ages 18 to 64 only</li> <li>Small proportion of long-term institutionalized population is not included</li> <li>Sample sizes were small for some disorders (schizophrenia, bipolar, dysthymia, and OCD)</li> <li>Excludes: Dementia, ethnicity</li> </ul>	<ul style="list-style-type: none"> <li>Incidence data in Canada are not available for all mental illnesses considered in the model</li> <li>NEMESIS data are age and sex specific; have the most complete information in terms of condition coverage for incidence/prevalence and comorbidities</li> </ul>
Canadian Study of Health and Aging Working Group (2000) <ul style="list-style-type: none"> <li>Dementia</li> <li>1991 Canadian Study of Health and Aging</li> </ul>	<ul style="list-style-type: none"> <li>Data are dated</li> <li>Ages 65+ only</li> <li>Excludes mild cognitive impairment</li> </ul>	<ul style="list-style-type: none"> <li>Only Canadian data source available</li> <li>Consistent with Alzheimer's Society Impact of Dementia <i>Rising Tides Study</i> (Smetanin <i>et al.</i> 2009)</li> </ul>
Childhood/Adolescent Prevalence and Incidence		
Data Source and Description	Key Data Limitations	Rational For Use
Estimated based on meta-analysis of transition rates and adult estimates: <ul style="list-style-type: none"> <li>Mood</li> <li>Anxiety</li> <li>ADHD</li> <li>Conduct Disorder</li> <li>ODD</li> </ul>	<ul style="list-style-type: none"> <li>Data for disorders included in the model are not available in Canada</li> <li>Estimated values are based on international data</li> <li>Data excludes:                             <ul style="list-style-type: none"> <li>Children under the age of 9</li> <li>Subclinical disorders</li> <li>Paediatric schizophrenia or other psychosis in children due to low prevalence/incidence</li> <li>Eating disorders due to low prevalence/incidence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Reliable robust estimates for MI in Canadian children and adolescence do not exist</li> <li>Meta-analysis provided odds ratios for odds of future MI given childhood or adolescence MI</li> <li>Longitudinal cohorts used for analysis provided the best and most reliable estimates for Canada</li> </ul>
Excess Mortality		
Data Source and Description	Key Data Limitations	Rational For Use
Harris and Barraclough (1998) <ul style="list-style-type: none"> <li>Increased risk of death from natural and unnatural causes for mental illnesses</li> </ul>	<ul style="list-style-type: none"> <li>Study only examines excess risk of death given mental illness</li> <li>Meta-analysis used to create standard mortality ratios for all natural and unnatural causes of death</li> <li>Includes data from 1966 to 1995 from Medline search</li> <li>There is no age or sex dependence to the relative risks</li> </ul>	<ul style="list-style-type: none"> <li>One consistent source that summarizes excess risk of death for all mental illnesses in the model</li> <li>Consistent data source in alignment with Dr. Rehm's model used for SUD prevalence estimates</li> </ul>

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Type II Diabetes and Heart Disease Prevalence and Incidence		
Data Source and Description	Key Data Limitations	Rational For Use
<p>NDSS</p> <ul style="list-style-type: none"> <li>Prevalence and incidence of diabetes by age-group and sex</li> </ul>	<ul style="list-style-type: none"> <li>Data do not distinguish between Type I, Type II and gestational diabetes (model assumes that 90% of the prevalent cases of diabetes reported are Type II)</li> <li>Data are linked to physician billings and hospital administrative data and only include 'treated prevalence' or users of the health care system who show evidence of service use due to diabetes</li> </ul>	<p>NDSS is the most comprehensive diabetes surveillance data in Canada. Data are available by age, sex and province.</p> <ul style="list-style-type: none"> <li>Conservative estimates</li> </ul>
<p>Statistics Canada CANSIM Table: 102-0524</p> <ul style="list-style-type: none"> <li>Mortality due to type II diabetes and heart disease</li> </ul>	<ul style="list-style-type: none"> <li>Mortality data do not distinguish between diabetes subtypes</li> <li>Reporting based on death certificates and may be underestimated for both heart disease and diabetes</li> </ul>	<p>Statistics Canada – CANSIM 102-0524</p> <ul style="list-style-type: none"> <li>Standard mortality database</li> </ul>
<p>Chow <i>et al.</i> (2005)</p> <ul style="list-style-type: none"> <li>Prevalence of heart disease in Canada by age and sex</li> </ul>	<ul style="list-style-type: none"> <li>Does not include incidence data</li> <li>Data are self-report for those ages 12+                             <ul style="list-style-type: none"> <li>May be under reported</li> <li>Subjective estimates</li> <li>Heart disease not explicitly defined in questionnaire</li> </ul> </li> <li>Data not stratified by heart disease type e.g. CHD, CAD, IHD</li> <li>Data excludes those on Indian reserves, Canadian Force bases and those residing in remote communities</li> </ul>	<ul style="list-style-type: none"> <li>Only Canadian data available</li> <li>Recommended by SMEs given availability of data – this is the best we have and provides a conservative estimate of heart disease. The use of US and international data were discouraged due to the differences in the health care systems</li> </ul>
Relative Risk Estimates between Mental Illness and Type II Diabetes/Heart Disease		
Data Source and Description	Key Data Limitations	Rational For Use
<p>Rugulies (2002)</p> <ul style="list-style-type: none"> <li>Meta-analysis to determine the relative risk for development of CHD in people with depression</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Data only consider the relationship between depression and CHD only which is not in alignment to the disorders included in the Life at Risk model for which the relative risk estimates were applied</li> <li>Meta-analysis includes international data mostly from the US which may not be representative of Canada. Estimates included in the meta-analysis may be subject to publication bias</li> </ul>	<ul style="list-style-type: none"> <li>Rugulies (2002) recommended by SMEs</li> <li>Majority of heart disease is CHD</li> <li>Frasure-Smith <i>et al.</i> (2006)                             <ul style="list-style-type: none"> <li>Supports findings of Rugulies (2002) and model assumptions</li> </ul> </li> <li>Frasure-Smith <i>et al.</i> (2008)                             <ul style="list-style-type: none"> <li>Supports findings of Rugulies (2002) and model assumptions</li> </ul> </li> </ul>

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<p>Patten (2005)</p> <ul style="list-style-type: none"> <li>Elevated risk of depression in persons with chronic disease</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Data available for depression only</li> <li>Chronic disease data includes a category for a general chronic disease which is not specific to type II diabetes or heart disease</li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
<p>Curkendall <i>et al.</i> (2004)</p> <ul style="list-style-type: none"> <li>Increased risk of cardiovascular disease and diabetes given schizophrenia</li> </ul>	<ul style="list-style-type: none"> <li>Study includes data from Saskatchewan only</li> <li>Analysis used administrative data and not all medical records could be reviewed for diagnosis validation</li> <li>The study did not adjust for cardiovascular risk factors including smoking, BMI and SUD</li> <li>Data were not stratified by age and sex</li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
<p>Rehm <i>et al.</i> (2010)</p> <ul style="list-style-type: none"> <li>Increased risk of ischaemic heart disease and diabetes given alcohol abuse/dependence</li> </ul>	<ul style="list-style-type: none"> <li>Meta-analysis only examined the relationship between alcohol consumption and chronic illness and did not examine the relationship with other SUDs                             <ul style="list-style-type: none"> <li>Alcohol abuse/dependence is approximately 90% of SUD prevalence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
<p>Ahtiluoto <i>et al.</i> (2010)</p> <ul style="list-style-type: none"> <li>Increased risk of dementia given type II diabetes</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Study includes a Finnish population over the age of 85</li> </ul>	<p>Ahtiluoto <i>et al.</i> (2010)</p> <ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
<b>Hospitalizations and Homelessness</b>		
<b>Data Source and Description</b>	<b>Key Data Limitations</b>	<b>Rational For Use</b>
<p>HRSDC (2011)</p> <ul style="list-style-type: none"> <li>Proportion of homeless people in Canada</li> </ul>	<ul style="list-style-type: none"> <li>The estimated homeless population in Canada ranged from 150,000 to 300,000</li> <li>The HRSDC does not provide further information on data source estimates and limitations</li> </ul>	<p>Best available data in Canada at this time where reasonable assumptions can be applied</p>
<p>Patterson <i>et al.</i> (2007)</p> <ul style="list-style-type: none"> <li>Proportion of homeless people with MI</li> </ul>	<ul style="list-style-type: none"> <li>Data are specific to the province of British Columbia and to those with serious additions and mental illness                             <ul style="list-style-type: none"> <li>Excludes those with less severe mental illness</li> </ul> </li> <li>Data are not stratified by age and sex</li> </ul>	
<p>Hwang (2010, Unpublished)</p> <ul style="list-style-type: none"> <li>Hospital utilization among homeless cohort and low income control group (relative health care utilization)</li> </ul>	<ul style="list-style-type: none"> <li>Study includes a small population sample from inner city Toronto</li> <li>Study does not encompass all health care services used</li> </ul>	

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<p>Hwang (2011)</p> <ul style="list-style-type: none"> <li>Relative homeless to housed hospitalization costs</li> </ul>	<ul style="list-style-type: none"> <li>Study includes a small population sample from inner city Toronto over the age of 18</li> <li>Data are not stratified by sex</li> <li>Housing status based on administrative data and subject to misclassification</li> <li>Data do not include duration of homelessness</li> <li>Length of stay estimates may be based on practices rather than severity of illness</li> </ul>	
<b>Economic Disability</b>		
<b>Data Source and Description</b>	<b>Key Data Limitations</b>	<b>Rational For Use</b>
<p>Dewa <i>et al.</i> (2007)</p> <ul style="list-style-type: none"> <li>Total and partial disability days for any mental disorder</li> <li>Total and partial disability days for any mental disorder and chronic condition</li> <li>Total and partial disability days for chronic condition only</li> <li>Based on CCHS 1.2</li> </ul>	<ul style="list-style-type: none"> <li>Ages 18 to 64 only</li> <li>Does not distinguish between different mental illnesses</li> <li>Measures were self-report and subject to recall and reporting bias</li> <li>Disability questions were not limited to work activities and included non-work activities</li> <li>Cross-sectional data cannot imply causality</li> <li>Based on the CCHS 1.2 which may underestimate the true disability</li> </ul>	<ul style="list-style-type: none"> <li>SME recommendation</li> </ul>
<p>Kouzis <i>et al.</i> (1994)</p> <ul style="list-style-type: none"> <li>Missed days from work for MI</li> </ul>	<ul style="list-style-type: none"> <li>Study dated</li> <li>Study included US sample from the Eastern Baltimore Mental Health Survey which may not be representative of Canada</li> </ul>	<ul style="list-style-type: none"> <li>Recommended by Dr. Don Addington for schizophrenia</li> </ul>
<b>Direct Health Costs</b>		
<b>Data Source and Description</b>	<b>Key Data Limitations</b>	<b>Rational For Use</b>
<p>Jacobs <i>et al.</i> 2010</p> <ul style="list-style-type: none"> <li>Total aggregate costs by province for inpatient services, physician services, community and social services, pharmaceuticals, other services, income support</li> </ul>	<ul style="list-style-type: none"> <li>Alternate funding for physicians not collected by most provinces.</li> <li>The report estimated the proportion of private and public psychiatric drugs based on the total public to private ratio of all drugs (psychiatric and non-psychiatric) for each province.</li> <li>Quebec calculates inpatient hospital costs based on systemic differences and cost allocation methods. This differs from methodologies used by other provinces.</li> <li>Psychiatric patient days are based on discharge data rather than days</li> </ul>	<ul style="list-style-type: none"> <li>Used in conjunction with the MB Health Policy data (Martens <i>et al.</i> 2004) to estimate total direct health care costs</li> <li>Jacobs <i>et al.</i> (2010) provides total costs per province for services used               <ul style="list-style-type: none"> <li>Data are complete for FFS payments to physicians inpatient hospital care and total pharmaceuticals</li> </ul> </li> </ul>

of care. Study investigators applied an adjustment factor which was not validated.

- Emergency room data attributable to diagnosis is only available in Alberta and Ontario.
  - Community mental health service data can encompass a variety of services across provinces with no standard definition. Services may be funded by different ministries.
  - Types of services used for mental health and additions cannot always be distinguished.
  - Shelter costs for homeless people with mental illness are only available in British Columbia.
  - Not-for-profit costs included the complete cost of government funding for community mental health and the amounts raised from non-government sources.
  - Employment programs only included data for provinces that report numbers of people with a psychiatric disability.
  - Income support only included provinces that reported disability attributable to mental illness.
  - Short-term disability does not track reasons for disability so data are not available for those who temporarily lose their jobs due to mental illness. Does not include short-term and long-term disability leaves covered by employer insurance plans.
  - Complete data across all services not available for all provinces.
  - Study excludes:
    - Attribution to specific mental illnesses
    - Dementia costs
    - Costs to the education system for children
    - Costs to the criminal justice system
    - Costs for child and youth services
    - 'Excess' costs of utilization for those with mental illness
    - Age and sex stratification
    - Complete data are not available for all provinces/territories for all service types
- Data for available provinces can be used to extrapolate on a per capita basis to provinces with data gaps for each service.

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<p>Martens <i>et al.</i> (2004)</p> <ul style="list-style-type: none"> <li>Utilization data (physician visits, psychiatrist visits, prescription drug use)</li> <li>Includes utilization data for mood, anxiety, schizophrenia, SUD</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba only</li> <li>Does not contain utilization data for all service types and for all mental illnesses in the Life at Risk model</li> <li>Mood disorders only includes depression and bipolar disorders (excludes dysthymia)</li> <li>Coding/reporting may vary across provinces</li> <li>Different provinces have different service definitions and health care systems</li> <li>Manitoba has high aboriginal population compared to other provinces</li> </ul>	<ul style="list-style-type: none"> <li>Used in conjunction with Jacobs <i>et al.</i> 2010 data to estimate direct costs using utilization-based costing methods</li> <li>Only utilization data available in Canada by MI type</li> </ul>
<p>Tranmer <i>et al.</i> 2003</p> <ul style="list-style-type: none"> <li>Number of people in LTC and community care with dementia</li> </ul>	<ul style="list-style-type: none"> <li>Ontario data only</li> <li>Data are dated</li> <li>Costs and services provided may vary across provinces and may have changed over time</li> </ul>	<p>Consistent with model and analysis completed for the Alzheimer Society's <i>Rising Tides Study</i> (Smetanin <i>et al.</i> 2009)– approach was recommended by subject matter experts in dementia</p>
<p>Wodchis <i>et al.</i> 2008</p> <ul style="list-style-type: none"> <li>Proportion of LTC residents with dementia admitted to LTC due to their dementia</li> <li>Proportion of people with dementia only and those with dementia plus a comorbid condition</li> <li>Incremental cost of care for those with dementia</li> </ul>	<ul style="list-style-type: none"> <li>Data are widely assumption driven and based on an Ontario sample which may not be representative of Canada</li> </ul>	
<p>Hollander <i>et al.</i> (2002)</p> <ul style="list-style-type: none"> <li>Costs of care for those 65+: LTC, administrative, LTC staff, physician, hospital, facility user fees, support staff, purchased services</li> </ul>	<ul style="list-style-type: none"> <li>Costs based on small study samples from Victoria and Winnipeg and may not be representative of Canada</li> <li>Costs and services provided may differ across provinces and may have changed over time</li> </ul>	
<p>Hux <i>et al.</i> (1998)</p> <ul style="list-style-type: none"> <li>Annual medication costs for those with AD based on 1991 CSHA</li> </ul>	<ul style="list-style-type: none"> <li>Data are dated</li> <li>Included cost of drugs for Alzheimer's disease only – not all dementia types</li> <li>Medication use and costs may have changed over time</li> </ul>	
<p>Shapiro and Tate (1997)</p> <ul style="list-style-type: none"> <li>Costs incurred by patients in community care with dementia alone and dementia with comorbidities</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba data only – based on the Manitoba Study of Health and Aging, which may not be representative of Canada</li> <li>Data are dated</li> <li>Costs and services provided under community care may differ across provinces and may have changed over time</li> </ul>	

## Life at Risk Analysis of The Impact of Mental Illness in Canada

Healthy Immigrant Effect		
Data Source and Description	Key Data Limitations	Rational For Use
<p>Menezes <i>et al.</i> (2011)</p> <ul style="list-style-type: none"> <li>Lower 12 month prevalence of psychiatric disorder in Canadian immigrants compared to non-immigrant Canadians</li> <li>Based on CCHS 1.2</li> </ul>	<ul style="list-style-type: none"> <li>Data only includes mood disorders, anxiety disorders, SUD and schizophrenia</li> <li>Ages 15+ from 10 provinces (excludes territories)</li> <li>Cross-sectional study design does not account for longitudinal trends</li> <li>Study does not examine “new” immigrants but rather immigrant status so it may include those who immigrated many years ago</li> </ul>	<p>Menezes <i>et al.</i> (2011)</p> <ul style="list-style-type: none"> <li>SME recommendation</li> <li>Only Canadian data available</li> </ul>



### 3 CURRENT AND FUTURE IMPACTS OF MENTAL ILLNESS IN CANADA: MODEL RESULTS

#### 3.1 PREVALENCE OF MENTAL ILLNESS IN CANADA

The following Section outlines the simulated prevalence of and number of people living with mental illness in Canada over a 30-year time horizon, including 12-month and lifetime prevalence numbers for each illness considered in the Life at Risk model.

As outlined in Section 1 there are many risk factors that may contribute to the onset of mental illness; however the current implementation of the Life at Risk model only includes previous or concurrent mental illness, immigrant status, heart disease and type II diabetes. These risk factors were simulated within the population and health modules of the platform to generate an outlook of the population demographics and prevalence of heart disease and type II diabetes in Canada that can be used to explain their associations with future changes in mental illness prevalence. The results of the heart disease and type II diabetes simulations are summarized in Appendix D.

For each mental illness, the number of people with that illness by age and sex is shown, along with the 12-month prevalence and the lifetime prevalence regardless of any co-morbid conditions. Therefore, summing the individual conditions presented in the following sections would yield a total greater than the values presented for any mental illness. The lifetime prevalence by age and sex is the prevalence of people who have had the mental illness at any time whether it is currently active or in remission, while the 12-month prevalence refers to active cases in the last 12-months.

##### 3.1.1 ANY MENTAL ILLNESS

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Table 20 and Figure 5 show the modeled estimates of the current and future number of people living with any mental illness in Canada in a given year. In 2011, it was estimated that a total of 6.8 million Canadians (annually) are living with a mental illness that meets diagnostic criteria, or 19.8% of the total population. Of these, approximately 53.2% are female. Over the next 30 years, the annual number of people living with any mental illness is expected to increase by 31.1%. This increase is driven by the population growth and changing population demographics. By 2041, the annual number of people living with a mental illness is expected to exceed 8.9 million or 20.5% of the total population. Females are expected to comprise 54.6% of the future population with mental illness.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 20** Estimated Number and 12-Month Prevalence of Any Disorder in Canada for Select Years 2011 to 2041

<i>Estimated Number and 12-Month Prevalence of Any* Mental Illness in Canada</i>	Year			
	2011	2021	2031	2041
<small>*Any includes Mood, Anxiety, Schizophrenia, SUD, ADHD, ODD, CD, Dementia</small>				
Males Ages 9 to 19	554,839	547,062	603,515	626,930
Males All Ages	3,178,446	3,415,276	3,736,764	4,044,688
% of Male Population Ages 9 to 19	24.4%	23.4%	23.6%	23.6%
% of Male Total Population (All Ages)	18.7%	18.3%	18.6%	18.9%
Females Ages 9 to 19	486,671	480,153	527,964	548,508
Females All Ages	3,619,181	3,994,881	4,448,014	4,866,402
% of Female Population Ages 9 to 19	22.5%	21.7%	21.8%	21.8%
% of Female Total Population (All Ages)	20.9%	21.0%	21.6%	22.2%
<b>Total Ages 9 to 19</b>	<b>1,041,509</b>	<b>1,027,216</b>	<b>1,131,479</b>	<b>1,175,438</b>
<b>Total All Ages</b>	<b>6,797,627</b>	<b>7,410,157</b>	<b>8,184,778</b>	<b>8,911,090</b>
<b>% of Population Ages 9 to 19</b>	<b>23.4%</b>	<b>22.6%</b>	<b>22.7%</b>	<b>22.8%</b>
<b>% of Total Population (All Ages)</b>	<b>19.8%</b>	<b>19.7%</b>	<b>20.1%</b>	<b>20.5%</b>

Figure 5 and Figure 6 show the estimated number of people and 12-month prevalence of any mental illness by age-group for 2011 and for each decade to 2041. The annual number of people living with a mental illness is highest in young adults ages 20 to 30, the ages that have the highest rates of disorders such as mood and anxiety. Across all age-groups, mood and anxiety disorders are the most prevalent, with approximately 4.0 million Canadians living with either a mood or anxiety disorder in 2011. By 2041, if the current circumstances do not change, the annual number of people living with a mood or anxiety disorder is estimated to reach over 4.9 million Canadians.

As shown in Section 2, the model evolves through the various transition rates between population states. The number of people in a given state is the net result of people entering and exiting that state. Therefore, the constant age and sex specific 12-month prevalence from 2011 to 2041 shown in Figure 6 indicate that the incidence and remission rates are correctly calibrated to maintain the constant prevalence assumption. Slight variations arise in situations when the prevalence cannot be kept exactly constant due to the complex interactions between incidence, remission, population growth and aging, and migration. Verification of the correct incidence and remission rates is important prior to scenario development where risk factors or transitions rates, not the prevalence, may be altered.

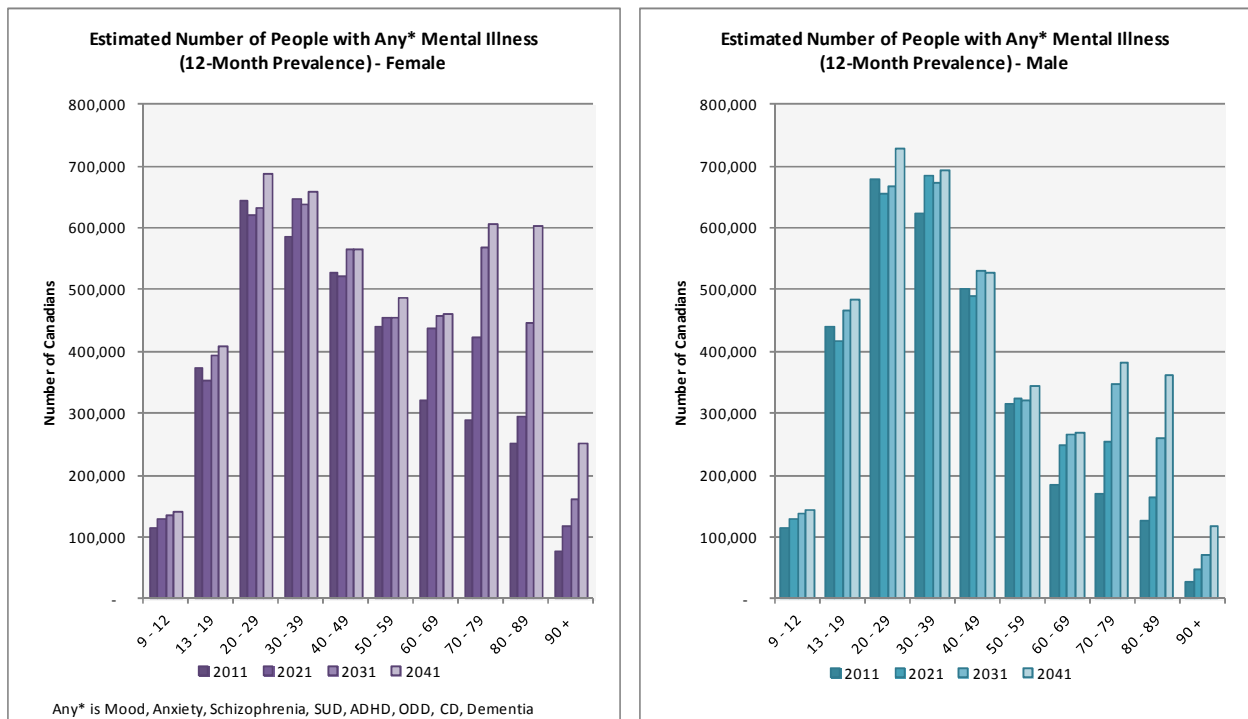
The figures below also show the number of children and adolescents living with any disorder in any given year. In 2011 it was estimated that a total of 1.0 million Canadian children and youth were living with a diagnosable mental illness. Of these, approximately 53.3% are male. When mood and anxiety

## Life at Risk Analysis of The Impact of Mental Illness in Canada

disorders are removed, the percentage which is male rises to 74.9%. By 2041 the annual number of children and youth living with a mental illness is expected to increase by 12.9% to 1.2 million.

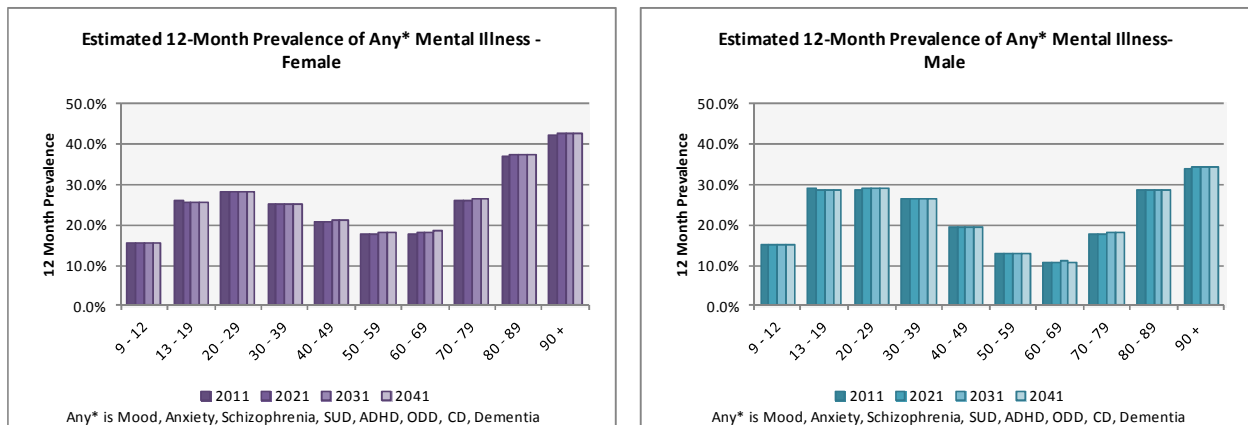
The estimated numbers of individuals with any disorder is also shown to increase for those ages 70+ and is much higher in females than males. This is primarily due to the onset of cognitive impairment including dementia in older age-groups and longer life expectancy of females versus males.

**Figure 5** Estimated Number of People with Any Disorder in Canada (12-Month Prevalence) for Select Years 2011 to 2041



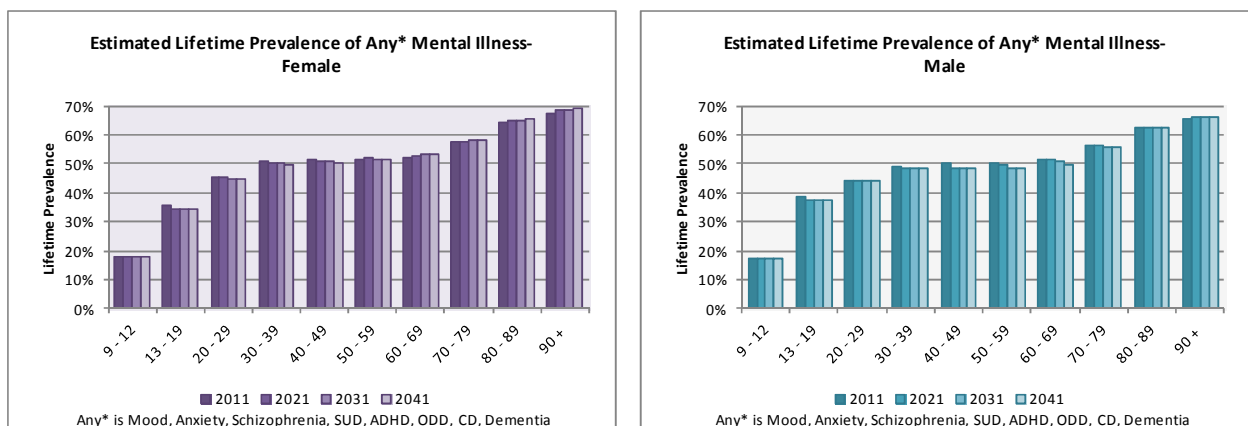
## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 6** Estimated 12-Month Prevalence of Any Disorder in Canada for Select Years 2011 to 2041



The estimated lifetime prevalence of any mental illness in Canada is shown in Figure 7. The likelihood of having a mental illness in one's lifetime is shown to increase with age but remains almost constant throughout the simulation timeframe as a result of the constant prevalence rate assumptions. For age-standardized prevalence and annual prevalence results, please refer to Appendix D.

**Figure 7** Estimated Lifetime Prevalence of Any Disorder in Canada for Select Years 2011 to 2041



### 3.1.2 ADHD

Table 21 shows the estimated 12-month prevalence and numbers of Canadian youth with ADHD over the next 30 years. In 2011, it was estimated that there are 170,608 children and adolescents living with ADHD, and of these approximately 87.0% are male. By 2041 the annual number of Canadian youth living with ADHD is expected to increase reaching 200,220. This increase is primarily driven by changes in population demographics.

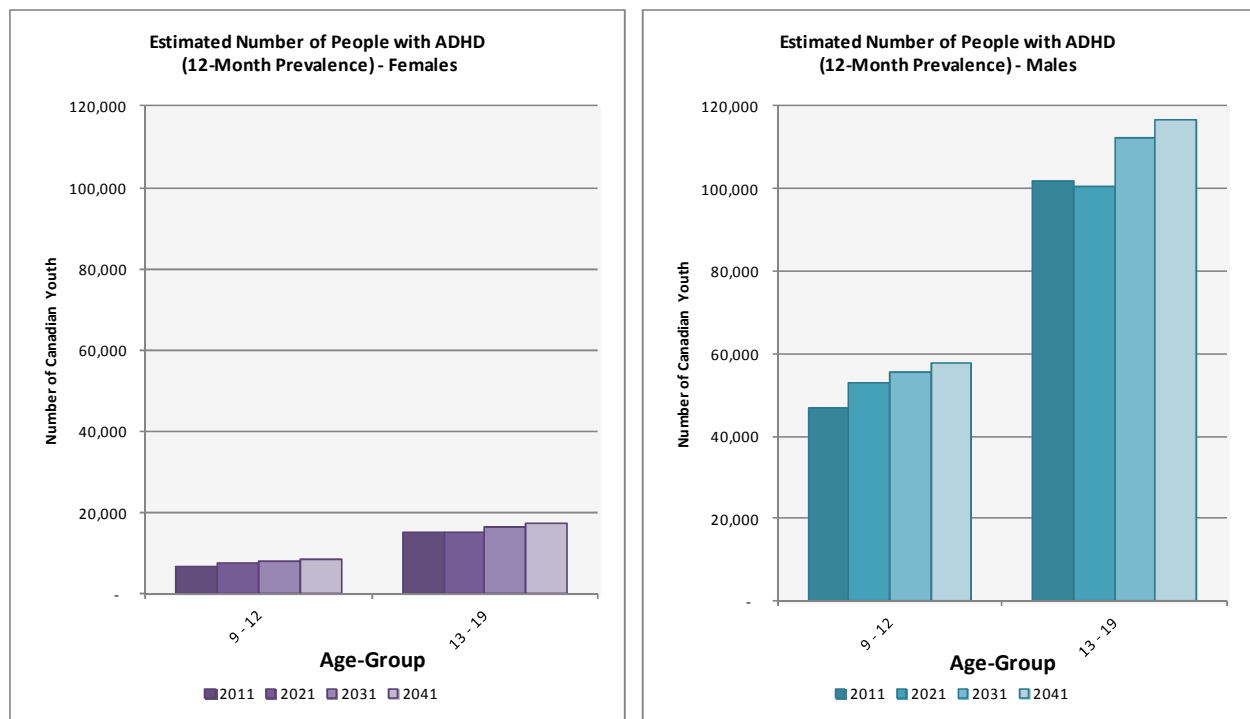
## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 21** Estimated Number and 12-Month Prevalence of ADHD in Canadian Youth Ages 9 to 19 for Select Years 2011 to 2041

	Year			
	2011	2021	2031	2041
Males	148,485	153,395	168,092	174,359
% of Male Population Ages 9 to 19	6.52%	6.58%	6.58%	6.58%
Females	22,123	22,787	24,930	25,861
% of Female Population Ages 9 to 19	1.02%	1.03%	1.03%	1.03%
<b>Total</b>	<b>170,608</b>	<b>176,182</b>	<b>193,022</b>	<b>200,220</b>
<b>% of Total Population Ages 9 to 19</b>	<b>3.84%</b>	<b>3.87%</b>	<b>3.88%</b>	<b>3.88%</b>

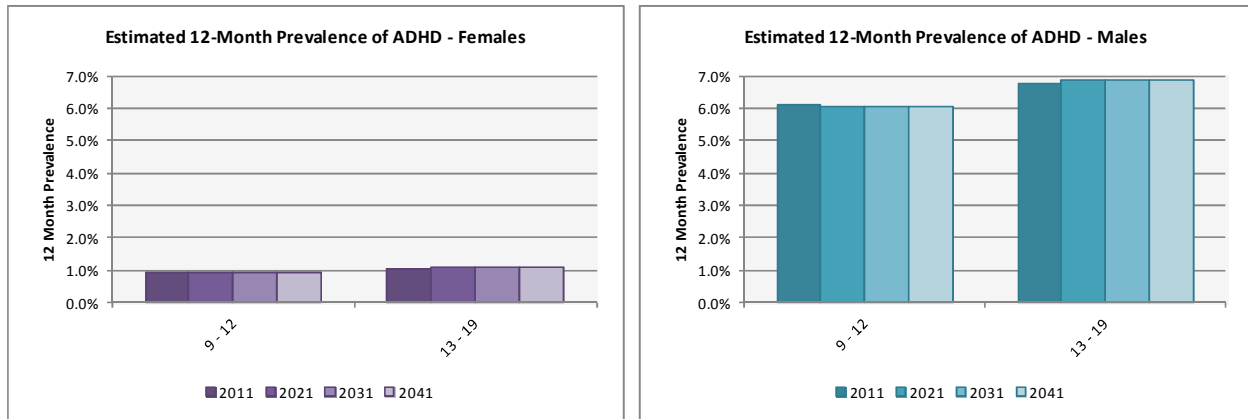
Figure 8 and Figure 9 show the estimated number of youth and 12-month prevalence of ADHD by age-group and sex over the next three decades. For both males and females, the numbers increase in adolescence. In 2011 there were estimated to be 101,768 males and 15,196 females aged 13 to 19 living with ADHD. By 2041 these numbers are expected to increase to 116,629 and 17,339, respectively; or 6.9% and 1.1% of the youth population.

**Figure 8** Estimated Number of Youth with ADHD in Canada (12-Month Prevalence) for Select Years 2011 to 2041



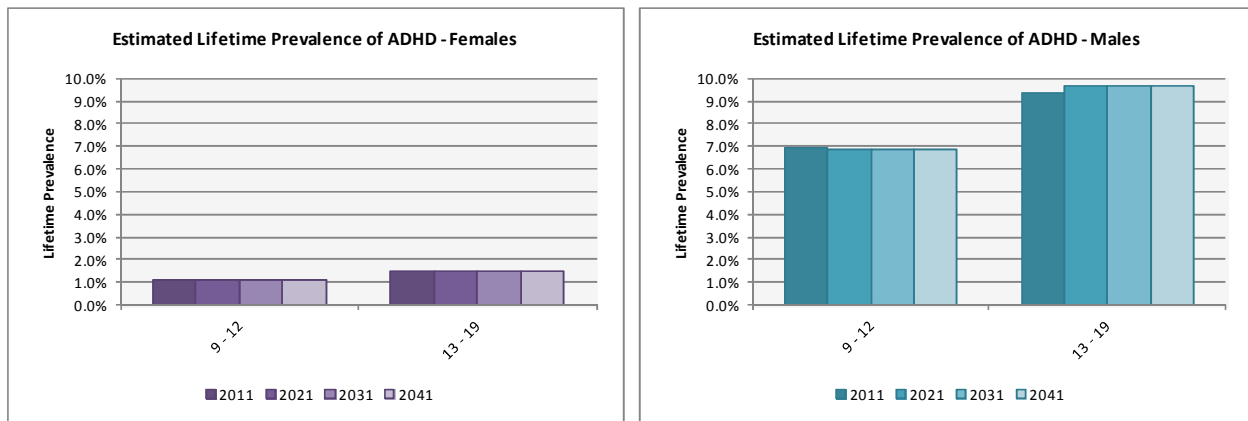
## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 9** Estimated 12-Month Prevalence of ADHD in Canadian Youth for Select Years 2011 to 2041



The estimated lifetime prevalence of ADHD from 2011 to 2041 is shown in Figure 10. The likelihood of having ADHD in one's lifetime is shown to remain fairly constant throughout the simulation timeframe as a result of the constant prevalence rate assumptions. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly.

**Figure 10** Estimated Lifetime Prevalence of ADHD in Canadian Youth for Select Years 2011 to 2041



For age-standardized prevalence rates and annual prevalence results please refer to Appendix D.

### 3.1.1.3 ODD

The simulation results estimated that there are 84,359 Canadian children and adolescents living with ODD in 2011. Of these approximately 56.7% are male. As the Canadian population demographics change

Life at Risk Analysis of The Impact of Mental Illness in Canada

the number of Canadian youth living with ODD in any given year is estimated to increase reaching 98,037 by 2041.

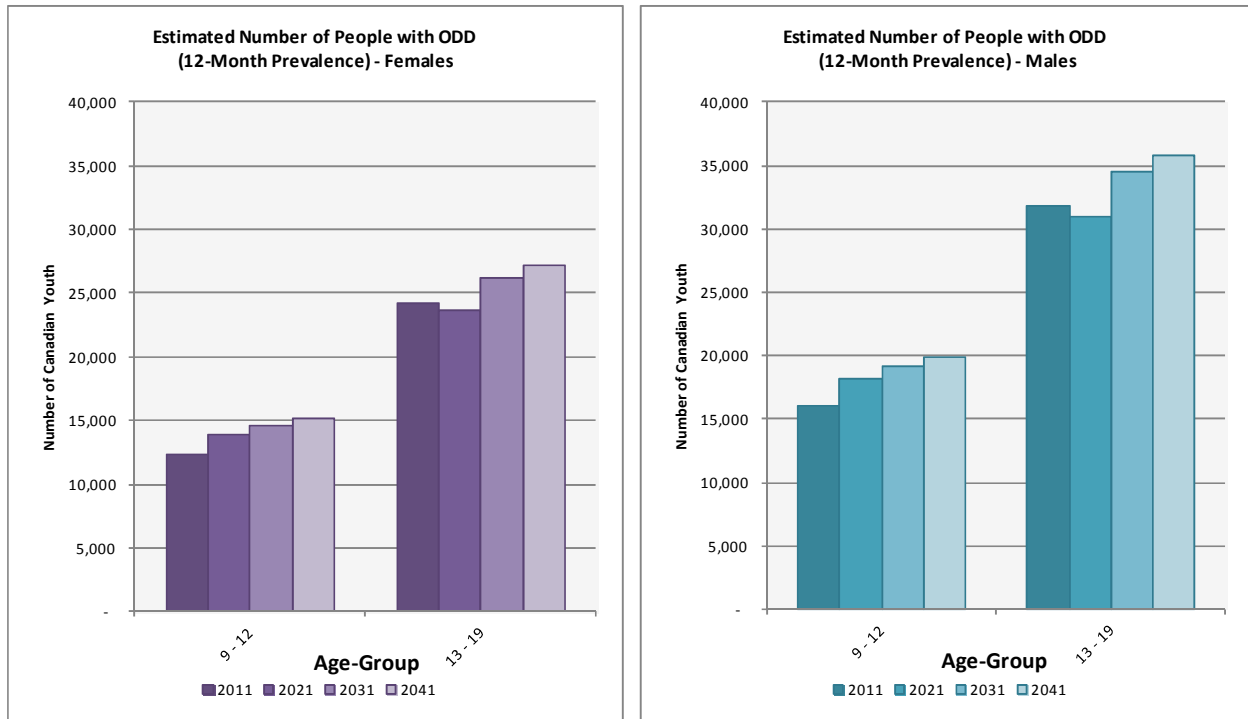
**Table 22** Estimated Number and 12-Month Prevalence of ODD in Canadian Youth Age 9 to 19 for Select Years 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of ODD in Canada</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Males	47,821	49,120	53,687	55,679
% of Male Population Ages 9 to 19	2.10%	2.11%	2.10%	2.10%
Females	36,537	37,432	40,841	42,359
% of Female Population Ages 9 to 19	1.69%	1.69%	1.69%	1.69%
<b>Total</b>	<b>84,359</b>	<b>86,552</b>	<b>94,527</b>	<b>98,037</b>
<b>% of Total Population Ages 9 to 19</b>	<b>1.90%</b>	<b>1.90%</b>	<b>1.90%</b>	<b>1.90%</b>

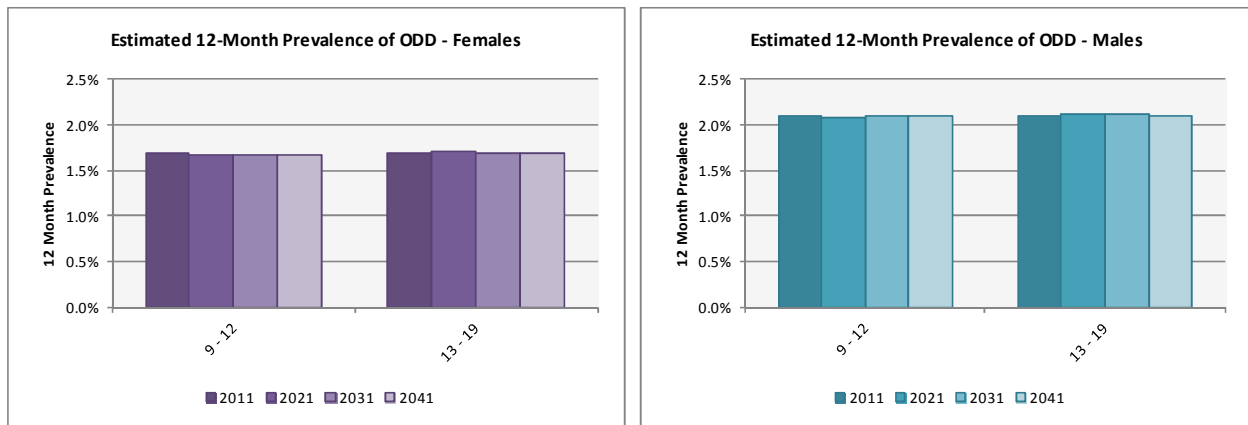
The estimated number of youth and 12-month prevalence of ODD for Canadian youth by age-group and sex from 2011 and over the next three decades are shown in Figure 11 and Figure 12. Similarly to ADHD, the estimated numbers increase in adolescence. In 2011 there were estimated to be 31,767 males and 24,261 females aged 13 to 19 living with ODD. By 2041 these numbers are estimated to increase to 35,835 and 27,254, respectively, or 2.1% and 1.7% of that age group. As shown in Table 9, there are few studies that include prevalence estimates for ODD. Among those that do there is a considerable range in the estimated values. In general, the prevalence of ODD and CD tends to be similar, and in Canadian studies, they both tend to be lower than ADHD. Following the recommendations of the SME committee, these trends were used to calibrate the model.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 11** Estimated Number of Youth with ODD in Canada (12-Month Prevalence) for Select Years 2011 to 2041



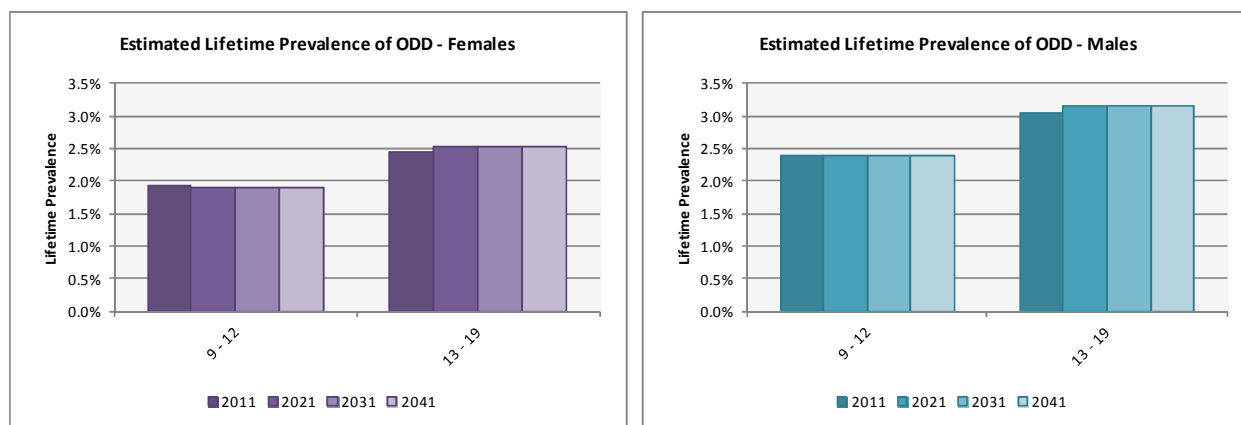
**Figure 12** Estimated 12-Month Prevalence of ODD in Canadian Youth for Select Years 2011 to 2041



The estimated lifetime prevalence of ODD is shown in Figure 13. The fairly constant age and sex specific 12-month and lifetime prevalence indicate from 2011 to 2041 that the incidence and remission rates were calibrated properly.



**Figure 13** Estimated Lifetime Prevalence of ODD in Canadian Youth for Select Years 2011 to 2041



For age-standardized rates and annual prevalence results please refer to Appendix D.

### 3.1.4 CONDUCT DISORDERS

The estimated numbers and 12-month prevalence of CD in Canadian children and adolescents is shown in Table 23. In 2011, it was estimated that there are 85,063 children and adolescents living with CD, and of these approximately 70.8% are male. By 2041 the annual number of Canadian youth living with CD is expected to increase reaching 99,606. This increase is primarily driven by changes in the population demographics.

**Table 23** Estimated Numbers and 12-Month Prevalence of Conduct Disorders in Canadian Youth Age 9 to 19 for Select Years 2011 to 2041

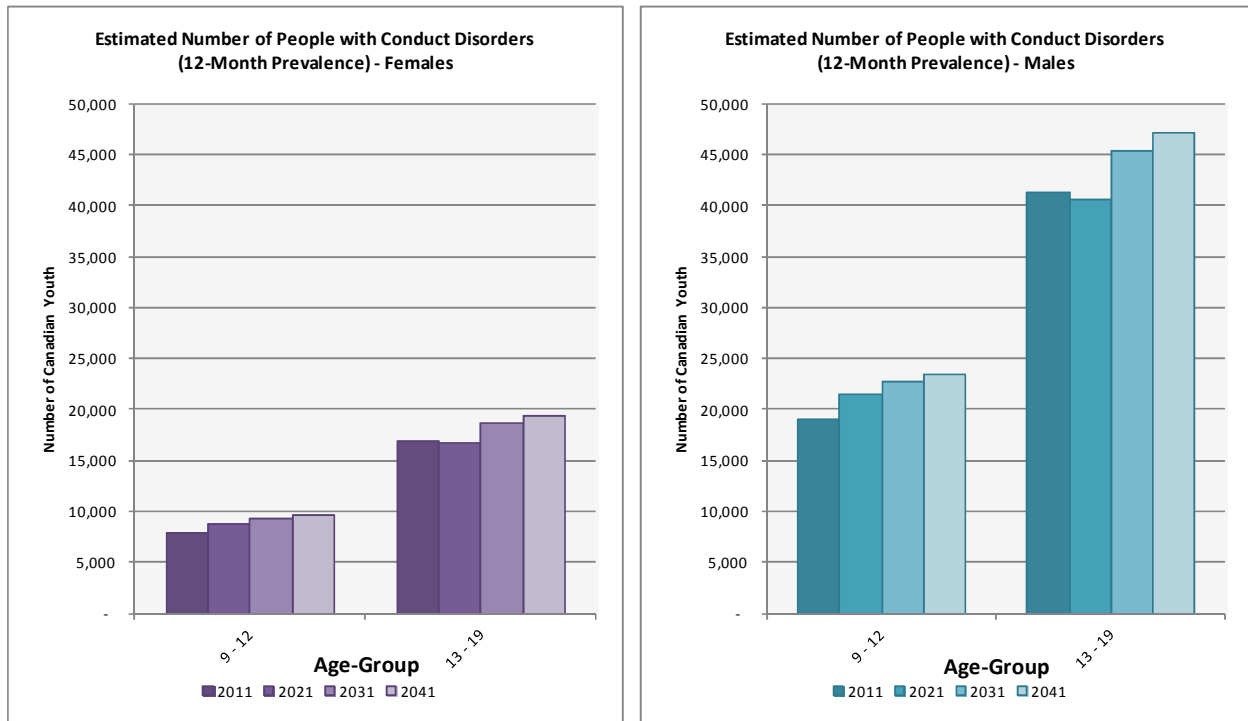
<i>Estimated Number and 12-Month Prevalence of Conduct Disorders in Canada</i>				
	Year			
	2011	2021	2031	2041
Males	60,265	62,142	68,088	70,625
% of Male Population Ages 9 to 19	2.65%	2.66%	2.67%	2.66%
Females	24,798	25,545	27,938	28,980
% of Female Population Ages 9 to 19	1.14%	1.15%	1.15%	1.15%
<b>Total</b>	<b>85,063</b>	<b>87,687</b>	<b>96,026</b>	<b>99,606</b>
<b>% of Total Population Ages 9 to 19</b>	<b>1.91%</b>	<b>1.93%</b>	<b>1.93%</b>	<b>1.93%</b>

The estimated numbers and 12-month prevalence of CD for Canadian youth by age-group and sex in 2011 and over the next 3 decades is shown in Figure 14 and Figure 15. Similar to ADHD and ODD, the estimated numbers increase in adolescence. In 2011 there were estimated to be 41,269 males and

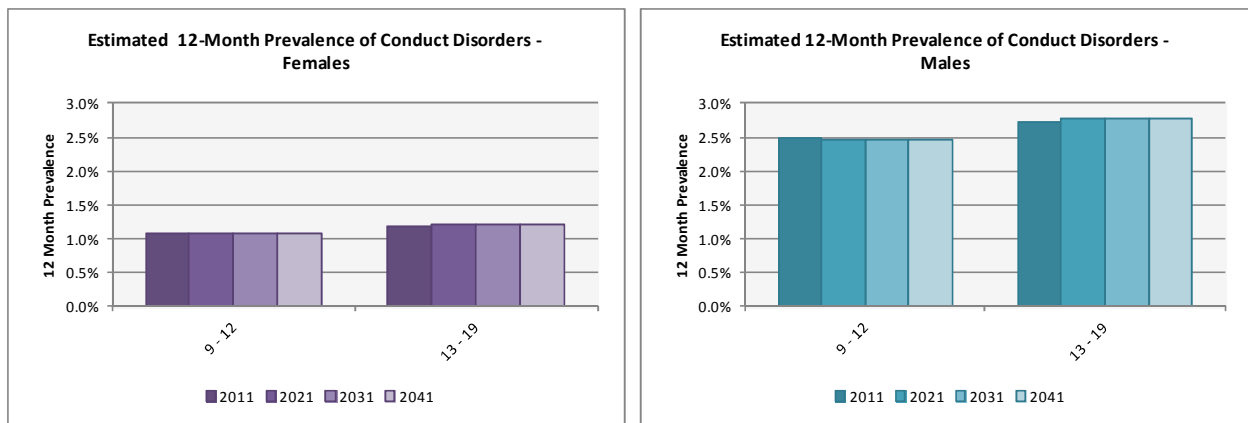
## Life at Risk Analysis of The Impact of Mental Illness in Canada

16,996 females of ages 13 to 19 living with ODD. By 2041 these numbers are expected to increase to 47,152 and 19,345, respectively, or 2.8% and 1.2% of that age group.

**Figure 14** Estimated Number of Youth with Conduct Disorders in Canada (12-Month Prevalence) for Select Years 2011 to 2041

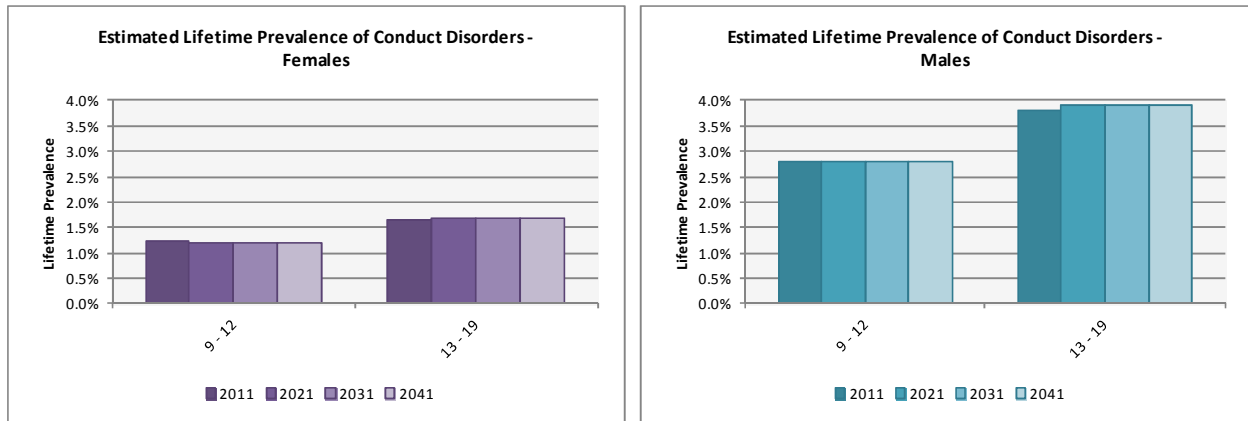


**Figure 15** Estimated 12-Month Prevalence of Conduct Disorders in Canadian Youth for Select Years 2011 to 2041



The estimated lifetime prevalence of CD for 2011 and over the next three decades is shown in Figure 16. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly.

**Figure 16** Estimated Lifetime Prevalence of Conduct Disorders in Canadian Youth for Select Years 2011 to 2041



For age-standardized prevalence rates and annual results please refer to Appendix D.

### 3.1.5 MOOD AND ANXIETY DISORDERS

Since diagnostic coding and reporting for mood and anxiety disorders often varies across provinces, where some diagnoses are reported as anxiety and others as mood, the results presented in this section combine both mood and anxiety diagnoses (See Kisley *et al.* 2009). Table 24 below shows the estimated number and 12-month prevalence of mood or anxiety disorders over the next 30 years for males and females. In 2011, it was estimated that there are over 4.0 million people living with a mood or anxiety disorder (including youth), and of these approximately 66.3% are female. By 2041 the annual number of people living with a mood or anxiety disorder is expected to increase by 22.9%, reaching over 4.9 million people or 11.4% of the total Canadian population. This increase is primarily driven by the aging population demographics; approximately 67.1% of these are female as a result of the longer life expectancy of females and the fact that mood and anxiety disorders are more common in females than males for almost all age-groups.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

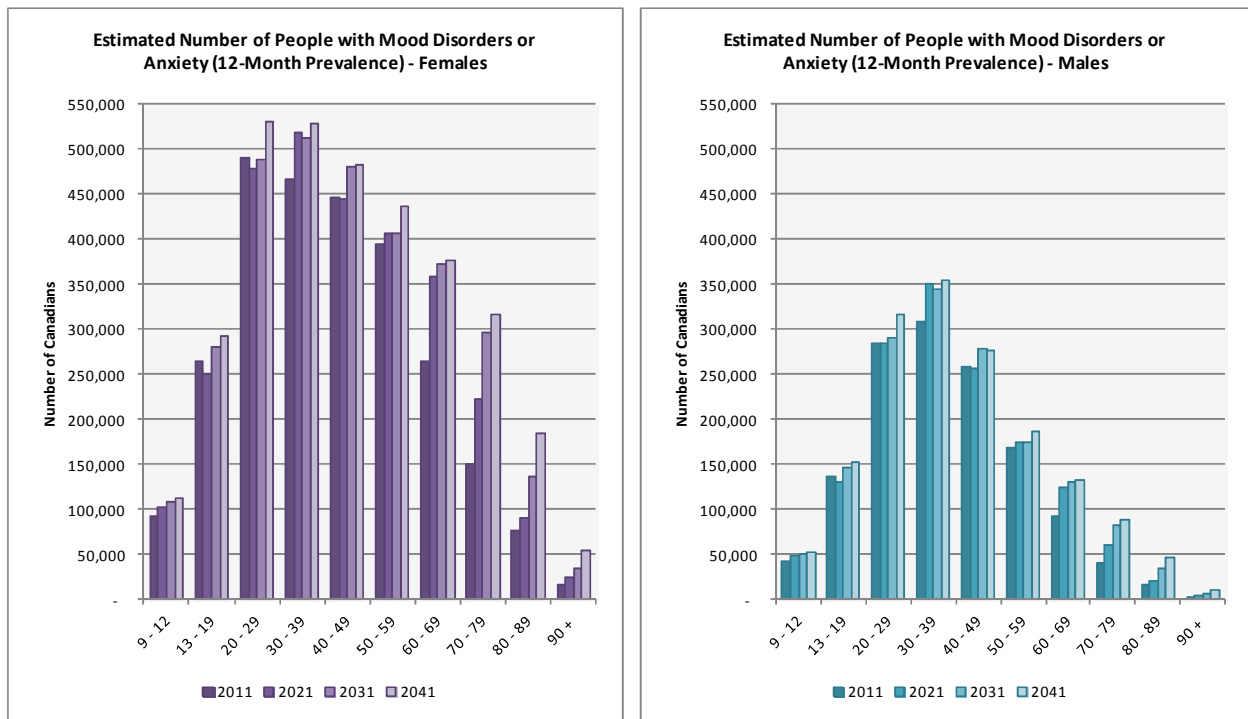
**Table 24** Estimated Number and 12-Month Prevalence of Mood or Anxiety Disorders in Canada for Select Years 2011 to 2041

	Year			
	2011	2021	2031	2041
Males Ages 9 to 19	179,827	179,987	198,241	206,001
Males All Ages	1,351,833	1,456,200	1,539,134	1,622,252
% of Male Population Ages 9 to 19	7.9%	7.7%	7.8%	7.8%
% of Male Total Population (All Ages)	7.9%	7.8%	7.6%	7.6%
Females Ages 9 to 19	357,221	354,946	389,921	405,099
Females All Ages	2,664,877	2,900,548	3,120,408	3,315,175
% of Female Population Ages 9 to 19	16.5%	16.0%	16.1%	16.1%
% of Female Total Population (All Ages)	15.4%	15.3%	15.2%	15.1%
<b>Total Ages 9 to 19</b>	<b>537,048</b>	<b>534,933</b>	<b>588,162</b>	<b>611,101</b>
<b>Total All Ages</b>	<b>4,016,710</b>	<b>4,356,748</b>	<b>4,659,542</b>	<b>4,937,427</b>
<b>% of Population Ages 9 to 19</b>	<b>12.1%</b>	<b>11.8%</b>	<b>11.8%</b>	<b>11.8%</b>
<b>% of Total Population (All Ages)</b>	<b>11.7%</b>	<b>11.6%</b>	<b>11.4%</b>	<b>11.4%</b>

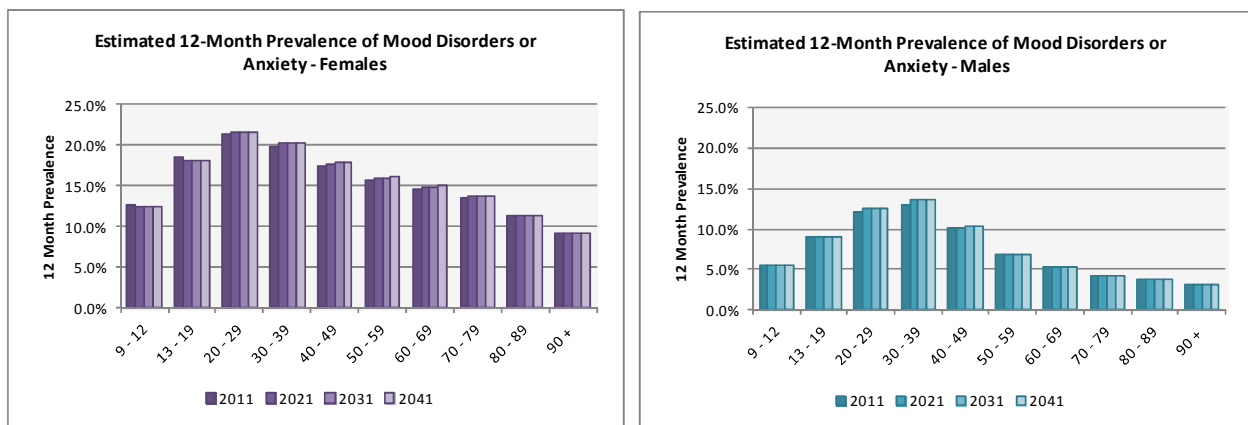
Figure 17 and Figure 18 show the estimated number and 12-month prevalence of mood or anxiety disorders by age-group and sex for 2011 and the next three decades. For both males and females, mood and anxiety disorders are most prevalent in young adulthood, between the ages of 20 and 39. For females, mood or anxiety was most prevalent for those aged 20 to 29 where prevalence was estimated to be constant from 2011 to 2041 at approximately 21.5%. For males, prevalence was estimated to be highest between ages 30 and 39, at about 13.5%.

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 17** Estimated Number of People with Mood or Anxiety Disorders in Canada (12-Month Prevalence) for Select Years 2011 to 2041



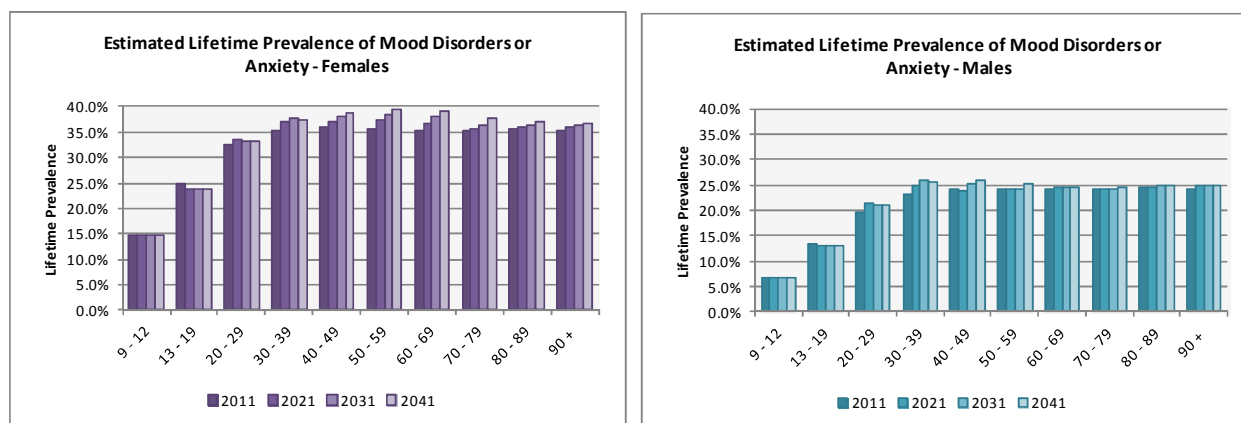
**Figure 18** Estimated 12-Month Prevalence of Mood or Anxiety Disorders in Canada for Select Years 2011 to 2041



The lifetime prevalence of mood or anxiety disorders is shown in Figure 19. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 19** Estimated Lifetime Prevalence of Mood or Anxiety Disorders in Canada for Select Years 2011 to 2041



For age-standardized prevalence, annual prevalence results and prevalence presented for mood and anxiety independently please refer to Appendix D.

### 3.1.6 SCHIZOPHRENIA

The estimated number and 12-month prevalence of schizophrenia is shown in Table 25. An estimated 210,540 people in 2011 are expected to be living with schizophrenia. With the aging of the Canadian population, this number is expected to increase by 34.3% to 282,790 in 2041.

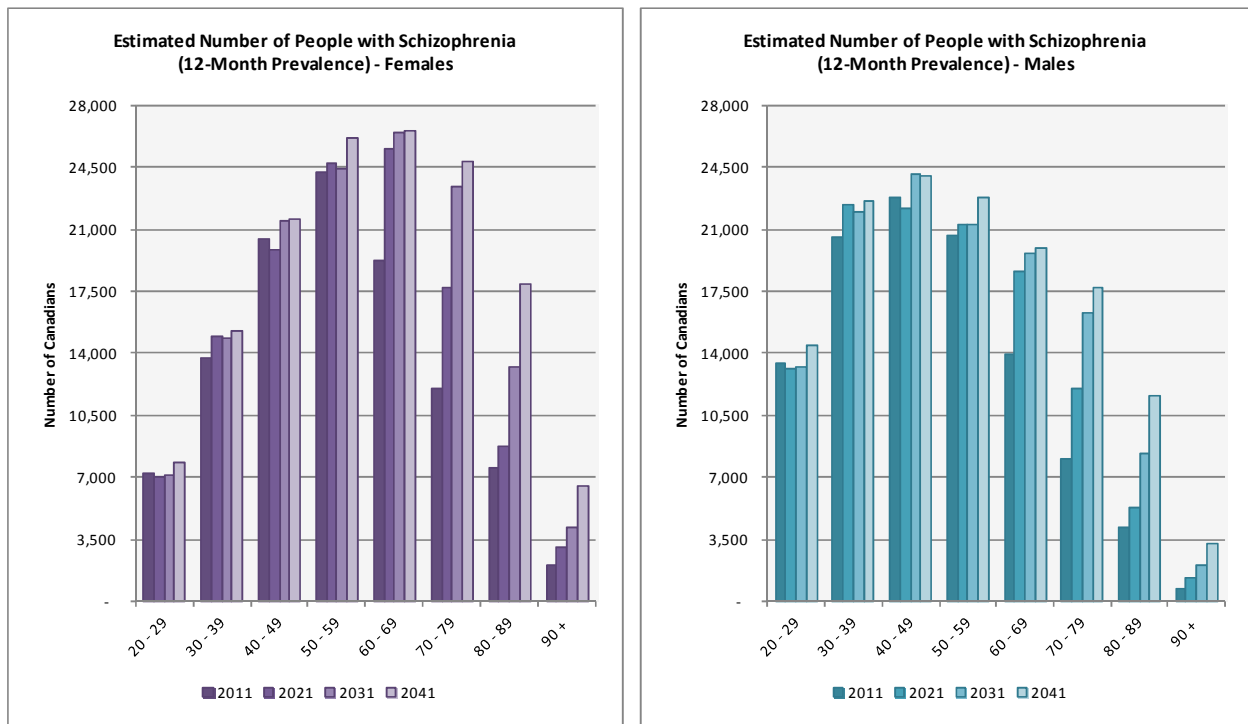
**Table 25** Estimated Number and 12-Month Prevalence of Schizophrenia in Canada for Select Years 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Schizophrenia in Canada</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Males	104,214	116,215	126,892	136,416
% of Male Total Population (All Ages)	0.61%	0.62%	0.63%	0.64%
Females	106,326	121,613	135,082	146,375
% of Female Total Population (All Ages)	0.61%	0.64%	0.66%	0.67%
<b>Total</b>	<b>210,540</b>	<b>237,828</b>	<b>261,974</b>	<b>282,790</b>
<b>% of Total Population (All Ages)</b>	<b>0.61%</b>	<b>0.63%</b>	<b>0.64%</b>	<b>0.65%</b>

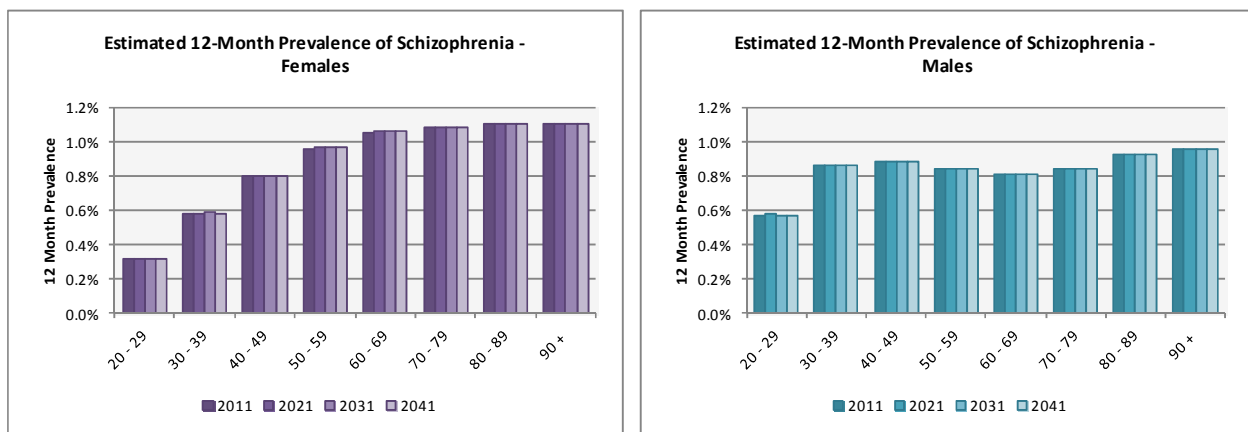
Figure 20 and Figure 21 show the estimated number and 12-month prevalence of schizophrenia by age-group and sex over the next 30 years. For females, prevalence is highest in those over the age of 60; whereas for males prevalence is highest in those ages 30 to 49. The higher prevalence of psychotic symptoms consistent with a diagnosis of schizophrenia in women over the age of 60 may be linked to reduced estrogen levels after menopause; estrogen may have a protective effect at younger ages (see Hafner *et al.* 1998; Riecher-Rossler and Hafner, 2000).

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 20** Estimated Number of People with Schizophrenia in Canada (12-Month Prevalence) for Select Years 2011 to 2041



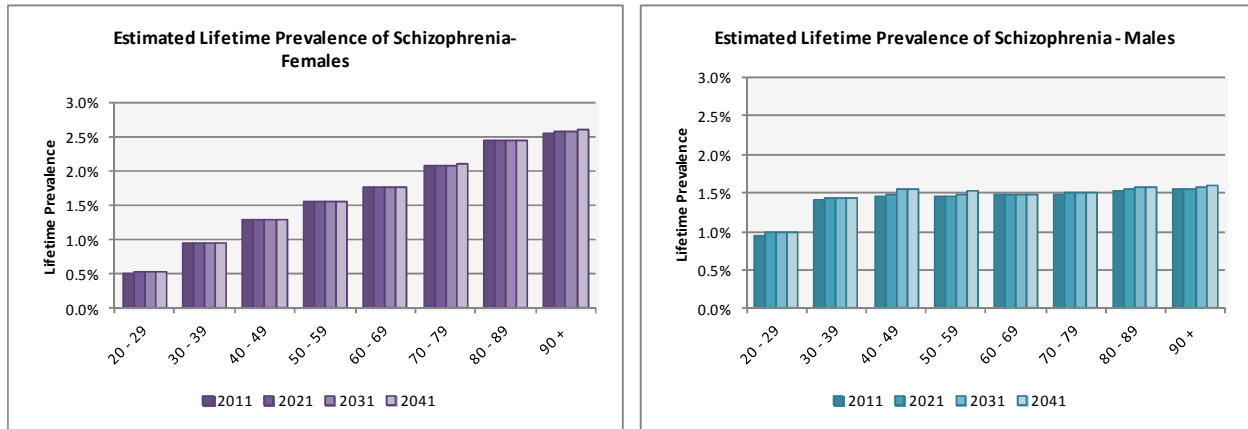
**Figure 21** Estimated 12-Month Prevalence of Schizophrenia in Canada for Select Years 2011 to 2041



The lifetime prevalence of schizophrenia is shown in Figure 22. The lifetime prevalence for females is shown to increase with age but remains relatively constant for males. The increase in lifetime prevalence for females is also a result of the longer life expectancy of females versus males. The likelihood of having schizophrenia in one's lifetime remains constant throughout the simulation timeframe. Note that although the lifetime prevalence for females exceeds the lifetime prevalence for

males at around age 50, the expected percentage of the total population with schizophrenia is very similar at 0.67% for females and 0.64% for males by 2041. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly. For age-standardized rates and annual prevalence results please refer to Appendix D.

**Figure 22** Estimated Lifetime Prevalence of Schizophrenia in Canada for Select Years 2011 to 2041



### 3.1.7 SUBSTANCE USE DISORDERS

As outlined in Section 2.7.2, within the model SUDs are comprised of substance dependence and/or abuse of: alcohol, cannabis, opioids (heroin and non-medical prescription opioids), cocaine, amphetamine/methamphetamine, and sedatives/tranquillizers. Table 26 shows the estimated number and 12-month prevalence of SUD in Canada in 2011 and over the next 30 years for males and females. In 2011, it was estimated that there are over 2.0 million people living with an SUD, of these approximately 72.5% are male. By 2041 the annual number of people living with an SUD is expected to increase by 10.1%, reaching over 2.2 million people or 5.1% of the total Canadian population. Given the steady state prevalence assumptions within the model, this increase is primarily driven by the growth of the population.



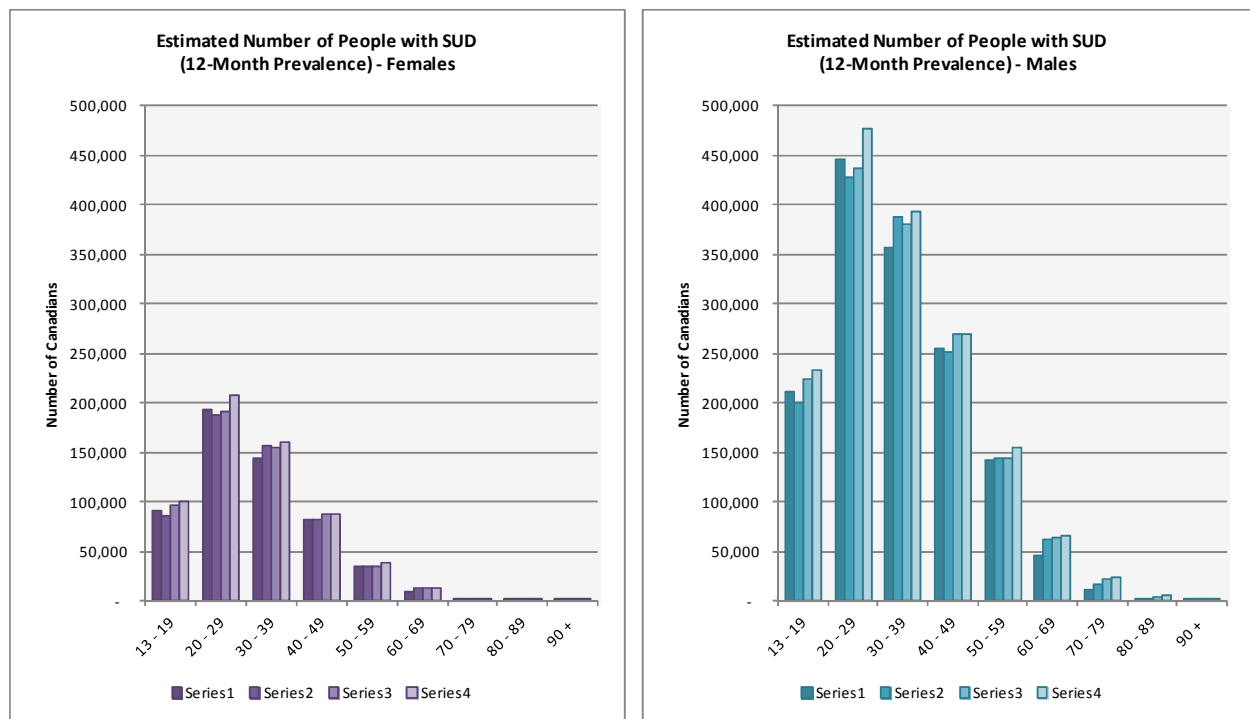
## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 26** Estimated Number and 12-Month Prevalence of SUD in Canada for Select Years 2011 to 2041

	Year			
	2011	2021	2031	2041
Males Ages 9 to 19	211,733	200,135	223,889	232,964
Males All Ages	1,471,148	1,491,545	1,546,771	1,622,281
% of Male Population Ages 9 to 19	9.3%	8.6%	8.8%	8.8%
% of Male Total Population (All Ages)	8.6%	8.0%	7.7%	7.6%
Females Ages 9 to 19	90,678	86,068	95,959	99,857
Females All Ages	558,058	563,937	582,654	611,711
% of Female Population Ages 9 to 19	4.2%	3.9%	4.0%	4.0%
% of Female Total Population (All Ages)	3.2%	3.0%	2.8%	2.8%
<b>Total Ages 9 to 19</b>	<b>302,410</b>	<b>286,202</b>	<b>319,847</b>	<b>332,821</b>
<b>Total All Ages</b>	<b>2,029,205</b>	<b>2,055,482</b>	<b>2,129,425</b>	<b>2,233,993</b>
<b>% of Population Ages 9 to 19</b>	<b>6.8%</b>	<b>6.3%</b>	<b>6.4%</b>	<b>6.4%</b>
<b>% of Total Population (All Ages)</b>	<b>5.9%</b>	<b>5.5%</b>	<b>5.2%</b>	<b>5.1%</b>

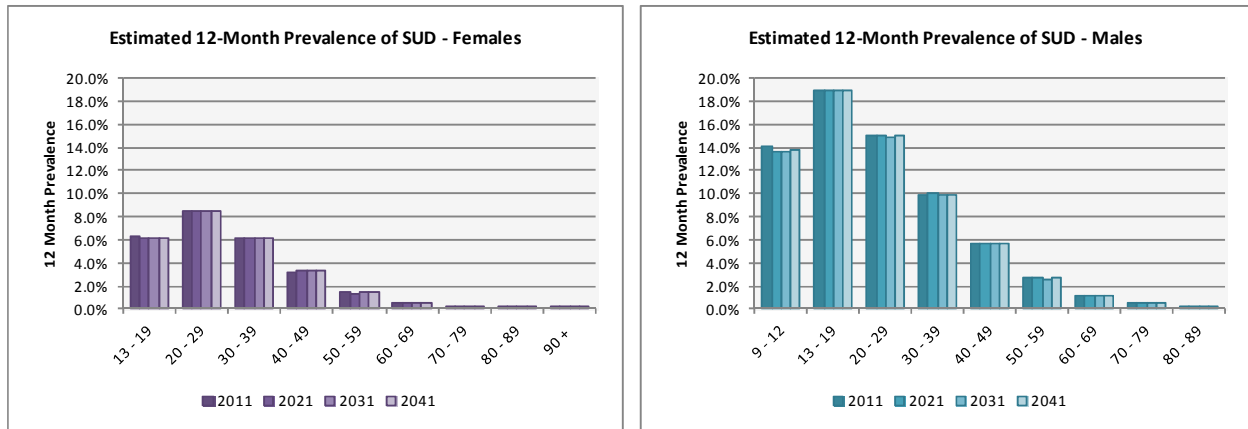
Figure 23 and Figure 24 show the estimated number and 12-month prevalence of SUD by age-group and sex in 2011 and over the next three decades. For both males and females, SUDs are most prevalent in young adulthood, between the ages of 20 and 29. For males in this age-group, SUDs were estimated to be 18.9% throughout the simulation timeframe; whereas for females they were estimated to be 8.5%.

**Figure 23** Estimated Number of People with SUD in Canada (12-Month Prevalence) for Select Years 2011 to 2041



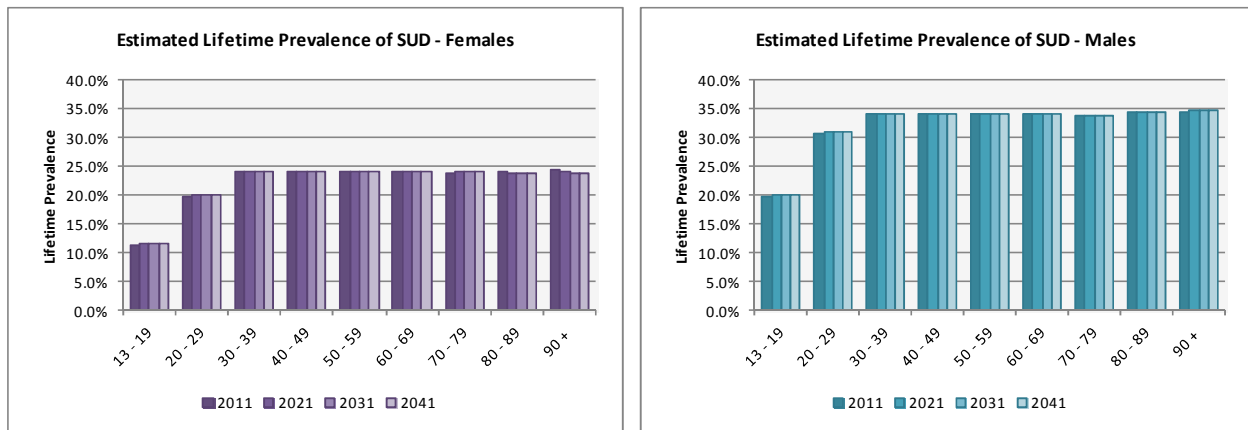
# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 24** Estimated 12-Month Prevalence of SUD in Canada for Select Years 2011 to 2041



The lifetime prevalence of SUDs is shown in Figure 25. The likelihood of having an SUD in one's lifetime is shown to remain constant over the age of 30. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly.

**Figure 25** Estimated Lifetime Prevalence of SUD in Canada for Select Years 2011 to 2041



For age-standardized rates and annual prevalence results please refer to Appendix D.

3.1.8 COGNITIVE IMPAIRMENT INCLUDING DEMENTIA

In 2011 the simulation results estimated a total of 747,129 Canadians would be living with dementia<sup>8</sup>; approximately 60.5% are female. Table 27 shows the estimated number and 12-month prevalence of dementia for males and females over the next 30 years. The annual number of people living with dementia is expected to increase over time. This is driven by the aging of the population. By 2041, the annual number of people living with dementia is expected to exceed 1.8 million, 2.4 times the current estimate.

**Table 27** Estimated Number and Prevalence of Cognitive Impairment including Dementia in Canada for Select Years 2011 to 2041

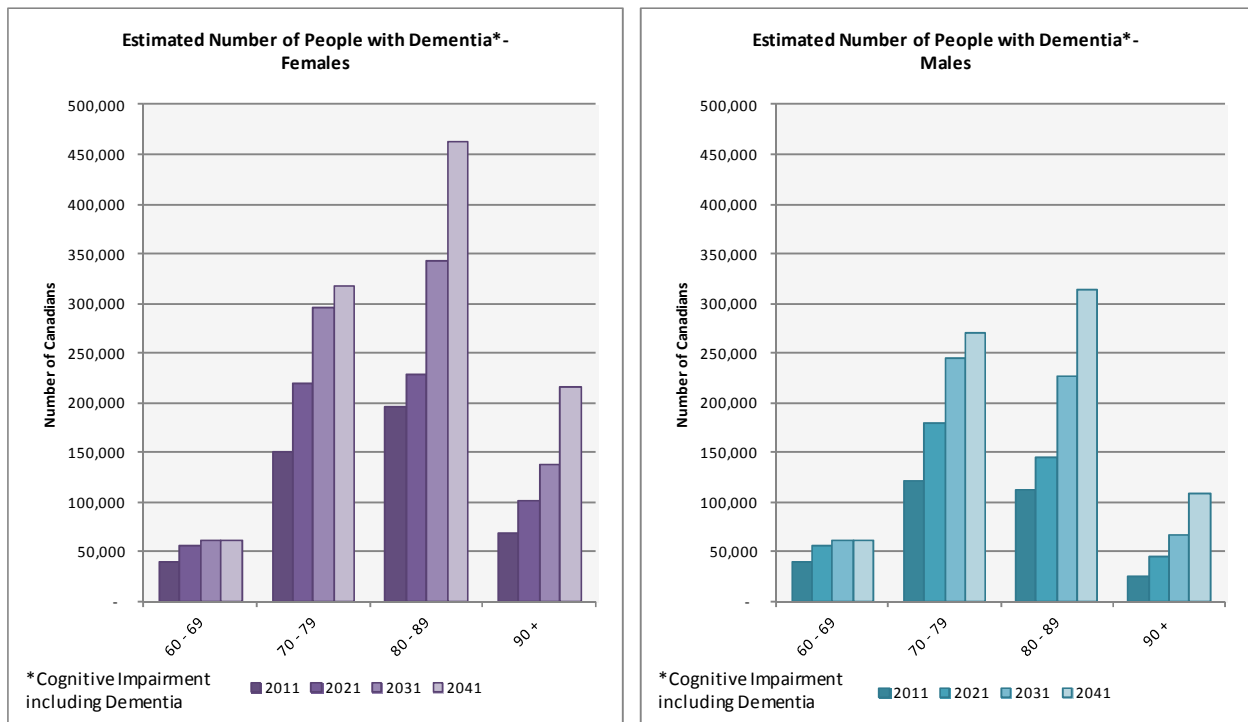
<b>Estimated Number and Prevalence of Dementia* in Canada</b>				
	<b>Year</b>			
* Cognitive Impairment Including Dementia	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Males	294,419	421,402	598,802	752,952
% of Male Total Population (All Ages)	1.7%	2.3%	3.0%	3.5%
Females	452,710	603,063	837,121	1,054,929
% of Female Total Population (All Ages)	2.6%	3.2%	4.1%	4.8%
<b>Total</b>	<b>747,129</b>	<b>1,024,465</b>	<b>1,435,923</b>	<b>1,807,881</b>
<b>% of Total Population (All Ages)</b>	<b>2.2%</b>	<b>2.7%</b>	<b>3.5%</b>	<b>4.2%</b>

Figure 26 and Figure 27 show the estimated number and 12-month prevalence of dementia by age-group and sex over the next three decades. In 2011 it was estimated that 194,744 females aged 80 to 89 would be living with dementia. By 2041 this number is expected to increase to 462,057. For males, the highest 12-month prevalence counts in 2011 were observed in those aged 70 to 79 where it was estimated that 120,205 would be living with dementia. By 2041 the highest 12-month prevalence counts for males were estimated to be among those aged 80 to 89 where 313,276 males would be living with the condition. As shown in Figure 27, 12-month prevalence as a percentage of the population is highest among those aged 90+ at 36.5% and 34.7% for females and males, respectively. The fairly constant age and sex specific 12-month and lifetime prevalence from 2011 to 2041 indicate that the incidence and remission rates were calibrated properly. For annual results please refer to Appendix D.

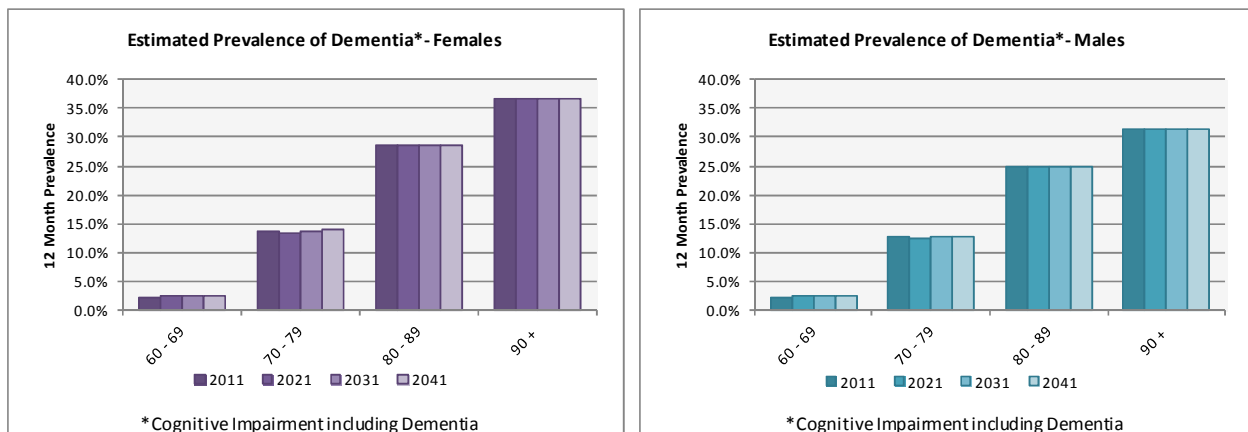
<sup>8</sup> Dementia includes cognitive impairment.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 26** Estimated Number of People with Cognitive Impairment including Dementia in Canada for Select Years 2011 to 2041



**Figure 27** Estimated Prevalence of Cognitive Impairment including Dementia in Canada for Select Years 2011 to 2041



### 3.2 CHILDHOOD AND ADOLESCENT TRANSITIONS

The results of meta-analysis of the unadjusted odds ratios and 95% confidence intervals shown in Section 2.7.2 are present in Table 28 and Table 29. The majority of odds ratios are statistically

significant, and strong homotypic<sup>9</sup> correlations are seen in both the childhood to adolescent and the adolescent to adult transitions. In addition, the odds ratios between externalizing disorders tend to be higher than between externalizing and internalizing disorders. A more detailed discussion of the meta-analysis results can be found in Copeland *et al.* (in preparation).

**Table 28** Transition Odds Ratios and 95% Confidence Intervals for Childhood to Adolescent Mental Illnesses

Childhood Illness	Adolescent Illness					
	ADHD	Anxiety	Conduct Disorders	Mood Disorders	ODD	SUD
<b>ADHD</b>	15.74 (7.20 - 34.40)	1.71 (0.99 - 9.28)	1.94 (0.63 - 5.99)	2.04 (1.13 - 3.67)	5.38 (2.69 - 10.75)	1.34 (0.31 - 5.85)
<b>Anxiety</b>	5.27 (2.27 - 12.22)	3.24 (1.82 - 5.78)	2.30 (1.30 - 4.05)	3.08 (1.83 - 5.19)	2.56 (0.97 - 6.78)	1.40 (0.75 - 2.59)
<b>Conduct Disorders</b>	10.38 (5.29 - 20.34)	1.09 (0.54 - 2.21)	6.92 (2.31 - 20.73)	1.24 (0.67 - 2.28)	3.71 (1.90 - 7.27)	2.14 (1.24 - 3.69)
<b>Mood Disorders</b>	5.61 (2.61 - 12.05)	3.72 (0.92 - 15.08)	3.55 (1.98 - 6.37)	3.84 (1.58 - 9.33)	4.39 (2.25 - 8.56)	2.94 (1.64 - 5.27)
<b>ODD</b>	5.24 (2.54 - 10.84)	2.49 (1.07 - 5.78)	3.40 (2.07 - 5.58)	2.38 (0.90 - 6.31)	5.24 (2.59 - 10.60)	1.88 (1.13 - 3.13)

Shaded cells are significant

**Table 29** Transition Odds Ratios and 95% Confidence Intervals for Adolescent to Adult Mental Illnesses

Adolescent Illness	Adult Illness		
	Anxiety	Mood Disorders	SUD
<b>ADHD</b>	2.43 (1.63 - 3.57)	1.24 (0.61 - 2.49)	2.88 (1.95 - 4.24)
<b>Anxiety</b>	3.95 (2.89 - 5.39)	2.56 (1.78 - 3.68)	1.05 (0.87 - 1.28)
<b>Conduct Disorders</b>	1.90 (1.48 - 2.43)	1.80 (1.19 - 2.74)	4.30 (2.53 - 7.32)
<b>Mood Disorders</b>	3.60 (2.21 - 5.87)	3.40 (2.76 - 4.19)	1.49 (0.92 - 2.40)
<b>ODD</b>	3.18 (1.49 - 6.76)	2.18 (1.24 - 3.85)	2.21 (1.66 - 2.93)
<b>SUD</b>	1.69 (1.38 - 2.08)	1.94 (1.43 - 2.62)	5.96 (4.30 - 8.27)

Shaded cells are significant

<sup>9</sup> Homotypic continuity refers to mental illnesses that are unaffected as the individual ages, thus the characteristics of such disorders are maintained and the mental illness is more likely to remain continuous (Goldberg and Goodyer, 2005).

Table 30 shows the relative risk of adolescent mental illnesses given prior childhood illnesses derived from the transition odds ratios and childhood and adolescent prevalence constraints. In all cases, there is a substantial relative risk associated with each transition. The estimated relative risks are sex-dependent. As the meta-analysis ORs are sex-independent, the sex-dependence arises from the use of sex-dependent prevalence rates in the calculations.

The relative risks of an adult mental illness given prior adolescent illness are shown in Table 31. The relative risks tend to be lower than in the childhood to adolescent transitions, though still relatively large. Please note that no relative risks were associated with dementia or schizophrenia as these were excluded from the meta-analysis.

**Table 30** Relative Risk of Adolescent Mental Illness Given Prior Childhood Illness

Prior Childhood Illness	Adolescent Illness					
	ADHD	Anxiety	Conduct Disorders	Mood Disorders	ODD	SUD
	<i>Male</i>					
<b>ADHD</b>	-	1.66	1.89	1.99	4.99	2.88
<b>Anxiety</b>	4.14	-	2.22	2.93	2.47	1.34
<b>Conduct Disorders</b>	6.54	1.09	-	1.23	3.50	3.38
<b>Mood Disorders</b>	4.28	3.33	3.31	-	4.09	2.45
<b>ODD</b>	4.06	2.33	3.18	2.30	-	3.09
	<i>Female</i>					
<b>ADHD</b>	-	1.60	1.92	1.92	4.98	3.17
<b>Anxiety</b>	5.10	-	2.27	2.78	2.50	1.37
<b>Conduct Disorders</b>	9.46	1.08	-	1.22	3.53	3.92
<b>Mood Disorders</b>	5.39	3.00	3.45	-	4.17	2.71
<b>ODD</b>	5.01	2.17	3.30	2.20	-	3.54

**Table 31** Relative Risk of Adult Mental Illness Given Prior Adolescent Illness

Prior Adolescent Illness	Adult Illness - Male			Adult Illness - Female		
	Anxiety	Mood Disorders	SUD	Anxiety	Mood Disorders	SUD
<b>ADHD</b>	2.21	1.23	2.23	2.00	1.22	2.52
<b>Anxiety</b>	-	2.43	1.04	-	2.33	1.05
<b>Conduct Disorders</b>	1.78	1.74	2.81	1.67	1.69	3.46
<b>Mood Disorders</b>	3.05	-	1.38	2.70	-	1.44
<b>ODD</b>	2.74	2.08	1.84	2.40	1.99	2.03
<b>SUD</b>	2.59	1.88	-	2.31	1.81	-

The high relative risks associated with the transitions from childhood to adolescence through to adulthood highlight the important role of early identification and treatment in potentially reducing the likelihood of subsequent mental illness later in life, as well as the need for intervention research to further understand and quantify the potential for treatment to prevent subsequent illness.

### 3.3 ECONOMIC COSTS OF MENTAL ILLNESS IN CANADA

The economic costs of mental illness in Canada include not only the direct health costs, but also the social and community costs, income support and other services included in Jacobs *et al.* (2010). Refer to Section 2.7.3 for a complete list and other costs not included in the model.

All costs presented in the following sections include a 2% inflation rate on top of an average 2.8% real cost increase. Present values are discounted at 3% annually. A sensitivity analysis of all costs to inflation and discount rates can be found in Appendix E. Annual values are reported in Appendix D.

#### 3.3.1 DIRECT ECONOMIC COSTS

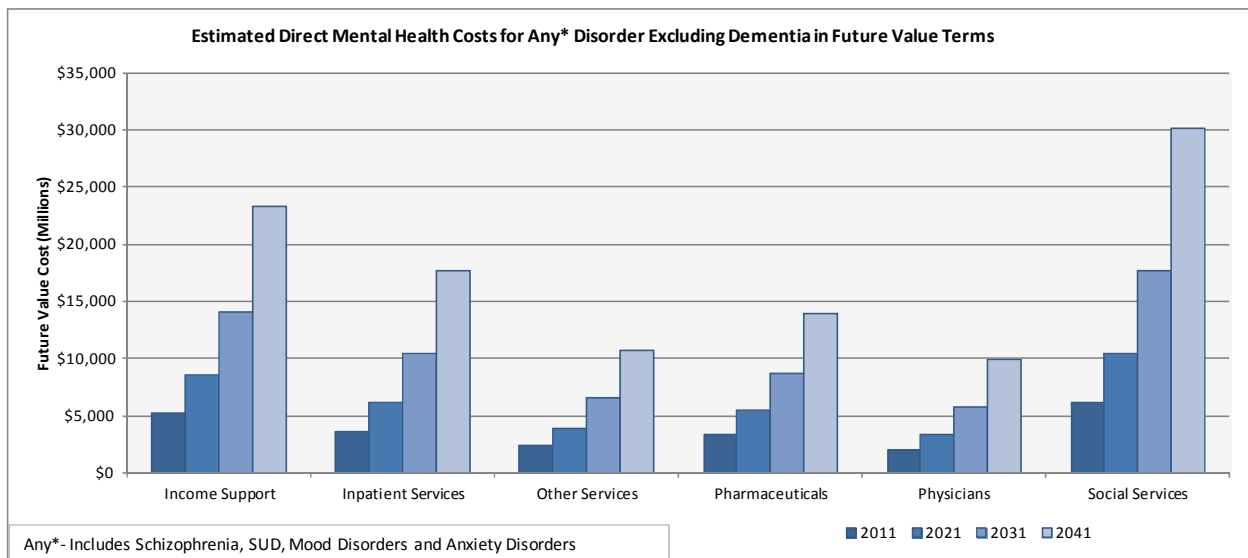
The prevalence-based cost estimates, based on the average cost per prevalent case, provided the most complete means to estimate the total economic costs of mental illness in Canada since the range of cost components included the majority of services used by those with mental illness and was much more inclusive of services than the data available for the utilization-based cost estimates. Nonetheless, the utilization-based methods provide insight into the differences in service use for select services due to select mental illnesses.

**Prevalence-Based Costs**

The prevalence-based costs estimate was divided into costs associated with cognitive impairment including dementia and costs due to the other mental illnesses included in the model due to the data sources available (Section 2.7.3).

The total direct costs of mental illness excluding dementia in Canada in 2011 are estimated to be over \$22 billion dollars. The magnitude of each of the cost categories for these mental illnesses is shown in Figure 28 in future value terms. Social and community services and income support are the two largest cost categories. As shown in Table 32, over the next 30 years, the nominal costs associated with mental illnesses excluding dementia will increase by over 4.6 times. The present value (in 2011 dollars) of the cumulative direct costs over that time frame, shown in Table 33, is estimated to be over \$990 billion dollars.

**Figure 28** Estimated Total Direct Costs for All Mental Illnesses\* Excluding Dementia in Future Value Terms





**Table 32** Estimated Annual Total Direct Costs for All Mental Illnesses\* Excluding Dementia in Future Value Terms

<b>Estimated Direct Costs for Any* Mental Illness Excluding Dementia in Future Value Terms</b>						
<b>(in \$ Millions)</b>						
	<b>Year</b>					
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>		
Income Support	\$ 5,158.0	\$ 8,518.4	\$ 14,119.3	\$ 23,279.6		
Inpatient Services	\$ 3,587.6	\$ 6,100.7	\$ 10,411.8	\$ 17,676.0		
Other Services	\$ 2,384.9	\$ 3,938.7	\$ 6,528.4	\$ 10,763.9		
Prescription Drugs	\$ 3,380.3	\$ 5,421.4	\$ 8,726.4	\$ 13,972.4		
Physicians	\$ 1,941.0	\$ 3,332.9	\$ 5,743.7	\$ 9,846.2		
Social Services	\$ 6,109.6	\$ 10,389.2	\$ 17,730.9	\$ 30,101.4		
<b>Total Direct Costs</b>	<b>\$ 22,561.4</b>	<b>\$ 37,701.2</b>	<b>\$ 63,260.4</b>	<b>\$ 105,639.5</b>		

\*Any includes mood, anxiety, schizophrenia, SUD

**Table 33** Estimated Cumulative Total Direct Costs of All Mental Illness\* Excluding Dementia in 2011 Present Value Terms

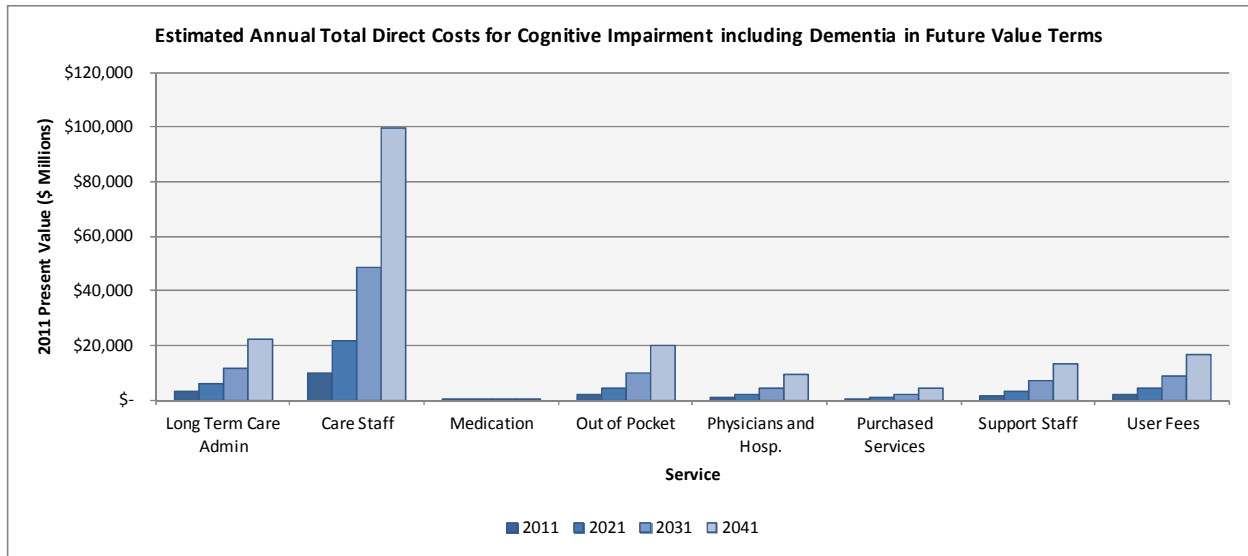
<b>Estimated Present Value of Cumulative Direct Costs for Any* Mental Illness Excluding Dementia</b>						
<b>(in 2011, \$ Millions)</b>						
	<b>Year</b>					
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>		
Income Support	\$ 5,158.0	\$ 63,002.2	\$ 134,290.1	\$ 221,956.6		
Inpatient Services	\$ 3,587.6	\$ 44,494.9	\$ 96,405.2	\$ 162,134.3		
Other Services	\$ 2,384.9	\$ 29,130.7	\$ 62,092.5	\$ 102,627.3		
Prescription Drugs	\$ 3,380.3	\$ 40,666.0	\$ 85,289.5	\$ 138,580.9		
Physicians	\$ 1,941.0	\$ 24,195.8	\$ 52,712.5	\$ 89,173.2		
Social Services	\$ 6,109.6	\$ 75,772.9	\$ 164,174.0	\$ 276,107.9		
<b>Total Direct Costs</b>	<b>\$ 22,561.4</b>	<b>\$ 277,262.4</b>	<b>\$ 594,963.7</b>	<b>\$ 990,580.1</b>		

\*Any includes mood, anxiety, schizophrenia, SUD

The direct costs associated with cognitive impairment including dementia are shown in Figure 29, Table 34 and Table 35. The primary contributor to dementia costs is for care staff. Of the total dementia costs, care staff account for about half. The annual costs in future values by 2041 could increase by almost 10-fold and exceed \$185 billion compared to the \$20 billion costs in 2011. The cumulative present value burden of dementia in 2011 dollars is over \$1.3 trillion dollars.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 29** Estimated Annual Total Direct Costs for Cognitive Impairment Including Dementia in Future Value Terms



**Table 34** Estimated Annual Total Direct Costs Associated with Cognitive Impairment Including Dementia in Future Value Terms

<b>Estimated Direct Prevalence-Based Costs Associated with Dementia in Future Value Terms</b>				
<b>(in \$ Millions)</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Administrative Costs	\$ 2,855.8	\$ 5,677.7	\$ 11,746.3	\$ 22,003.5
Care Staff	\$ 9,844.4	\$ 21,682.2	\$ 48,776.2	\$ 99,728.0
Prescription Drugs	\$ 23.1	\$ 48.3	\$ 104.0	\$ 203.3
Out of Pocket	\$ 1,988.0	\$ 4,423.0	\$ 9,936.3	\$ 19,940.5
Physicians and Hospital	\$ 773.1	\$ 1,814.2	\$ 4,307.5	\$ 9,280.8
Purchased Services	\$ 369.5	\$ 858.3	\$ 2,005.4	\$ 4,246.5
Support Staff	\$ 1,705.4	\$ 3,390.6	\$ 7,014.7	\$ 13,140.1
User Fees	\$ 2,181.5	\$ 4,337.1	\$ 8,972.9	\$ 16,808.2
<b>Total Direct Costs</b>	<b>\$ 19,740.9</b>	<b>\$ 42,231.4</b>	<b>\$ 92,863.1</b>	<b>\$ 185,350.9</b>

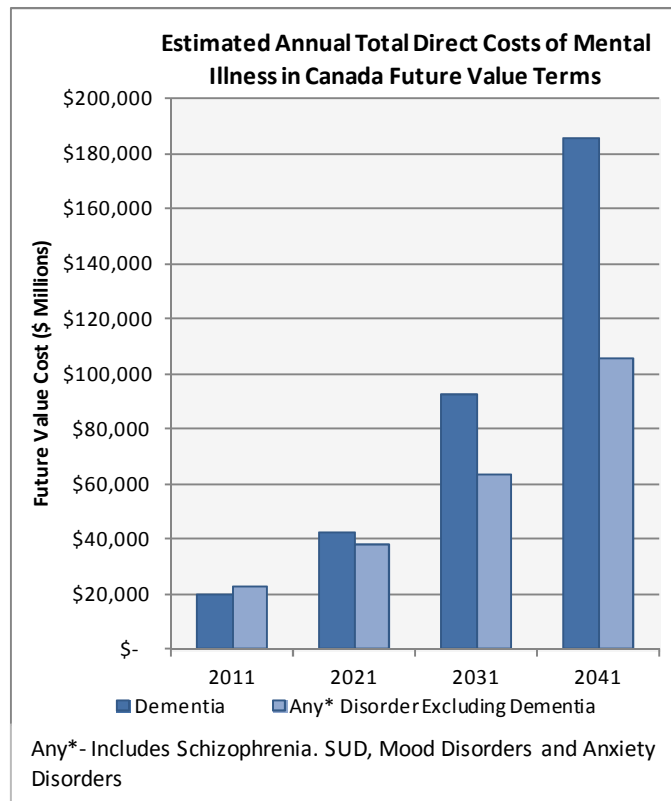
## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 35** Estimated Cumulative Total Direct Costs Associated with Cognitive Impairment Including Dementia in 2011 Present Value Terms

<b>Estimated Cumulative Direct Prevalence-Based Costs Associated with Dementia in 2011 Present Value Terms</b>				
<b>(in \$ Millions)</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Administrative Costs	\$ 2,855.8	\$ 38,234.6	\$ 92,407.6	\$ 171,691.3
Care Staff	\$ 9,844.4	\$ 139,984.4	\$ 357,147.3	\$ 703,504.8
Prescription Drugs	\$ 23.1	\$ 318.9	\$ 790.4	\$ 1,509.6
Out of Pocket	\$ 1,988.0	\$ 28,385.4	\$ 72,759.7	\$ 142,526.6
Physicians and Hospital	\$ 773.1	\$ 11,405.9	\$ 30,168.4	\$ 61,715.2
Purchased Services	\$ 369.5	\$ 5,426.7	\$ 14,219.0	\$ 28,759.1
Support Staff	\$ 1,705.4	\$ 22,833.0	\$ 55,183.9	\$ 102,530.5
User Fees	\$ 2,181.5	\$ 29,207.0	\$ 70,589.0	\$ 131,152.9
<b>Total Direct Costs</b>	<b>\$ 19,740.9</b>	<b>\$ 275,796.0</b>	<b>\$ 693,265.3</b>	<b>\$ 1,343,390.1</b>

Figure 30 compares the trends in total direct costs due to cognitive impairment including dementia and the direct costs for other mental illnesses. While other mental illnesses currently exceed the costs associated with dementia, overtime the annual dementia-associated costs are shown to exceed the annual costs of all other mental illnesses combined. This increase, due to the rising number of people with dementia, is driven by the rapidly aging population. Of the included costs, cognitive impairment including dementia accounts for 47% of the total direct costs included in the analysis. By 2041, this could grow to 64% of the total direct costs.

**Figure 30** Estimated Annual Total Direct Costs of Mental Illness in Canada in Future Value Terms



**Table 36** Estimated Total Direct Costs for All Mental Illness\* (Present values are in 2011 dollars.)

<b>Estimated Total Direct Costs for All* Mental Illnesses (in \$ Millions)</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Annual Future Value	\$ 42,302.3	\$ 79,932.5	\$ 156,123.5	\$ 290,990.4
Cumulative Present Value	\$ 42,302.3	\$ 553,058.4	\$ 1,288,228.9	\$ 2,333,970.0

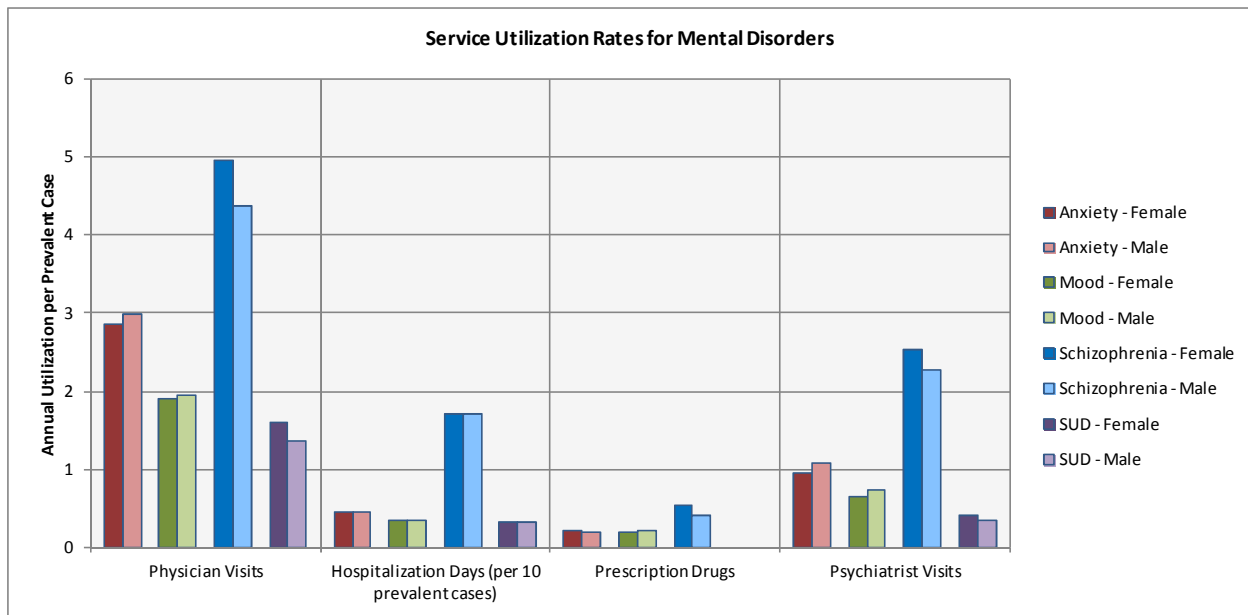
The total costs for all mental illnesses included in the model are presented in Table 36. The annual nominal costs are expected to rise by almost 600% over the next 30 years. The cumulative present value of the direct costs of mental illness over the next 30 years is estimated to be over \$2.3 trillion.

**Utilization Estimates and Relative Costs**

While the prevalence-based costs provide a broad overview of the economic consequences of all mental illnesses, the utilization rates and unit cost estimates highlight the difference in demand due to specific

mental illnesses. For each of anxiety, mood disorders, schizophrenia and SUD, Figure 31 shows the relative service utilization rates for physician (excluding psychiatrists) visits, psychiatrist visits, hospitalization days, and prescription drug use. While the prevalence of schizophrenia is low (Section 3.1.6), patients with schizophrenia have the highest service utilization rates in each category. Patients with SUDs have the lowest utilization rates; however note that data on prescription drugs (i.e. methadone) for those with SUD were not available and those rates are excluded from this analysis.

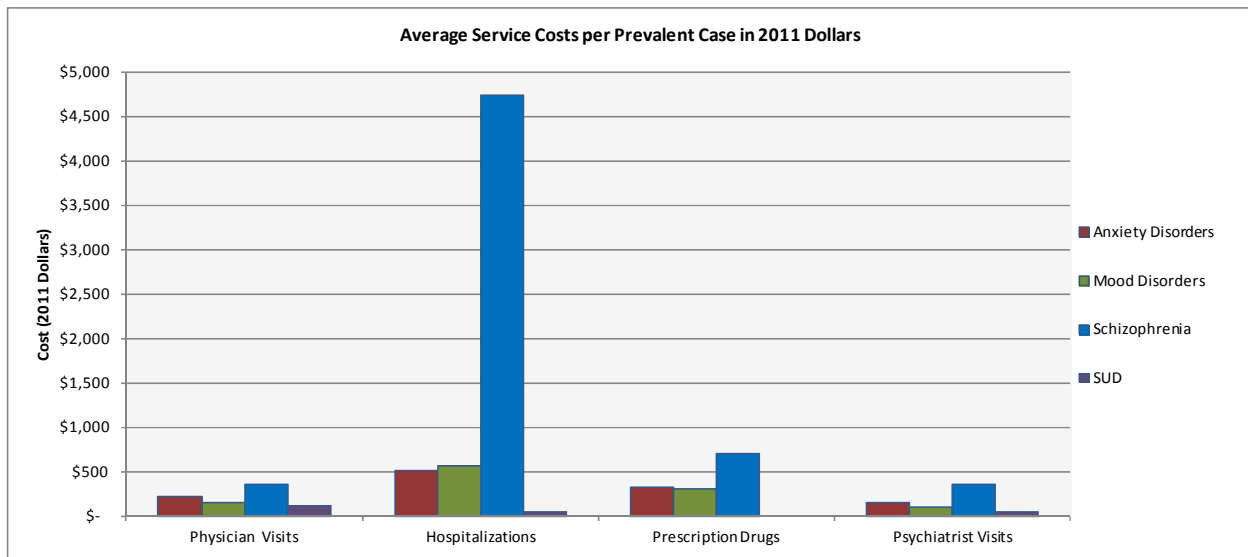
**Figure 31** Selected Service Utilization for Anxiety, Mood Disorders, Schizophrenia and SUD (Martens *et al*, 2004)



Using the total non-dementia costs as constraints along with the utilization rates, yields estimates for the average per-prevalent case unit costs for each combination of service and mental illness. As shown in Figure 32, not only do schizophrenia patients have the greatest utilization rates, they also have the greatest average costs per prevalent case. Similarly, SUD patients have the lowest per prevalent case costs.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 32** Average Service Costs per Prevalent Case for Anxiety, Mood Disorders, Schizophrenia and SUD in 2011 Dollars

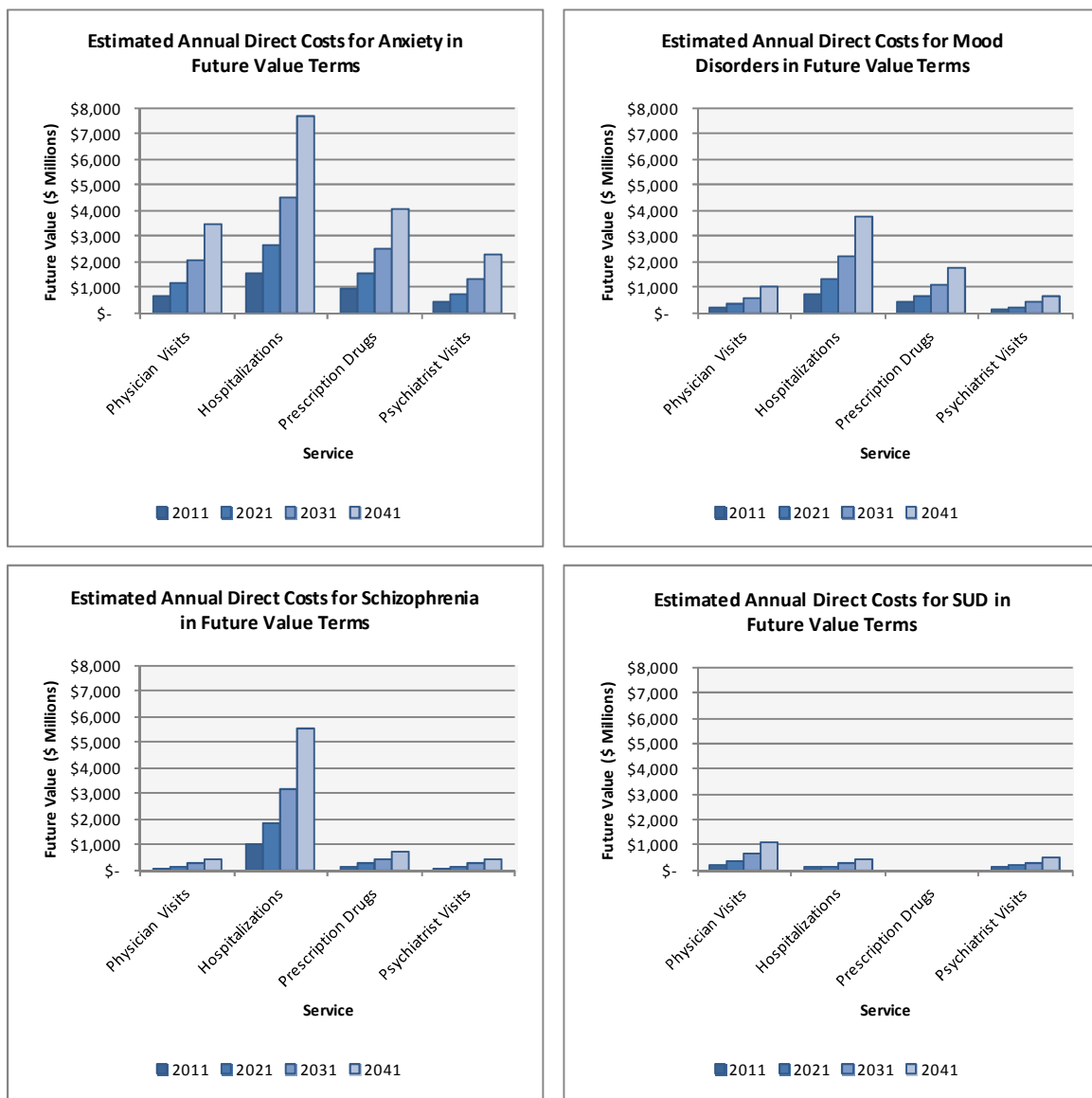


The annual direct costs for anxiety, mood disorders, schizophrenia and SUD are shown in Figure 33. The increase in nominal costs over the next 30 years is driven by real costs increases, inflation, and overall population growth (see Section 2.5.2). The majority of the costs from the health services included here are due to mood disorders and anxiety. The relative split between the two is based upon the utilization rate data from Manitoba (see Section 2.7.3).

While the prevalence of schizophrenia is low, the hospitalization costs are quite high due to the large number of hospitalization days which schizophrenia patients require on average. Unlike the other three illnesses, for SUD, the largest cost component is physician visits. It is important to note that overnight stays in private pay residential facilities and stays in detoxification centers or community-based addictions programs are not captured in these costs.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 33** Estimated Annual Direct Costs in Future Value Terms for Anxiety Disorders, Mood Disorders, Schizophrenia, and SUD



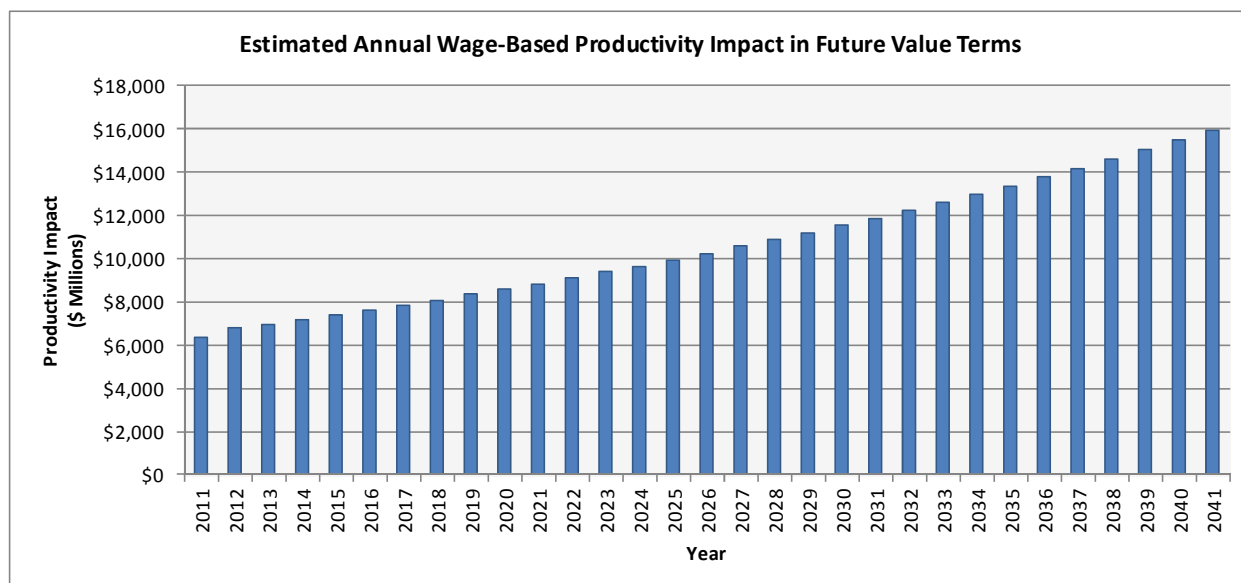
### 3.3.2 INDIRECT ECONOMIC COSTS

The indirect economic costs reflect the impact of illness upon the productivity of the labour force. Starting from the present-day state of the economy, the indirect economic consequences of mental illness are the forgone wages due to the presence of mental illness. Figure 34 shows the annual nominal wage impact due to mental illness over the next 30 years if mental illnesses were removed from the population at the beginning of 2011. Due to the compounding nature of the economy where small

## Life at Risk Analysis of The Impact of Mental Illness in Canada

annual improvements can grow over time to become much larger, the annual wage-based productivity impact grows to over \$15 billion by 2041 in nominal terms. The cumulative present value costs, shown in Table 37, exceed \$197 billion in 2011 dollars. In other words, if the government were to be able to borrow that amount today to invest in the elimination all mental illness in the population, the indirect economic benefits would recoup the costs over the next 30 years.

**Figure 34** Estimated Indirect Wage-Based Productivity Impact of Mental Illness in Canada in Future Values



**Table 37** Estimated Indirect Wage-Based Productivity Impact of Mental Illness in Canada (Present values are in 2011 dollars.)

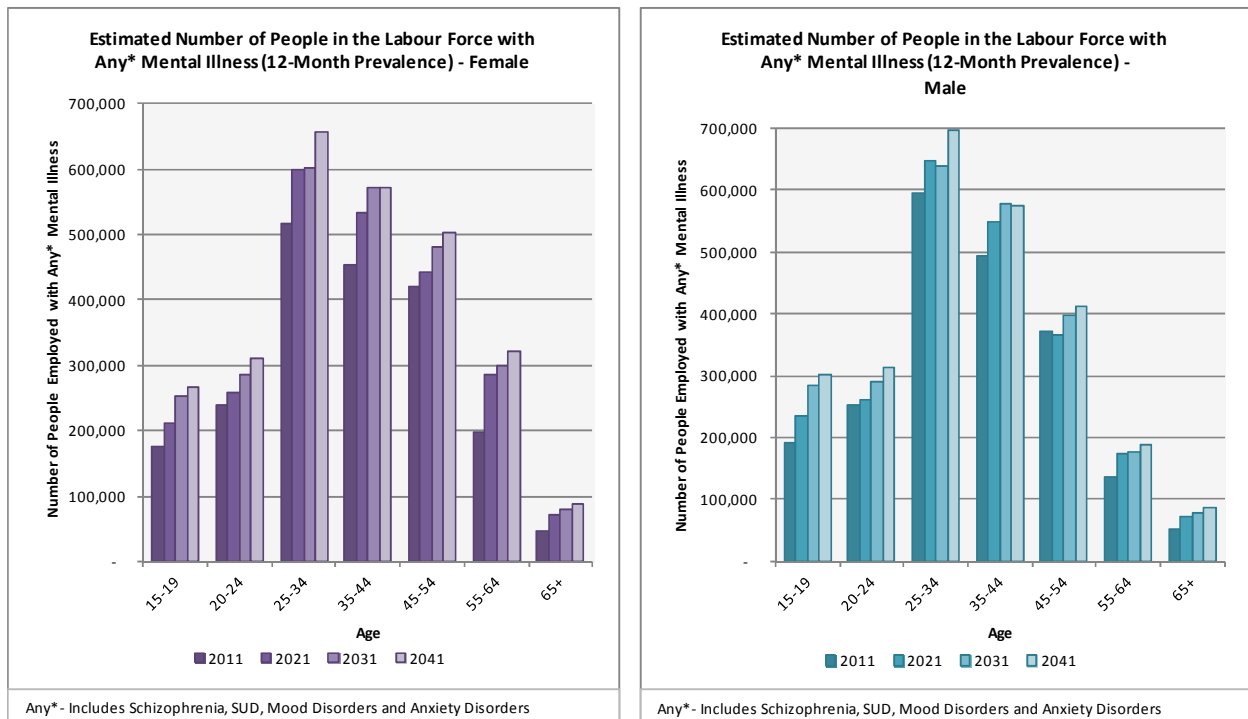
<b>Estimated Wage-Based Productivity Impact for All* Mental Illnesses (in \$ Millions)</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Annual Future Value	\$ 6,382.9	\$ 8,835.4	\$ 11,874.0	\$ 15,957.7
Cumulative Present Value	\$ 6,382.9	\$ 70,211.6	\$ 134,040.2	\$ 197,868.9

As shown in Figure 35, the number of people with mental illness in the labour force will continue to increase in the future across all ages and for both men and women. In particular, as individuals stay in the labour force longer, the prevalence in the oldest age group shows an increase. With the aging of the population, this component of the labour force will become increasingly important in the future.

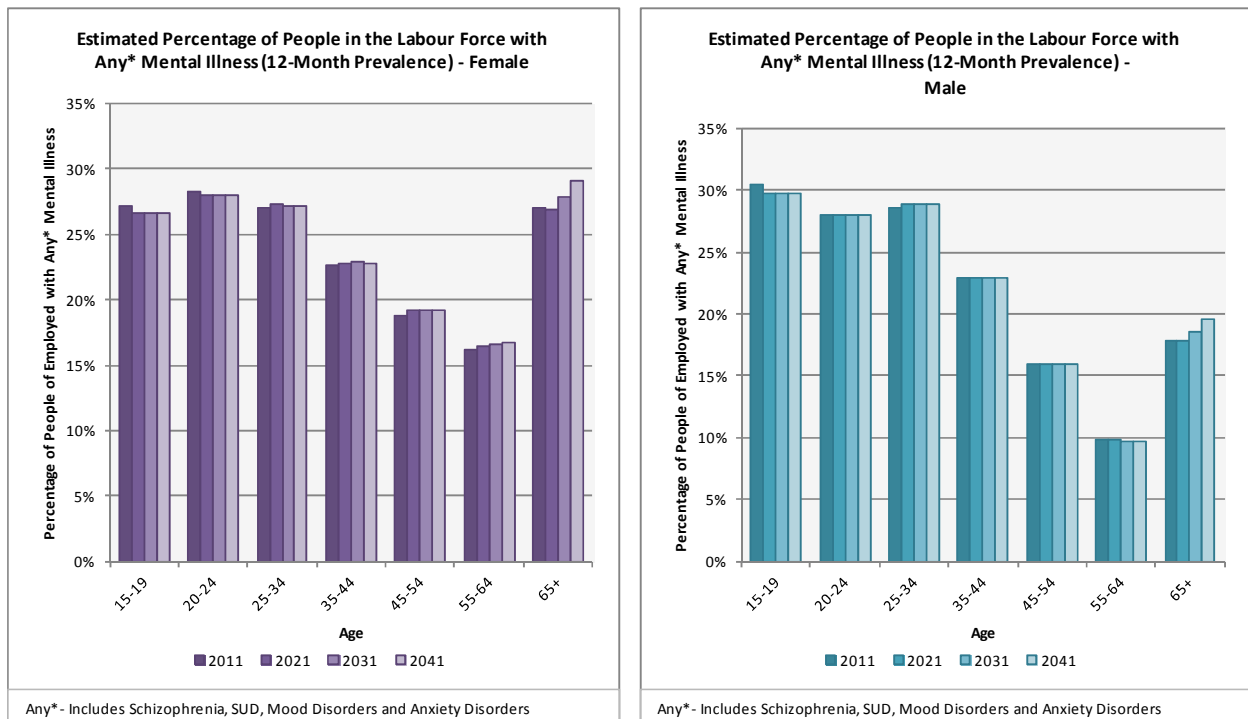


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**Figure 35** Estimated Number of Employed Individuals with Mental Illness in Canada for Select Years 2011 to 2041



**Figure 36** Estimated Prevalence (12-month) of Any Mental Illness\* Among the Employed for Select Years 2011 to 2041

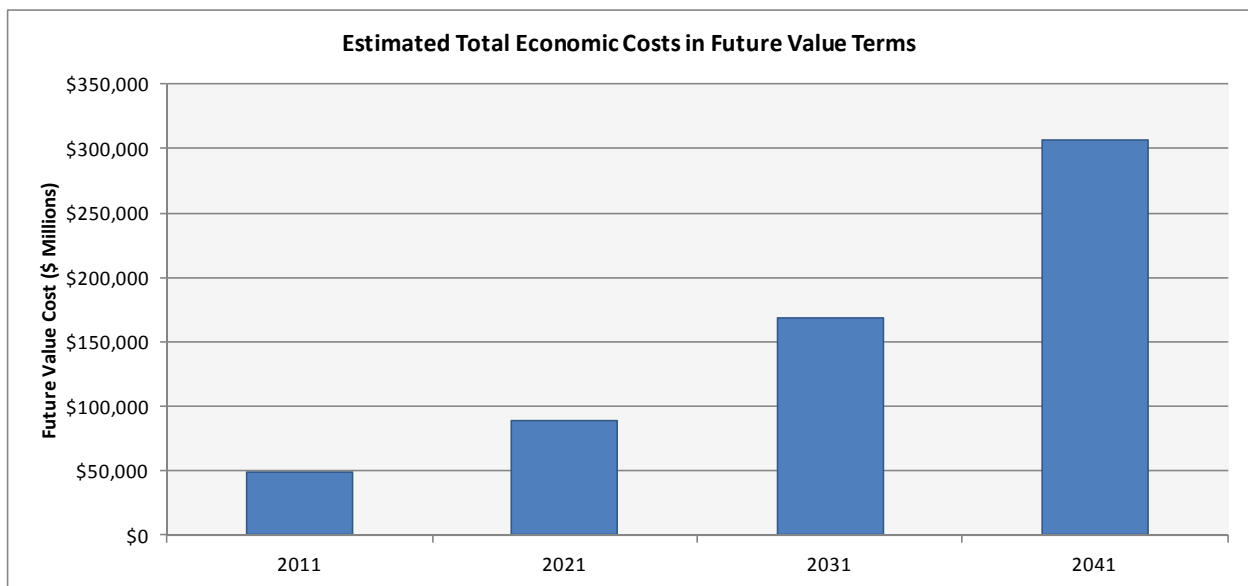


3.3.3 TOTAL ECONOMIC IMPACT OF MENTAL ILLNESS

The total economic consequence of mental illness in Canada in this model is the combination of the direct economic costs plus the indirect economic costs. In nominal terms, the total annual economic costs associated with mental illness are expected to exceed \$306 billion by 2041. Figure 37 highlights the rapidly increasing annual economic consequences of mental illness in Canada. Over the next 30 years, the nominal annual costs will increase by over 6-fold.

As shown in Table 38, in 2011 present value terms, the total cumulative costs over the next 30 years could exceed \$2.5 trillion dollars. A large component of this cost is due to direct costs associated with cognitive impairment including dementia, the prevalence of which is increasing driven by the aging population.

**Figure 37** Estimated Annual Total Economic Impact of Mental Illness in Canada in Future Dollars



**Table 38** Estimated Total Economic Impact of Mental Illness in Canada

<i>Estimated Total Economic Impact of All* Mental Illnesses (in \$ Millions)</i>				
	Year			
	2011	2021	2031	2041
Annual Future Value	\$ 48,685.2	\$ 88,767.9	\$ 167,997.5	\$ 306,948.1
Cumulative Present Value	\$ 48,685.2	\$ 623,270.0	\$ 1,422,269.2	\$ 2,531,838.9

#### 3.3.4 HOMELESSNESS AND HOSPITALIZATIONS

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Of the total costs of hospitalization due to mental illness in Canada in 2011, estimated to be over \$3.4 billion dollars (Jacobs *et al.*, 2010), \$48 million of that, or 1.4%, is attributable to the homeless population. Given that only 0.5% of the population is homeless, this almost 3-fold increase is attributable to a combination of excess utilization and costs for homeless individuals and the high prevalence of mental illness in the homeless population. This connection between homelessness, mental illness and higher than average costs likely extends beyond hospitalizations, but data are not currently available to extend the analysis.

## 4 CONCLUSIONS

### 4.1 GENERAL CONCLUSIONS AND IMPLICATIONS

The results of this study provide an indication of the size and shape of the impact of mental illness (mood disorders, anxiety disorders, schizophrenia, SUDs, ADHD, conduct disorder, ODD, and cognitive impairment including dementia) on Canadian society based on a simulated model of available data with reasonable and conservative assumptions.

The aging population and concurrent factors such as heart disease and type II diabetes are expected to contribute to the rise in the number of people with mental illness in Canada. The current analysis estimated that the numbers of Canadians with a major mental illness is expected to increase by 31.1% within the next 30 years and will eventually affect over 8.9 million Canadians annually, accounting for approximately 20.5% of the total population of Canada. This increase is primarily driven by Canada's population growth, wherein the number of Canadians is expected to increase from 34.5 million in 2011 to 43.4 million in 2041, a 26.4% increase. This estimated burden is expected to have a substantial impact on the capacity of the public and private health care systems to provide essential mental health care services, community care as well as patient and caregiver support services. The impact on families is unknown but expected to be significant.

The most common mental illnesses in Canada among adults and youth are mood and anxiety disorders affecting over 4.0 million Canadians in 2011. In 30 years, approximately 4.9 million Canadians (including children and adolescents) are expected to be living with a mood or anxiety disorder.

The simulation model also estimated that there are over one million Canadian children and adolescents between the ages of 9 and 19 years living with a mental illness<sup>10</sup> in Canada. Over the next generation, this number is estimated to reach over almost 1.2 million. Individuals who develop a mental illness during either childhood or adolescence are at considerable risk of developing another mental illness in adulthood and today only a small proportion receive treatment.

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<sup>10</sup> Childhood and adolescent mental illnesses included in the model are mood disorders, anxiety disorders, CDs, ODD, ADHD and SUDs (for adolescents only).

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Mental illness was estimated to cost the Canadian economy over \$42.3 billion dollars today in direct costs for all mental illness including dementia. Of this, \$21.3 billion dollars are costs to the health care system. This accounts for approximately 10.6% of the estimated \$200.5 billion dollars spent on health care in Canada in 2011 (Canadian Institute of Health Information, 2011). In addition, the indirect economic impact of mental illnesses in Canada exceeds \$6.3 billion dollars annually with approximately 2 of every 9 workers (or 21.4% of the working population) estimated to have a mental illness that potentially affects their productivity at work.

When compared to the direct costs of cognitive impairment including dementia, the annual direct costs of all other mental illnesses are estimated to be greater in 2011. Here the costs of all mental illnesses excluding dementia were estimated to be \$22.6 whereas the dementia costs were estimated to be \$19.7 billion dollars. However, over the next 30 years as the population ages and the number of people living with dementia increases relative to other mental illnesses, the annual costs of dementia are expected to exceed the costs of all other mental illnesses combined, accounting for 64% of the total direct costs of mental illness in Canada by 2041 or \$185.4 billion in annual future value terms. In contrast, the costs in 2041 for all mental illnesses excluding dementia were estimated to be \$105.6 billion in annual future value terms.

The utilization-based analysis for select illnesses and services indicated that among mood and anxiety disorders, substance use disorders, and schizophrenia, schizophrenia had the highest physician, hospitalization, prescription drug and psychiatrist costs per case.

### 4.2 STUDY LIMITATIONS AND FUTURE RESEARCH

The limitations of this study fall into two main categories – those that pertain to scope and those that pertain to data availability, quality or congruency. The availability of quality population-based data at a national level and in particular longitudinal data remains a key challenge in modeling the impact of mental illness. For this study a variety of data sources were used as inputs, each with its own strengths, weaknesses and limitations.

The Canadian and provincial data used in this analysis provided for reasonable approximations for the prevalence of adult mental illnesses and reasonable estimates for health care service use and costs to Canadian society. However, data from a national perspective were limited because they often did not

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include standardized mental illness definitions, diagnostic criteria or longitudinal trends. Furthermore, many available sources were dated. A key limitation was the availability of consistent, reliable and standardized Canadian data for childhood and adolescent illnesses (particularly for prevalence) as well as incidence data for all age-groups. Data on direct health care costs in Canada were also a challenge. While total cost estimates for a range of services were available from the Jacobs *et al.* (2010) report, these data are likely underestimated and could not be attributed to specific mental illnesses.

As a result of Canadian data limitations, the data used in this study were supplemented with proxy data from other countries. The international data used provided consistent definitions for the mental illnesses included in the study, allowed for an examination of longitudinal trends from childhood through to adulthood, and provided a reasonable approximation for mental illness incidence. Notwithstanding these strengths, the international datasets used may not be representative of Canadian setting or trends that we can expect for Canada.

The scope of this study focused on the life and economic impacts of major mental illnesses in Canada. As a result of data and time constraints the study does not include:

- All types of mental illnesses;
- Stratification of results by severity levels of the illness;
- Stratification of results by provinces and territories;
- The costs and impacts of sub-threshold disorders and the increased risk associated with future mental illnesses;
- Costs and impacts borne by informal caregivers providing unpaid care to those with mental illness;
- Excess service use and costs for those with mental illness not directly provided for the mental illness diagnosis;
- Additional physical comorbidities (eg. chronic pain or cancer<sup>11</sup>) linked to increased risk of mental illness or vice versa;
- Costs to the justice and social service systems related to mental illness;
- Education and child/youth service costs related to mental illness;

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<sup>11</sup> See Baillargeon *et al.* 2011

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- Mental illness within FNIM populations or immigrant populations;
- Incorporation of other risk factors such as socioeconomic status, adverse childhood experiences etc.;
- Incorporation of other outcomes such as leaving school early, early parenting and underemployment;
- Continuums of care (including community care) to support system change analysis;
- Supply and demand for mental health care resources;
- Time-dependent analysis of prevalence or incidence trends; and
- Suicide rates and attempts linked to mental illness and costs related to treatment and prevention of suicide.

Despite these limitations, the current model represents one of the most complete data syntheses to date on the state and impact of mental illness and addictions for Canada. The next phase of this study will use the 30-year baseline assessment to assess potential mental health interventions on reducing the impact of mental illness in Canada. In addition, each of the above mentioned scope limitations have been identified as a potential area for future research and expansion of the Life at Risk base model.

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**B DATA SOURCES**

**Table 39** Summary of Data Sources Used and Considered

Adult Prevalence		
Data Source and Description	Key Data Limitations	Rational For Use
<p>OHS-MHS (1990)</p> <ul style="list-style-type: none"> <li>Mood Disorders (major depression, dysthymia, bipolar disorder)</li> <li>Anxiety Disorders (social phobia, simple phobia, panic disorder, agoraphobia, generalized anxiety disorder)</li> </ul>	<ul style="list-style-type: none"> <li>Data are 20 + years old</li> <li>Ontario only, other provinces will differ</li> <li>Ages 15-64 only</li> <li>Excludes:                             <ul style="list-style-type: none"> <li>Panic disorder<sup>12</sup></li> <li>Schizophrenia</li> <li>Antisocial personality disorder</li> <li>Ethnicity</li> <li>Severity of illness</li> <li>Institutionalized populations</li> <li>Homeless populations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Internally consistent dataset for mood and anxiety</li> <li>Data available by age-group and sex</li> <li>Comorbidity among MI: mood, anxiety and SUD</li> <li>Employment data for those with mood and anxiety</li> <li>Provides 12 month and lifetime prevalence for accounting purposes</li> <li>Rates were similar to the CCHS 1.2 for disorders common to each study</li> <li>SME recommended</li> </ul>
<p>Martens <i>et al.</i> (2004)</p> <ul style="list-style-type: none"> <li>Schizophrenia</li> <li>Cognitive impairment including dementia</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba only, other provinces may differ</li> <li>Treated prevalence</li> <li>Ages 55+ only (for dementia)</li> <li>Dementia may include cognitive impairment coded as dementia by physician</li> <li>Diagnostic coding varies by province</li> <li>Excludes: Young onset dementia, Severity of illness, Ethnicity</li> </ul>	<ul style="list-style-type: none"> <li>Comorbidity among MI: dementia, schizophrenia, SUD, anxiety</li> <li>SME recommended for dementia, schizophrenia</li> <li>If dementia data are capturing cognitive impairment this may provide a more complete picture of the economic burden</li> </ul>
<p>Rehm <i>et al.</i> (2011)</p> <ul style="list-style-type: none"> <li>Custom analysis for this project</li> <li>Consistently estimated epidemiologic indicators for SUD in Canada</li> <li>SUD defined as substance abuse and/or dependence</li> <li>Includes: alcohol, cocaine, heroin, non-medical prescription opioid, cannabis, amphetamine/methamphetamine</li> </ul>	<ul style="list-style-type: none"> <li>Combination of international and Canadian data</li> <li>Excludes:                             <ul style="list-style-type: none"> <li>Prescription drug and over the counter drug abuse/dependence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> <li>Consistently estimated by incorporating prevalence, incidence, duration, remission, relative risk and mortality for those with SUD matched to general population by age, sex and case fatality within the same statistical disease model</li> </ul>
<p>Goldner <i>et al.</i> (2002)</p> <ul style="list-style-type: none"> <li>Systematic literature review of prevalence of schizophrenic disorders</li> </ul>	<ul style="list-style-type: none"> <li>Included international systematic review of literature with each study varying in methodology and estimates</li> </ul>	<ul style="list-style-type: none"> <li>Used to estimate the 12-month and lifetime prevalence ratios to split the MB prevalence rates</li> </ul>

<sup>12</sup> Note that the OHS-MHS collected data on panic disorders but it was not included in the data extraction for the Life at Risk model due to the small sample sizes.

<ul style="list-style-type: none"> <li>• Excludes:             <ul style="list-style-type: none"> <li>○ Age and sex stratification</li> <li>○ Severity of illness</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• SMEs recommended using international data to supplement the MB data</li> </ul>
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**Examples of Other Sources Considered for Adult Prevalence**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Canadian Study of Health and Aging Working Group (1994)– dated</li> <li>• OHS-MHS (1990) for SUD</li> <li>• Berr <i>et al.</i> (2005)             <ul style="list-style-type: none"> <li>○ Dementia</li> <li>○ Meta-analysis from EURODEM (European dementia studies)</li> <li>○ Ages 65+</li> </ul> </li> <li>• Five province feasibility study (PHAC, 2007)             <ul style="list-style-type: none"> <li>○ Does not provide breakdown by MI type; BC/NS have breakdown for mood/anxiety which were used for comparison purposes</li> </ul> </li> <li>• Bijl <i>et al.</i> (2002)             <ul style="list-style-type: none"> <li>○ NEMESIS – condition coverage for incidence/prevalence and comorbidities in alignment with project scope;</li> <li>○ Ages 18 to 64</li> <li>○ Mood, anxiety, schizophrenia, SUD</li> <li>○ Not used since its international data.</li> </ul> </li> <li>• Offord <i>et al.</i> (1996)             <ul style="list-style-type: none"> <li>○ OHS-MHS (1990)</li> <li>○ prevalence for those 15 to 64</li> <li>○ Mood</li> <li>○ Not used since custom cut data were provided by SMEs</li> </ul> </li> <li>• Patten (2000)             <ul style="list-style-type: none"> <li>○ 12 month prevalence of major depression in Calgary</li> </ul> </li> <li>• CCHS 1.2             <ul style="list-style-type: none"> <li>○ Ages 15 to 65+</li> <li>○ Major depression, mania, panic disorder, social phobia, agoraphobia</li> <li>○ Not used due to limited condition coverage</li> <li>○ Doesn't have same capacity as OHS-MHS. Prevalence was in ball park with OHS-MHS</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Patten <i>et al.</i> (2006)             <ul style="list-style-type: none"> <li>○ CCHS 1.2 ages 15-65+</li> <li>○ Major depression only</li> </ul> </li> <li>• Newman and Bland (1998)             <ul style="list-style-type: none"> <li>○ 18-65+</li> <li>○ Four year prevalence (1984 to 89)</li> <li>○ Anxiety</li> </ul> </li> <li>• Mathers <i>et al.</i> (1999)             <ul style="list-style-type: none"> <li>○ Data available by sex only</li> <li>○ Australian dataset</li> <li>○ Period of study 1996-97</li> <li>○ Mood disorders, anxiety disorders, schizophrenia, dementia, SUD</li> </ul> </li> <li>• Saha <i>et al.</i> (2007)             <ul style="list-style-type: none"> <li>○ Systematic literature review from 188 studies from 46 countries</li> <li>○ Sex-specific prevalence of schizophrenia</li> </ul> </li> <li>• Williams <i>et al.</i> (2007)             <ul style="list-style-type: none"> <li>○ National Survey of American Life</li> <li>○ US study</li> <li>○ Ages 18+</li> <li>○ Mood disorders only</li> </ul> </li> <li>• Eaton <i>et al.</i> (2007)             <ul style="list-style-type: none"> <li>○ NIMH Epidemiologic catchment area (Baltimore)</li> <li>○ study period 1981 with follow-up in 1993 and 2004</li> <li>○ Ages 18-65</li> <li>○ Mood disorders only</li> </ul> </li> <li>• National Survey of Mental Health and Well Being (1997) and (2007)             <ul style="list-style-type: none"> <li>○ Australian study</li> <li>○ Ages 18+</li> <li>○ Mood, anxiety</li> </ul> </li> <li>• Kessler <i>et al.</i> (2003)             <ul style="list-style-type: none"> <li>○ National Comorbidity Survey from the US</li> <li>○ Ages 18+</li> <li>○ Major depression only</li> </ul> </li> </ul> |
|---|--|

**Adult Incidence**

Data Source and Description	Key Data Limitations	Rational For Use
<p>Bijl <i>et al.</i> (2002)</p> <ul style="list-style-type: none"> <li>• Mood</li> <li>• Anxiety</li> <li>• SUD</li> <li>• Schizophrenia</li> </ul>	<ul style="list-style-type: none"> <li>• International data may not be representative of Canada</li> <li>• Ages 18 to 64 only</li> <li>• Small proportion of long-term institutionalized population is not</li> </ul>	<ul style="list-style-type: none"> <li>• Incidence data in Canada are not available for all mental illnesses considered in the model</li> <li>• NEMESIS data are age and</li> </ul>

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	<ul style="list-style-type: none"> <li>included</li> <li>Sample sizes were small for some disorders (schizophrenia, bipolar, dysthymia, and OCD)</li> <li>Excludes: Dementia, ethnicity</li> </ul>	sex specific; have the most complete information in terms of condition coverage for incidence/prevalence and comorbidities
<p>Canadian Study of Health and Aging Working Group (2000)</p> <ul style="list-style-type: none"> <li>Dementia</li> <li>1991 Canadian Study of Health and Aging</li> </ul>	<ul style="list-style-type: none"> <li>Data are dated</li> <li>Ages 65+ only</li> <li>Excludes mild cognitive impairment</li> </ul>	<ul style="list-style-type: none"> <li>Only Canadian data source available</li> <li>Consistent with Alzheimer's Society Impact of Dementia <i>Rising Tides Study</i> (Smetanin <i>et al.</i> 2009)</li> </ul>
<p><b>Examples of Other Sources Considered for Adult Incidence</b></p>		
<ul style="list-style-type: none"> <li>Newman and Bland (1998) – period of study was 1986-91 for Edmonton only. <ul style="list-style-type: none"> <li>Ages 18-65+</li> <li>Only 1 year of data</li> <li>Mood disorders, anxiety disorders</li> </ul> </li> <li>Patten (2002) <ul style="list-style-type: none"> <li>One year point estimate based on NPHS</li> <li>Period of study 1996-97</li> <li>Ages 12-65+</li> <li>Major depression only</li> </ul> </li> <li>Eaton <i>et al.</i> (2007) <ul style="list-style-type: none"> <li>US data from the NIMH Epidemiologic Catchment area (Baltimore)</li> <li>Ages 18-65+</li> <li>1981 baseline with follow-up in 1993 and 2004</li> <li>Mood disorders only</li> </ul> </li> <li>Mathers <i>et al.</i> (1999) <ul style="list-style-type: none"> <li>Data available by sex only</li> <li>Australian dataset</li> <li>Period of study 1996-97</li> <li>Mood disorders, anxiety disorders, schizophrenia, SUD</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Bijl <i>et al.</i> (2002) <ul style="list-style-type: none"> <li>Netherlands Mental Health Survey and Incidence Study (1997-98)</li> <li>Data by age-group (18 to 65) and sex</li> <li>Mood, anxiety, SUD, schizophrenia, eating disorder</li> <li>One or more DSM-III-R diagnoses</li> </ul> </li> <li>Jablensky <i>et al.</i> (1992) <ul style="list-style-type: none"> <li>Instruments used in the study are dated</li> <li>Schizophrenia only</li> <li>Australian study</li> </ul> </li> <li>McGrath <i>et al.</i> (2004) <ul style="list-style-type: none"> <li>Systematic review across 100 core studies, 23 cohort studies involving 33 countries</li> <li>Incidence rates of schizophrenia by sex and age</li> </ul> </li> <li>de Graaf <i>et al.</i> (2002) <ul style="list-style-type: none"> <li>Netherlands Mental Health Survey and Incidence Study (1997-98)</li> <li>Incidence by sex and age-group (18 to 64)</li> <li>Mood, anxiety, SUD, schizophrenia, eating disorder</li> <li>One or more DSM-III-R diagnoses</li> </ul> </li> </ul>	
<p><b>Childhood/Adolescent Prevalence and Incidence</b></p>		
<p><b>Data Source and Description</b></p>	<p><b>Key Data Limitations</b></p>	<p><b>Rational For Use</b></p>
<p>Estimated based on meta-analysis of transition rates and adult estimates:</p> <ul style="list-style-type: none"> <li>Mood</li> <li>Anxiety</li> <li>ADHD</li> <li>Conduct Disorder</li> <li>ODD</li> </ul>	<ul style="list-style-type: none"> <li>Data for disorders included in the model are not available in Canada</li> <li>Estimated values are based on international data</li> <li>Data excludes: <ul style="list-style-type: none"> <li>Children under the age of 9</li> <li>Subclinical disorders</li> <li>Paediatric schizophrenia or other psychosis in children due to low prevalence/incidence</li> <li>Eating disorders due to low prevalence/incidence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Reliable robust estimates for MI in Canadian children and adolescence do not exist</li> <li>Meta-analysis provided odds ratios for odds of future MI given childhood or adolescence MI</li> <li>Longitudinal cohorts used for analysis provided the best and most reliable estimates for Canada</li> </ul>



Excess Mortality		
Data Source and Description	Key Data Limitations	Rational For Use
<p><b>Examples of Other Sources Considered for Childhood/Adolescent Prevalence and Incidence</b></p> <ul style="list-style-type: none"> <li>• Dunedin – Kim-Cohen <i>et al.</i> (2003)                             <ul style="list-style-type: none"> <li>○ Mood, anxiety, SUD</li> <li>○ NZ longitudinal cohort</li> <li>○ Custom cut data used as part of our meta-analysis (literature source used for comparison of prevalence results)</li> </ul> </li> <li>• Christchurch – Fergusson <i>et al.</i> (1993)                             <ul style="list-style-type: none"> <li>○ Mood, anxiety, SUD, ADHD, CD, ODD</li> <li>○ NZ longitudinal cohort</li> <li>○ Custom cut data used as part of our meta-analysis (literature source used for comparison of prevalence results)</li> </ul> </li> <li>• Waddell (2002)                             <ul style="list-style-type: none"> <li>○ Mood disorders, anxiety disorders, SUD, ADHD, CD, ODD</li> <li>○ Systematic review of childhood/adolescent disorders for those aged 4-17</li> <li>○ Literature source used for comparison of prevalence results</li> </ul> </li> <li>• Costello <i>et al.</i> (2003)                             <ul style="list-style-type: none"> <li>○ Mood disorders, anxiety disorders, SUD, ADHD, CD, ODD</li> <li>○ Custom cut data from GSMS used as part of our meta-analysis (literature source used as comparison for prevalence results)</li> </ul> </li> <li>• Ontario Child Health Study (Offord <i>et al.</i> 1987)                             <ul style="list-style-type: none"> <li>○ Prevalence of emotional and behavioural disorders in children aged 4 to 16</li> <li>○ CD, hyperactivity, emotional disorder,</li> <li>○ Dated – data collected in 1983</li> <li>○ Ontario only</li> </ul> </li> <li>• Quebec Child Health Study – Breton <i>et al.</i> (1999)                             <ul style="list-style-type: none"> <li>○ Mood disorders, anxiety disorders, ADHD, CD, ODD</li> <li>○ Does not include SUD</li> <li>○ 6 month prevalence for those 6 to 14 in Quebec</li> <li>○ Literature source used as comparison for prevalence results</li> </ul> </li> <li>• Spady <i>et al.</i> (2001) + updates from Larry Svenson (2010) – AB administrative data                             <ul style="list-style-type: none"> <li>○ Mood, anxiety, SUD, CD</li> <li>○ Does not include ODD</li> <li>○ Data by age and sex</li> <li>○ Literature source used as comparison for prevalence results</li> </ul> </li> </ul>		
<p><b>Examples of Other Sources Considered for Excess Mortality</b></p> <ul style="list-style-type: none"> <li>• Wolfson <i>et al.</i> (2001)                             <ul style="list-style-type: none"> <li>○ Dementia survival estimates based on CSHA for ages 65+</li> </ul> </li> <li>• CIHI – National Trauma Registry Analytic Bulletin (2004)                             <ul style="list-style-type: none"> <li>○ Death due to suicide and suicide attempts by age- and sex for 2001-2002</li> <li>○ Not attributable to mental illness</li> </ul> </li> <li>• Mathers <i>et al.</i> (1999)                             <ul style="list-style-type: none"> <li>○ Data available age and sex and cause of death</li> <li>○ Australian dataset</li> <li>○ Period of study 1996-97</li> </ul> </li> <li>• Bruce <i>et al.</i> (1994)                             <ul style="list-style-type: none"> <li>○ 9 year mortality data linked to psychiatric status by sex for those 40+</li> <li>○ Study period 1980-89</li> <li>○ US study</li> </ul> </li> <li>• Grasbeck <i>et al.</i> (1996)                             <ul style="list-style-type: none"> <li>○ Increased mortality for those with anxiety syndromes between 1972 and 1992 from the Lundby cohort</li> </ul> </li> <li>• Laursen <i>et al.</i> (2007)                             <ul style="list-style-type: none"> <li>○ Age- sex specific survival analysis and excess mortality given psychiatric disorder</li> </ul> </li> </ul>		

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<ul style="list-style-type: none"> <li>• Osby <i>et al.</i> (2000)               <ul style="list-style-type: none"> <li>○ SMR by age and sex for those with schizophrenia</li> <li>○ 1973-1995</li> <li>○ Swedish study</li> </ul> </li> <li>• Osby <i>et al.</i> (2001)               <ul style="list-style-type: none"> <li>○ SMR by sex for those unipolar depression and bipolar</li> <li>○ 1973-1995</li> <li>○ Swedish study</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ Unipolar depressive disorder, bipolar depressive disorder, schizoaffective disorder, schizophrenia</li> <li>○ Study from Denmark</li> </ul>	
<ul style="list-style-type: none"> <li>• Dutta <i>et al.</i> (2007)               <ul style="list-style-type: none"> <li>○ Age and sex- specific mortality rates for those with bipolar disorder over a 35 year period (1965-1999)</li> <li>○ UK study</li> </ul> </li> </ul>		
<b>Economic Disability</b>		
Data Source and Description	Key Data Limitations	Rational For Use
Dewa <i>et al.</i> (2007) <ul style="list-style-type: none"> <li>• Total and partial disability days for any mental disorder</li> <li>• Total and partial disability days for any mental disorder and chronic condition</li> <li>• Total and partial disability days for chronic condition only</li> <li>• Based on CCHS 1.2</li> </ul>	<ul style="list-style-type: none"> <li>• Ages 18 to 64 only</li> <li>• Does not distinguish between different mental illnesses</li> <li>• Measures were self-report and subject to recall and reporting bias</li> <li>• Disability questions were not limited to work activities and included non-work activities</li> <li>• Cross-sectional data cannot imply causality</li> <li>• Based on the CCHS 1.2 which may underestimate the true disability</li> </ul>	<ul style="list-style-type: none"> <li>• SME recommendation</li> </ul>
Kouzis <i>et al.</i> (1994) <ul style="list-style-type: none"> <li>• Missed days from work for MI</li> </ul>	<ul style="list-style-type: none"> <li>• Study dated</li> <li>• Study included US sample from the Eastern Baltimore Mental Health Survey which may not be representative of Canada</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended by Dr. Don Addington for schizophrenia</li> </ul>
<b>Direct Health Costs</b>		
Data Source and Description	Key Data Limitations	Rational For Use
Jacobs <i>et al.</i> 2010 <ul style="list-style-type: none"> <li>• Total aggregate costs by province for inpatient services, physician services, community and social services, pharmaceuticals, other services, income support</li> </ul>	<ul style="list-style-type: none"> <li>• Alternate funding for physicians not collected by most provinces.</li> <li>• The report estimated the proportion of private and public psychiatric drugs based on the total public to private ratio of all drugs (psychiatric and non-psychiatric) for each province.</li> <li>• Quebec calculates inpatient hospital costs based on systemic differences and cost allocation methods. This differs from methodologies used by other provinces.</li> <li>• Psychiatric patient days are based on discharge data rather than days of care. Study investigators applied an adjustment factor which was not validated.</li> <li>• Emergency room data attributable</li> </ul>	<ul style="list-style-type: none"> <li>• Used in conjunction with the MB Health Policy data (Martens <i>et al.</i> 2004) to estimate total direct health care costs</li> <li>• Jacobs <i>et al.</i> (2010) provides total costs per province for services used               <ul style="list-style-type: none"> <li>○ Data are complete for FFS payments to physicians inpatient hospital care and total pharmaceuticals</li> </ul> </li> <li>• Data for available provinces can be used to extrapolate on a per capita basis to provinces with data gaps for each service.</li> </ul>

to diagnosis is only available in Alberta and Ontario.

- Community mental health service data can encompass a variety of services across provinces with no standard definition. Services may be funded by different ministries.
- Types of services used for mental health and additions cannot always be distinguished.
- Shelter costs for homeless people with mental illness are only available in British Columbia.
- Not-for-profit costs included the complete cost of government funding for community mental health and the amounts raised from non-government sources.
- Employment programs only included data for provinces that report numbers of people with a psychiatric disability.
- Income support only included provinces that reported disability attributable to mental illness.
- Short-term disability does not track reasons for disability so data are not available for those who temporarily lose their jobs due to mental illness. Does not include short-term and long-term disability leaves covered by employer insurance plans.
- Complete data across all services not available for all provinces.
- Study excludes:
  - Attribution to specific mental illnesses
  - Dementia costs
  - Costs to the education system for children
  - Costs to the criminal justice system
  - Costs for child and youth services
  - 'Excess' costs of utilization for those with mental illness
  - Age and sex stratification
  - Complete data are not available for all provinces/territories for all service types

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<p>Martens <i>et al.</i> (2004)</p> <ul style="list-style-type: none"> <li>Utilization data (physician visits, psychiatrist visits, prescription drug use)</li> <li>Includes utilization data for mood, anxiety, schizophrenia, SUD</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba only</li> <li>Does not contain utilization data for all service types and for all mental illnesses in the Life at Risk model</li> <li>Mood disorders only includes depression and bipolar disorders (excludes dysthymia)</li> <li>Coding/reporting may vary across provinces</li> <li>Different provinces have different service definitions and health care systems</li> <li>Manitoba has high aboriginal population compared to other provinces</li> </ul>	<ul style="list-style-type: none"> <li>Used in conjunction with Jacobs <i>et al.</i> 2010 data to estimate direct costs using utilization-based costing methods</li> <li>Only utilization data available in Canada by MI type</li> </ul>
<p>Tranmer <i>et al.</i> 2003</p> <ul style="list-style-type: none"> <li>Number of people in LTC and community care with dementia</li> </ul>	<ul style="list-style-type: none"> <li>Ontario data only</li> <li>Data are dated</li> <li>Costs and services provided may vary across provinces and may have changed over time</li> </ul>	<p>Consistent with model and analysis completed for the Alzheimer Society's <i>Rising Tides Study</i> (Smetanin <i>et al.</i> 2009)– approach was recommended by subject matter experts in dementia</p>
<p>Wodchis <i>et al.</i> 2008</p> <ul style="list-style-type: none"> <li>Proportion of LTC residents with dementia admitted to LTC due to their dementia</li> <li>Proportion of people with dementia only and those with dementia plus a comorbid condition</li> <li>Incremental cost of care for those with dementia</li> </ul>	<ul style="list-style-type: none"> <li>Data are widely assumption driven and based on an Ontario sample which may not be representative of Canada</li> </ul>	
<p>Hollander <i>et al.</i> (2002)</p> <ul style="list-style-type: none"> <li>Costs of care for those 65+: LTC, administrative, LTC staff, physician, hospital, facility user fees, support staff, purchased services</li> </ul>	<ul style="list-style-type: none"> <li>Costs based on small study samples from Victoria and Winnipeg and may not be representative of Canada</li> <li>Costs and services provided may differ across provinces and may have changed over time</li> </ul>	
<p>Hux <i>et al.</i> (1998)</p> <ul style="list-style-type: none"> <li>Annual medication costs for those with AD based on 1991 CSHA</li> </ul>	<ul style="list-style-type: none"> <li>Data are dated</li> <li>Included cost of drugs for Alzheimer's disease only – not all dementia types</li> <li>Medication use and costs may have changed over time</li> </ul>	
<p>Shapiro and Tate (1997)</p> <ul style="list-style-type: none"> <li>Costs incurred by patients in community care with dementia alone and dementia with comorbidities</li> </ul>	<ul style="list-style-type: none"> <li>Manitoba data only – based on the Manitoba Study of Health and Aging, which may not be representative of Canada</li> <li>Data are dated</li> <li>Costs and services provided under community care may differ across provinces and may have changed over time</li> </ul>	

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<b>Examples of Other Data Sources Considered for Direct Costs</b>		
<ul style="list-style-type: none"> <li>• Five province feasibility study (PHAC, 2007)               <ul style="list-style-type: none"> <li>○ Does not provide breakdown by MI type</li> <li>○ BC/NS provide breakdown for mood and anxiety</li> <li>○ Hospitalizations, GP visits, psychiatrist visit, Other MD visit, Outpatient clinic visit</li> <li>○ Used for comparison of estimates</li> </ul> </li> <li>• CIHI – hospitalizations from Hospital Morbidity File (1999/2000)               <ul style="list-style-type: none"> <li>○ Rates and LOS due to MDD by sex</li> <li>○ Rates and LOS due to bipolar disorder by sex</li> </ul> </li> <li>• CCHS linked to ON data – Courtesy of Betty Lin               <ul style="list-style-type: none"> <li>○ Average costs billed per person for all cause physician visits, mental health physician &amp; psychiatrist visits</li> <li>○ Ontario data only</li> <li>○ Doesn't cover all disorders or all services</li> </ul> </li> </ul>		
<b>Healthy Immigrant Effect</b>		
<b>Data Source and Description</b>	<b>Key Data Limitations</b>	<b>Rational For Use</b>
Menezes <i>et al.</i> (2011) <ul style="list-style-type: none"> <li>• Lower 12 month prevalence of psychiatric disorder in Canadian immigrants compared to non-immigrant Canadians</li> <li>• Based on CCHS 1.2</li> </ul>	<ul style="list-style-type: none"> <li>• Data only includes mood disorders, anxiety disorders, SUD and schizophrenia</li> <li>• Ages 15+ from 10 provinces (excludes territories)</li> <li>• Cross-sectional study design does not account for longitudinal trends</li> <li>• Study does not examine “new” immigrants but rather immigrant status so it may include those who immigrated many years ago</li> </ul>	Menezes <i>et al.</i> (2011) <ul style="list-style-type: none"> <li>• SME recommendation</li> <li>• Only Canadian data available</li> </ul>
<b>Type II Diabetes and Heart Disease Prevalence and Incidence</b>		
<b>Data Source and Description</b>	<b>Key Data Limitations</b>	<b>Rational For Use</b>
NDSS <ul style="list-style-type: none"> <li>• Prevalence and incidence of diabetes by age-group and sex</li> </ul>	<ul style="list-style-type: none"> <li>• Data do not distinguish between Type I, Type II and gestational diabetes (model assumes that 90% of the prevalent cases of diabetes reported are Type II)</li> <li>• Data are linked to physician billings and hospital administrative data and only include ‘treated prevalence’ or users of the health care system who show evidence of service use due to diabetes</li> </ul>	NDSS is the most comprehensive diabetes surveillance data in Canada. Data are available by age, sex and province. <ul style="list-style-type: none"> <li>• Conservative estimates</li> </ul>
Statistics Canada CANSIM Table: 102-0524 <ul style="list-style-type: none"> <li>• Mortality due to type II diabetes and heart disease</li> </ul>	<ul style="list-style-type: none"> <li>• Mortality data do not distinguish between diabetes subtypes</li> <li>• Reporting based on death certificates and may be underestimated for both heart disease and diabetes</li> </ul>	Statistics Canada – CANSIM 102-0524 <ul style="list-style-type: none"> <li>• Standard mortality database</li> </ul>
Chow <i>et al.</i> (2005) <ul style="list-style-type: none"> <li>• Prevalence of heart disease in Canada by age and sex</li> </ul>	<ul style="list-style-type: none"> <li>• Does not include incidence data</li> <li>• Data are self-report for those ages 12+               <ul style="list-style-type: none"> <li>○ May be under reported</li> <li>○ Subjective estimates</li> <li>○ Heart disease not explicitly defined in questionnaire</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Only Canadian data available</li> <li>• Recommended by SMEs given availability of data – this is the best we have and provides a conservative estimate of heart disease. The use of US and international data were</li> </ul>

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	<ul style="list-style-type: none"> <li>Data not stratified by heart disease type e.g. CHD, CAD, IHD</li> <li>Data excludes those on Indian reserves, Canadian Force bases and those residing in remote communities</li> </ul>	discouraged due to the differences in the health care systems
Relative Risk Estimates between Mental Illness and Type II Diabetes/Heart Disease		
Data Source and Description	Key Data Limitations	Rational For Use
Rugulies (2002) <ul style="list-style-type: none"> <li>Meta-analysis to determine the relative risk for development of CHD in people with depression</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Data only consider the relationship between depression and CHD only which is not in alignment to the disorders included in the Life at Risk model for which the relative risk estimates were applied</li> <li>Meta-analysis includes international data mostly from the US which may not be representative of Canada. Estimates included in the meta-analysis may be subject to publication bias</li> </ul>	<ul style="list-style-type: none"> <li>Rugulies (2002) recommended by SMEs</li> <li>Majority of heart disease is CHD</li> <li>Frasure-Smith <i>et al.</i> (2006)               <ul style="list-style-type: none"> <li>Supports findings of Rugulies (2002) and model assumptions</li> </ul> </li> <li>Frasure-Smith <i>et al.</i> (2008)               <ul style="list-style-type: none"> <li>Supports findings of Rugulies (2002) and model assumptions</li> </ul> </li> </ul>
Patten (2005) <ul style="list-style-type: none"> <li>Elevated risk of depression in persons with chronic disease</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Data available for depression only</li> <li>Chronic disease data includes a category for a general chronic disease which is not specific to type II diabetes or heart disease</li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
Curkendall <i>et al.</i> (2004) <ul style="list-style-type: none"> <li>Increased risk of cardiovascular disease and diabetes given schizophrenia</li> </ul>	<ul style="list-style-type: none"> <li>Study includes data from Saskatchewan only</li> <li>Analysis used administrative data and not all medical records could be reviewed for diagnosis validation</li> <li>The study did not adjust for cardiovascular risk factors including smoking, BMI and SUD</li> <li>Data were not stratified by age and sex</li> <li></li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
Rehm <i>et al.</i> (2010) <ul style="list-style-type: none"> <li>Increased risk of ischaemic heart disease and diabetes given alcohol abuse/dependence</li> </ul>	<ul style="list-style-type: none"> <li>Meta-analysis only examined the relationship between alcohol consumption and chronic illness and did not examine the relationship with other SUDs               <ul style="list-style-type: none"> <li>Alcohol abuse/dependence is approximately 90% of SUD prevalence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>
Ahtiluoto <i>et al.</i> (2010) <ul style="list-style-type: none"> <li>Increased risk of dementia given type II diabetes</li> </ul>	<ul style="list-style-type: none"> <li>Data are not stratified by age and sex</li> <li>Study includes a Finnish population over the age of 85</li> </ul>	Ahtiluoto <i>et al.</i> (2010) <ul style="list-style-type: none"> <li>Recommended by SMEs</li> </ul>

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Hospitalizations and Homelessness		
Data Source and Description	Key Data Limitations	Rational For Use
<b>Examples of Other Data Sources Considered</b> <ul style="list-style-type: none"> <li>• Frasure-Smith <i>et al.</i> (2006)                             <ul style="list-style-type: none"> <li>○ Relative risk of depression leading to onset of CHD – supports assumptions</li> </ul> </li> <li>• Frasure-Smith <i>et al.</i> (2008)                             <ul style="list-style-type: none"> <li>○ Anxiety and depression are predictors of major adverse events in patients with CAD – supporting assumptions</li> </ul> </li> </ul>		
HRSDC (2011) <ul style="list-style-type: none"> <li>• Proportion of homeless people in Canada</li> </ul>	<ul style="list-style-type: none"> <li>• The estimated homeless population in Canada ranged from 150,000 to 300,000</li> <li>• The HRSDC does not provide further information on data source estimates and limitations</li> </ul>	Best available data in Canada at this time where reasonable assumptions can be applied
Patterson <i>et al.</i> (2007) <ul style="list-style-type: none"> <li>• Proportion of homeless people with MI</li> </ul>	<ul style="list-style-type: none"> <li>• Data are specific to the province of British Columbia and to those with serious additions and mental illness                             <ul style="list-style-type: none"> <li>○ Excludes those with less severe mental illness</li> </ul> </li> <li>• Data are not stratified by age and sex</li> </ul>	
Hwang (2010, Unpublished) <ul style="list-style-type: none"> <li>• Hospital utilization among homeless cohort and low income control group (relative health care utilization)</li> </ul>	<ul style="list-style-type: none"> <li>• Study includes a small population sample from inner city Toronto</li> <li>• Study does not encompass all health care services used</li> </ul>	
Hwang (2011) <ul style="list-style-type: none"> <li>• Relative homeless to housed hospitalization costs</li> </ul>	<ul style="list-style-type: none"> <li>• Study includes a small population sample from inner city Toronto over the age of 18</li> <li>• Data are not stratified by sex</li> <li>• Housing status based on administrative data and subject to misclassification</li> <li>• Data do not include duration of homelessness</li> <li>• Length of stay estimates may be based on practices rather than severity of illness</li> </ul>	

## C DETAILED LIFE AT RISK® METHODOLOGY

The Mental Health Model can be divided into three key areas focusing on demographics, disease incidence and mortality, and economics. While the separation of parts helps to provide clarity, it is important to note that all three parts are implemented as a single, integrated model.

### C.1 DEMOGRAPHIC MODEL

#### C.1.1 BIRTH

---

The birth rate is assumed to be proportional to the number of females between the ages of 15 and 45,

$$\dot{B}^s = \beta^s \sum_{a=15}^{45} P^{a,\text{female}}$$

where the proportionality constant is assumed to follow the trend estimated from the historical values.

#### C.1.2 DEATH

---

Death is handled in a manner similar to birth. For each age-group, there is a rate coefficient characterizing their likelihood of death due to all causes.

$$\dot{P}^{a,s} = -\bar{\mu}^{a,s} P^{a,s}$$

Again, the values of  $\bar{\mu}^{ag}$  are assumed to follow a decreasing trend based on historical values. Note that when various health states are added to the model, the historical trend is decomposed into rates dependent upon the health states.

#### C.1.3 MIGRATION

---

Immigration and emigration have a significant impact on the growth of the Canadian population. Migration rates depend significantly on government policy and therefore trends are difficult to estimate from historical data. Therefore, immigration and emigration rates per capita,  $\alpha_{Imm}$  and  $\alpha_{Em}$  respectively, are assumed to be constant and based on the historical average. Therefore,

$$\dot{P}_{Migration}^{a,s} = \alpha_{Imm} P^{a,s} - \alpha_{Em} P^{a,s}$$



### C.1.4 AGING

---

The last component in the demographic model is the aging of the population. The aging model adopted is

$$\dot{P}^{a,s} = \frac{P^{(a-1),s}}{\Delta_{a-1}} - \frac{P^{a,s}}{\Delta_a}$$

where the first term describes the people aging from age-group  $a-1$  into age-group  $a$ , and the second term describes the people aging out of age-group  $a$  into  $a+1$ . The width of age-group  $a$  is  $\Delta_a$  and it generally 1 year.

### C.1.5 DEMOGRAPHIC DATA

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The demographic data used to populate the model is from Statistics Canada. Table 40 lists the CANSIM Tables used.

**Table 40** Demographic Data Sources

Variable	Description	CANSIM Table Number
Population	The population of Canada by age and sex	051-0001
Births	The number of births in Canada by sex	051-0013
Deaths	Number of deaths in Canada by age and sex	051-0002
Immigration	Immigration into Canada by age and sex	051-0012
Emigration	Emigration from Canada by age and sex	051-0012

## C.2 DISEASE MODEL

### C.2.1 INCIDENCE AND REMISSION

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In the model, disease incidence and remission are simple transitions from one health state to another. The net transition rate is a product of the ‘no-risk’ incidence rate times the relative risk of incidence dependent upon other cell properties.

$$\dot{P}^{a,s,k} \Big|_{\text{Disease}} = \sum_j \lambda^{a,s,j \rightarrow k} P^{a,s,j} - \sum_j \lambda^{a,s,k \rightarrow j} P^{a,s,k}$$

Each disease transition can be factors into a base ‘no-risk’ rate, and relative risk factors.

$$\lambda^{a,s,j \rightarrow k} = \lambda_0^{a,s \rightarrow k} r^{j \rightarrow k}$$

The no-risk rate  $\lambda_0^{a,s \rightarrow k}$  represents the intrinsic incidence or remission rate that would occur after the risk factors included in the model are removed. The relative risk,  $r^{j \rightarrow k}$ , is estimated by averaging the excess risk of all the pair-wise contributors to the full states  $j$  and  $k$ .

### C.2.2 MORTALITY

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Disease mortality is parameterized in terms of the excess risk of death compared to the healthy population.

$$\dot{P}^{a,s,k} \Big|_{\text{Mortality}} = - \left( \mu_{\text{Healthy}}^{a,s} \beta^{a,s,k} - \bar{\mu}^{a,s} \right) P^{a,s,k}$$

where  $\beta^{a,s,k}$  is the excess risk of death for people in health state  $k$ . Note the constraint

$$\sum_k \mu_{\text{Healthy}}^{a,s} \beta^{a,s,k} P^{a,s,k} = \bar{\mu}^{a,s} P^{a,s}$$

can be used to calculate  $\mu_{\text{Healthy}}^{a,s}$  given the excess risk factors and population prevalence.

The excess mortality risk of the combination of diseases is equal to the largest excess mortality risk on any of the individual conditions:

$$\beta^{a,g,k} = \max_{K \in k} \left( \beta^{a,g,K} \right)$$

### C.2.3 CALIBRATION

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Since time series of prevalence is not known, the no-risk incidence and remission rates are calibrated to maintain constant age- and sex-specific prevalence of each condition simultaneously. These no-risk rates are then used in the base model and all scenario runs.

Under the assumption of time-independent prevalence of remission,

$$\rho^{a,s,K_R} = \frac{P^{a,s,K_R}}{P^{a,s}}$$

one obtains

$$\dot{\rho}^{a,s,K_R} = 0 \Rightarrow \frac{\dot{P}_R^{a,s,K_R}}{P_R^{a,s,K_R}} = \frac{\dot{P}^{a,s}}{P^{a,s}}$$

In addition, the total change in  $P^{a,s,K_R}$  can be split into changes due to remission and due to other causes:

$$\dot{P}^{a,s,K_R} = \lambda^{a,s,K_A \rightarrow K_R} P^{a,s,K_A} + \dot{P}^{a,s,K_R} \Big|_{\text{Other}}$$

This allows for one to determine the net remission rate to be:

$$\lambda^{a,s,\rightarrow K_R} = \frac{1}{P^{a,s,K_A}} \left( \frac{\dot{P}^{a,s} \Big|_{\text{Other}}}{P^{a,s}} P^{a,s,K_R} - \dot{P}^{a,s,K_R} \Big|_{\text{Other}} \right)$$

For consistency with the previous equations, this requires that the remission rates satisfy

### C.3 ECONOMIC FRAMEWORK

For full details of the economic framework, refer to the supplementary appendix titled *Life at Risk: Economic Modelling Framework*.

#### C.3.1 ECONOMIC DATA

The economic data used to populate the model is from Statistics Canada. Table 41 lists the CANSIM Tables used.

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 41** Economic Data Sources

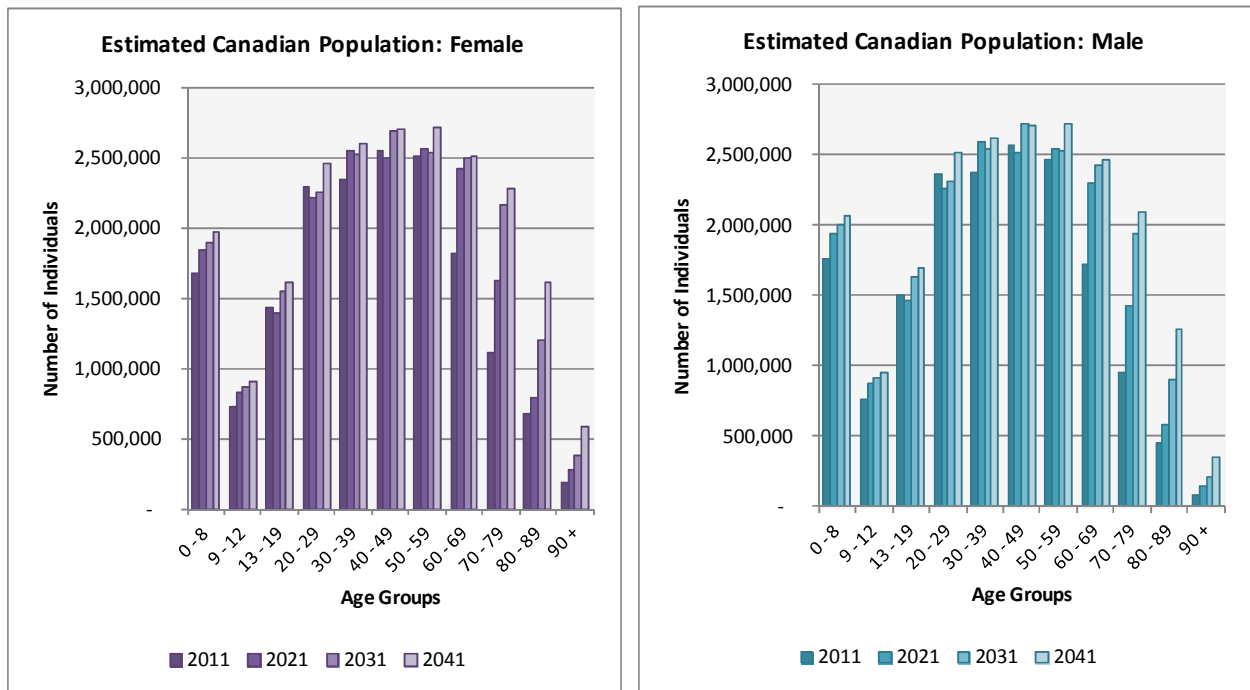
Variable	Description	CANSIM Table Number
GDP	Annual gross domestic product from 1961 to 2009	380-0001
Pre-tax Corporate Profits	Annual pre-tax profits from 1961 to 2009	380-0001
Total Wages	Annual total wages from 1961 to 2009	384-0001
Real Average Wages	Real average wages (in 2006 dollars) by age and sex from 1976 to 2006	202-0407
Labour force statistics	Employed, unemployed and non-labour by age and sex from 1976 to 2007	282-0002
Government Employees	Public sector employment by age and sex from 1976 to 2007	282-0008
Government Accounts	Government expenses and revenue from 1981 to 2009	384-0004
Consumer price index	Consumer price index from 1914 to 2010	326-0021

**D DETAILED RESULTS**

**D.1 DEMOGRAPHIC PROJECTIONS**

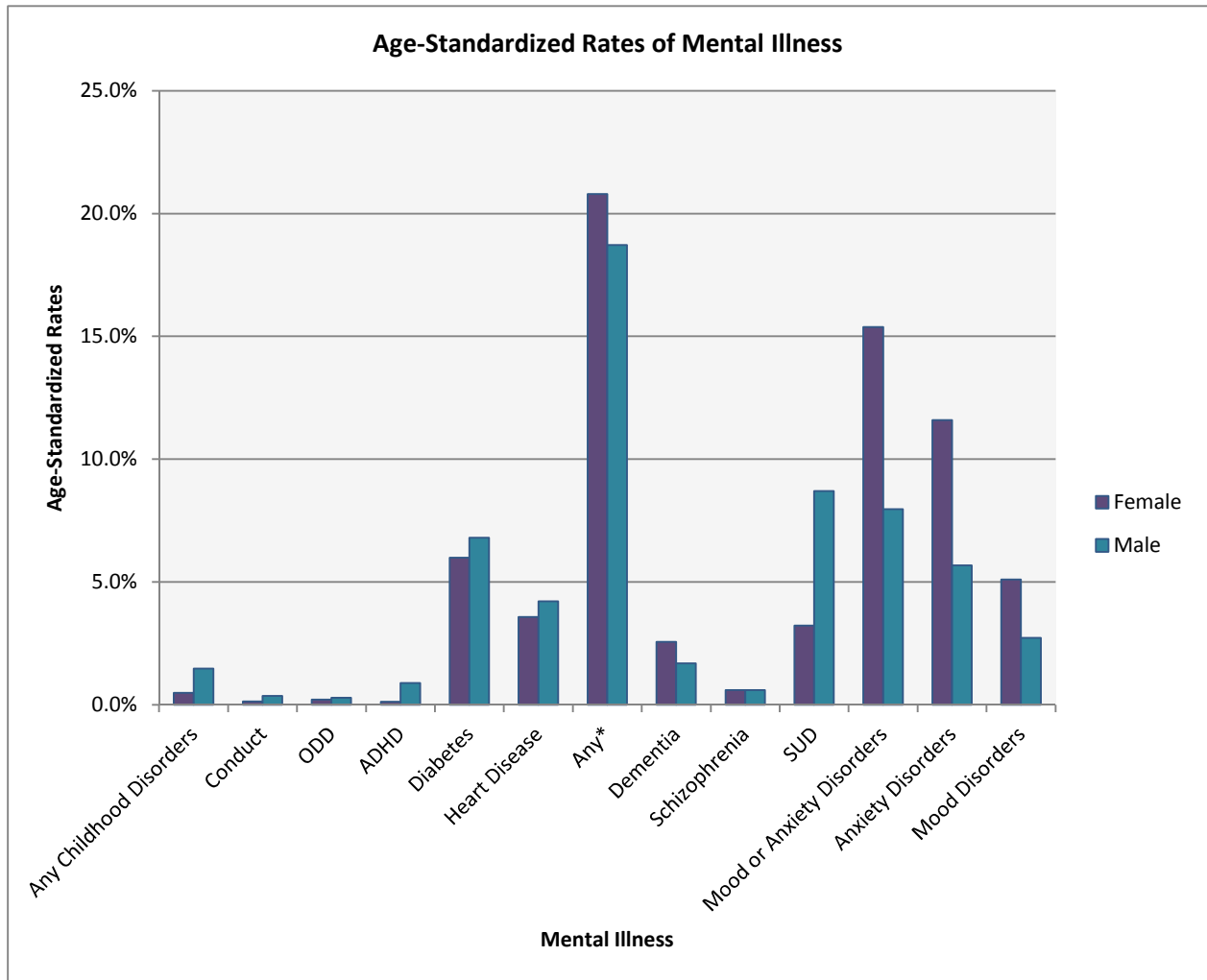
The demographic projection by age group and sex are shown in Figure 38.

**Figure 38** Estimated Demographic Projections



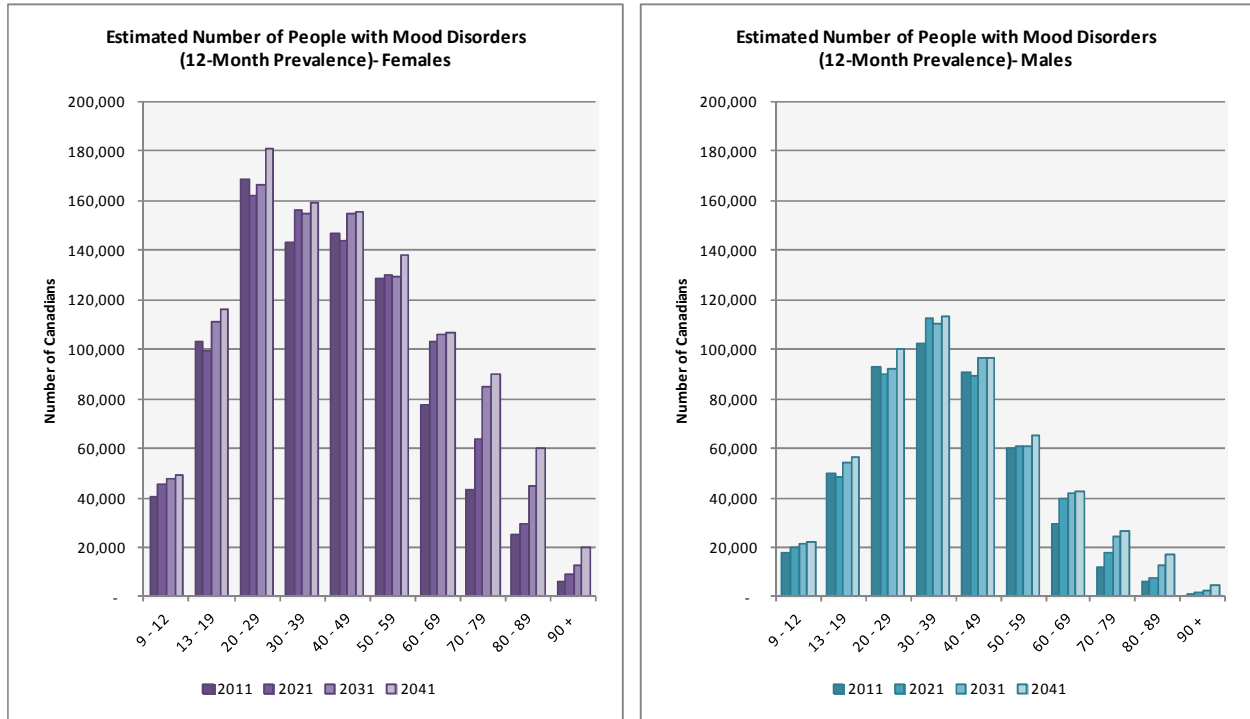
D.2 AGE-STANDARDIZED RATES

Figure 39 Age-Standardized Rates of Mental Illness in Canada by Mental Illness Type and Sex

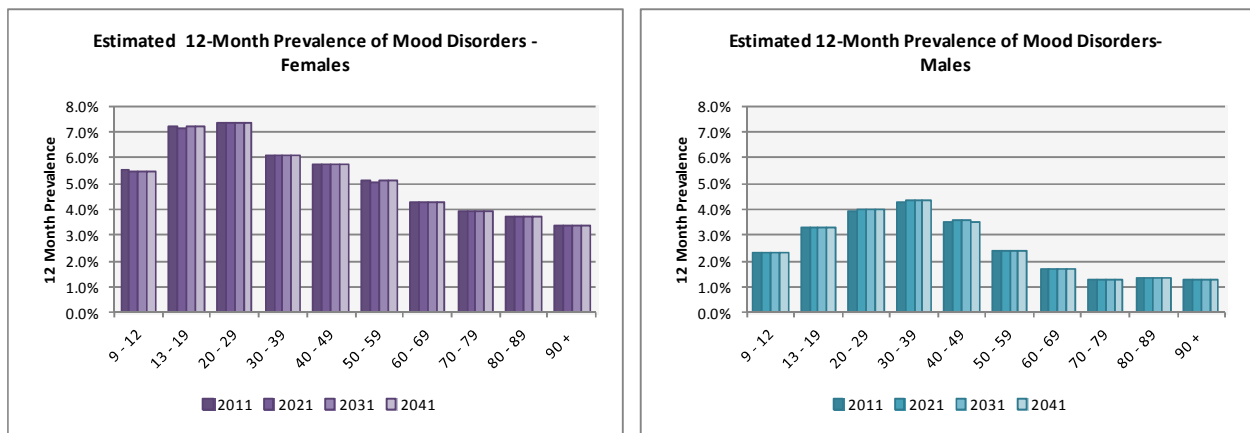


D.3 MOOD DISORDERS

**Figure 40** Estimated Number of People with Mood Disorders in Canada (12-Month Prevalence) for Select Years 2011 to 2041

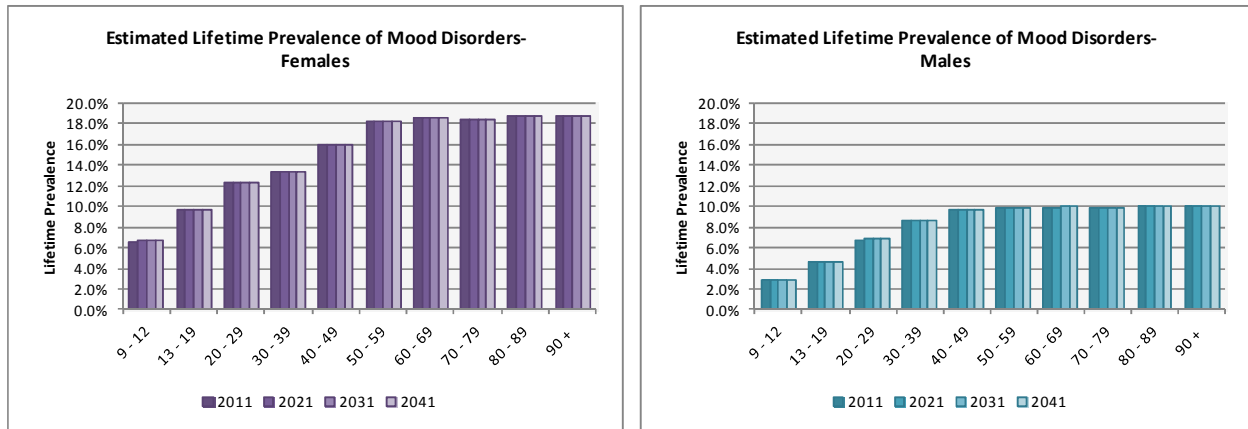


**Figure 41** Estimated 12-Month Prevalence of Mood Disorders in Canada for Select Years 2011 to 2041



# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 42** Estimated Lifetime Prevalence of Mood Disorders in Canada for Select Years 2011 to 2041



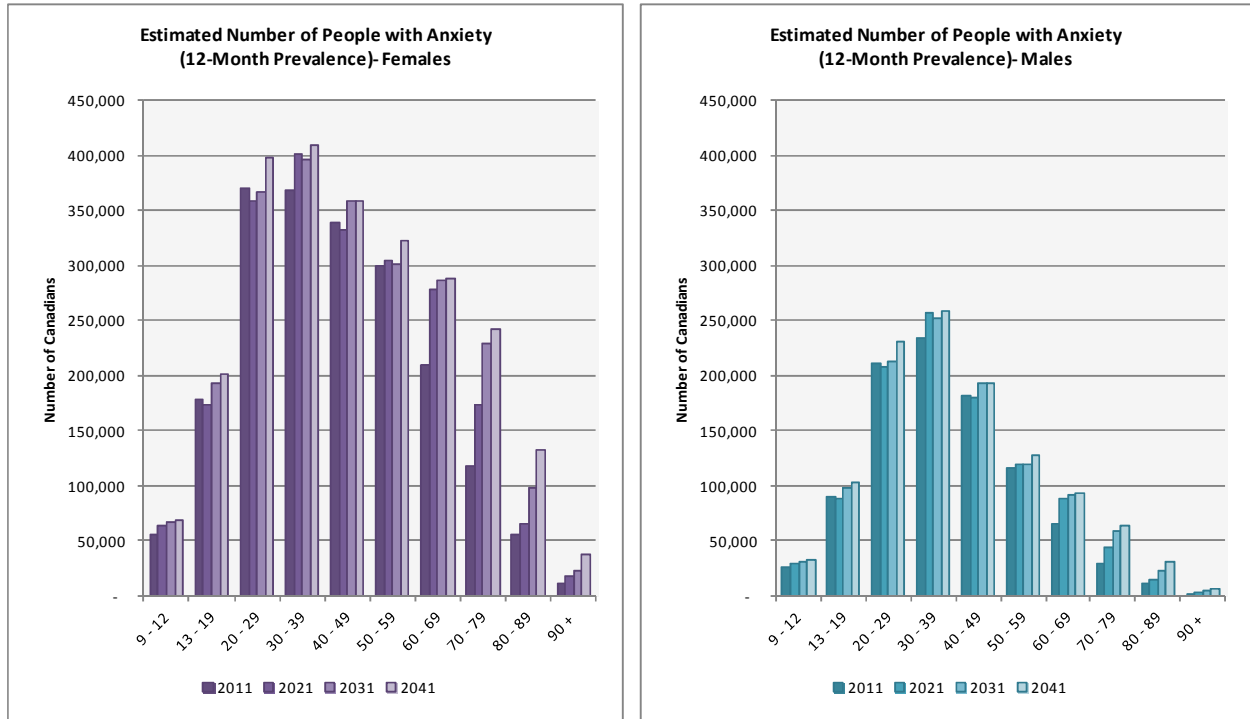
**Table 42** Estimated 12-Month Prevalence of Mood Disorders in Canada for Select Years 2011 to 2041

	Year			
	2011	2021	2031	2041
<b>Males Ages 9 to 19</b>	68,042	68,624	75,523	78,469
<b>Males All Ages</b>	462,458	488,450	516,172	544,003
<b>% of Male Population Ages 9 to 19</b>	3.0%	2.9%	3.0%	3.0%
<b>% of Male Total Population (All Ages)</b>	2.7%	2.6%	2.6%	2.5%
<b>Females Ages 9 to 19</b>	143,517	144,869	158,957	165,122
<b>Females All Ages</b>	882,832	942,720	1,011,784	1,074,944
<b>% of Female Population Ages 9 to 19</b>	6.6%	6.5%	6.6%	6.6%
<b>% of Female Total Population (All Ages)</b>	5.1%	5.0%	4.9%	4.9%
<b>Total Ages 9 to 19</b>	<b>211,559</b>	<b>213,493</b>	<b>234,481</b>	<b>243,591</b>
<b>Total All Ages</b>	<b>1,345,290</b>	<b>1,431,170</b>	<b>1,527,955</b>	<b>1,618,947</b>
<b>% of Population Ages 9 to 19</b>	<b>4.8%</b>	<b>4.7%</b>	<b>4.7%</b>	<b>4.7%</b>
<b>% of Total Population (All Ages)</b>	<b>3.9%</b>	<b>3.8%</b>	<b>3.8%</b>	<b>3.7%</b>

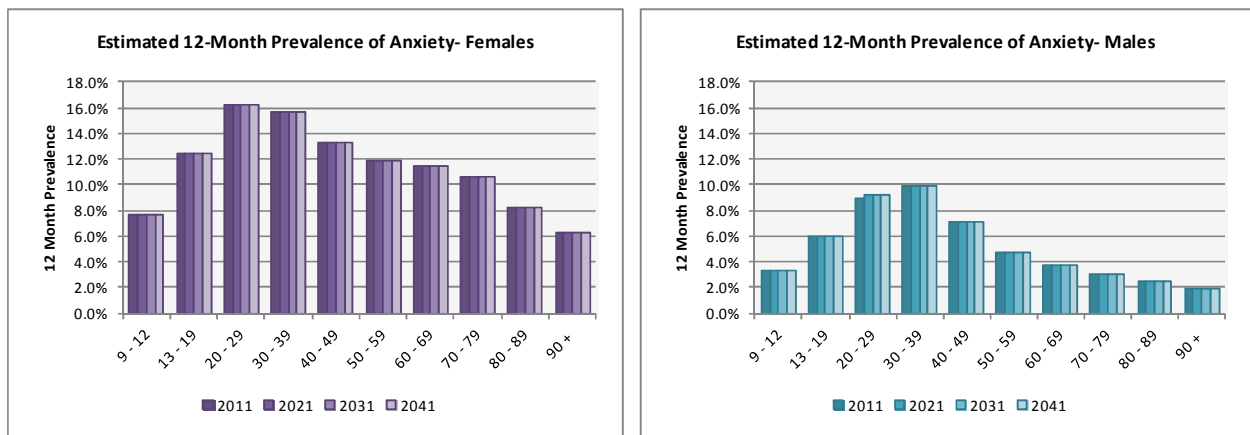


D.4 ANXIETY DISORDERS

**Figure 43** Estimated Number of People with Anxiety Disorders in Canada (12-Month Prevalence) for Select Years 2011 to 2041

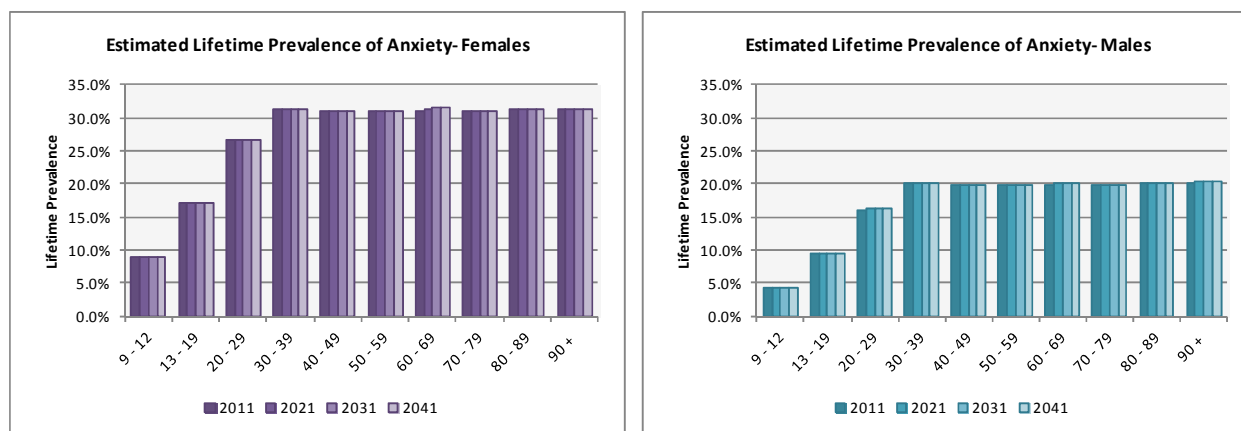


**Figure 44** Estimated 12-Month Prevalence of Anxiety Disorders in Canada for Select Years 2011 to 2041



## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 45** Estimated Lifetime Prevalence of Anxiety Disorders in Canada for Select Years 2011 to 2041



**Table 43** Estimated 12-Month Prevalence of Anxiety Disorders in Canada for Select Years 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Anxiety Disorders in Canada</b>				
	<b>Year</b>			
	<b>2011</b>	<b>2021</b>	<b>2031</b>	<b>2041</b>
Males Ages 9 to 19	115,939	117,423	129,630	134,723
Males All Ages	966,933	1,028,673	1,082,866	1,140,436
% of Male Population Ages 9 to 19	5.1%	5.0%	5.1%	5.1%
% of Male Total Population (All Ages)	5.7%	5.5%	5.4%	5.3%
Females Ages 9 to 19	233,850	233,850	233,850	233,850
Females All Ages	2,004,194	2,164,946	2,318,705	2,457,372
% of Female Population Ages 9 to 19	10.7%	10.6%	10.7%	10.7%
% of Female Total Population (All Ages)	11.6%	11.4%	11.3%	11.2%
<b>Total Ages 9 to 19</b>	<b>349,789</b>	<b>351,273</b>	<b>363,480</b>	<b>368,574</b>
<b>Total All Ages</b>	<b>2,971,127</b>	<b>3,193,619</b>	<b>3,401,571</b>	<b>3,597,808</b>
<b>% of Population Ages 9 to 19</b>	<b>7.8%</b>	<b>7.8%</b>	<b>7.8%</b>	<b>7.8%</b>
<b>% of Total Population (All Ages)</b>	<b>8.6%</b>	<b>8.5%</b>	<b>8.4%</b>	<b>8.3%</b>

### D.5 HEART DISEASE

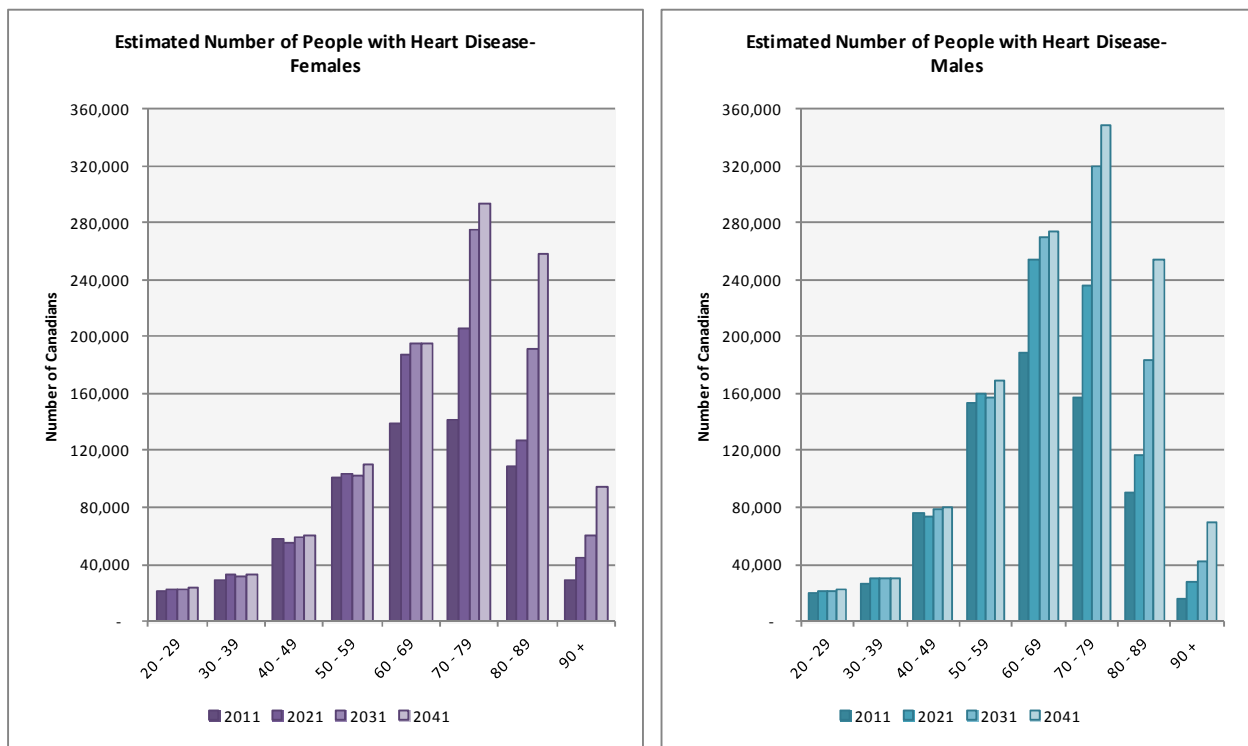
Heart disease is a key risk factor for the development of many mental illnesses, and is also a disease which has an elevated relative risk given some mental illnesses. Therefore, the prevalence of heart disease will both be affected by mental illnesses and also drive mental illnesses.

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 44** Estimated Prevalence of Heart Disease in Canada for Select Years 2011 to 2041

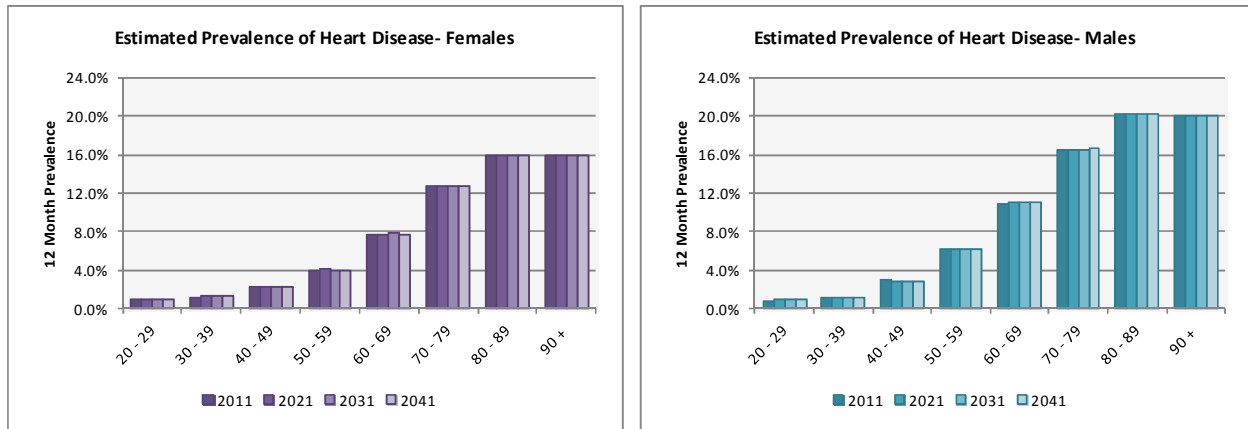
	Year			
	2011	2021	2031	2041
Males	727,944	917,547	1,102,303	1,246,992
% of Male Total Population (All Ages)	4.3%	4.9%	5.5%	5.8%
Females	627,268	777,940	939,078	1,067,920
% of Female Total Population (All Ages)	3.6%	4.1%	4.6%	4.9%
<b>Total</b>	<b>1,355,212</b>	<b>1,695,487</b>	<b>2,041,381</b>	<b>2,314,912</b>
<b>% of Total Population (All Ages)</b>	<b>3.9%</b>	<b>4.5%</b>	<b>5.0%</b>	<b>5.3%</b>

**Figure 46** Estimated Number of People with Heart Disease for Select Years 2011 to 2041



# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 47** Estimated Prevalence of Heart Disease in Canada for Select Years 2011 to 2041



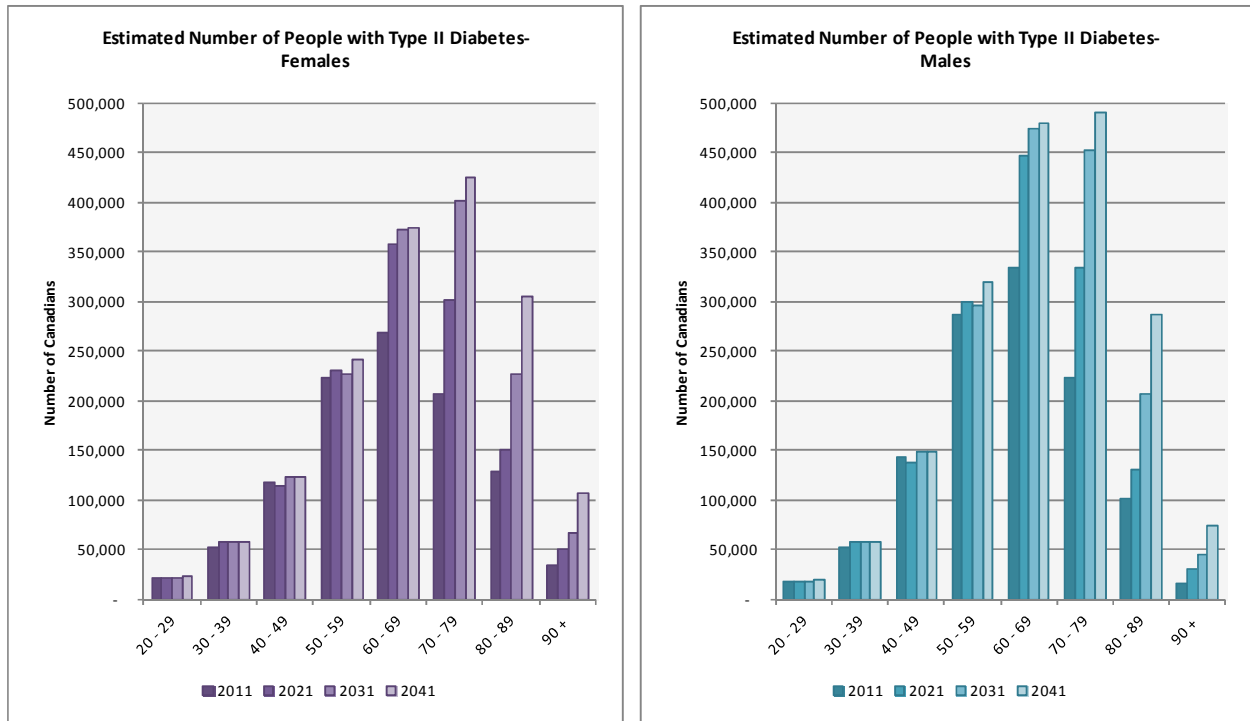
## D.6 TYPE II DIABETES

**Table 45** Estimated Prevalence of Type II Diabetes in Canada for Select Years 2011 to 2041

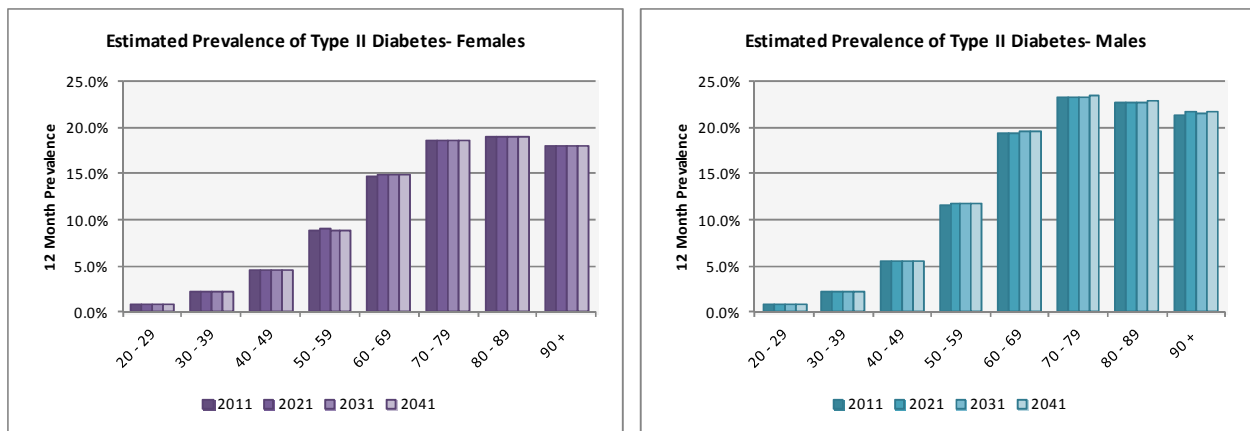
	Year			
	2011	2021	2031	2041
<b>Estimated Number and Prevalence of Type II Diabetes in Canada</b>				
Males	1,174,769	1,455,900	1,696,913	1,876,305
% of Male Total Population (All Ages)	6.9%	7.8%	8.4%	8.7%
Females	1,050,821	1,282,061	1,495,327	1,656,712
% of Female Total Population (All Ages)	6.1%	6.8%	7.3%	7.5%
<b>Total</b>	<b>2,225,590</b>	<b>2,737,961</b>	<b>3,192,239</b>	<b>3,533,017</b>
<b>% of Total Population (All Ages)</b>	<b>6.5%</b>	<b>7.3%</b>	<b>7.8%</b>	<b>8.1%</b>

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Figure 48** Estimated Number of People with Type II Diabetes for Select Years 2011 to 2041



**Figure 49** Estimated Prevalence of Type II Diabetes in Canada for Select Years 2011 to 2041



D.7 DETAILED PREVALENCE BY AGE AND SEX FOR EACH ILLNESS

**Table 46** Estimated Number of Females with Anxiety by Age From 2011 to 2041

Year	Age Group										Total
	9 - 12	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +	
2011	55,934	177,917	369,819	367,737	339,471	299,517	208,632	117,708	55,889	11,571	2,004,194
2012	55,643	176,136	371,428	371,826	335,289	304,634	216,555	120,796	56,427	12,345	2,021,079
2013	55,706	174,139	372,011	376,137	331,551	308,645	224,432	124,603	56,915	13,066	2,037,206
2014	56,130	172,175	371,882	380,382	328,557	311,402	232,201	129,127	57,411	13,731	2,052,998
2015	56,878	170,451	371,167	384,414	326,492	312,887	239,777	134,316	57,967	14,346	2,068,693
2016	57,871	169,193	369,925	388,149	325,414	313,193	247,091	140,068	58,636	14,915	2,084,457
2017	59,006	168,548	368,208	391,533	325,288	312,493	254,180	146,257	59,469	15,446	2,100,430
2018	60,175	168,591	366,097	394,524	326,023	311,000	260,982	152,749	60,511	15,944	2,116,596
2019	61,289	169,324	363,715	397,088	327,495	308,945	267,292	159,423	61,805	16,416	2,132,792
2020	62,286	170,687	361,221	399,196	329,568	306,563	272,973	166,178	63,387	16,868	2,148,927
2021	63,136	172,566	358,807	400,831	332,103	304,078	277,903	172,933	65,281	17,308	2,164,946
2022	63,836	174,815	356,667	401,980	334,961	301,697	282,015	179,626	67,502	17,744	2,180,843
2023	64,397	177,277	354,987	402,647	338,014	299,596	285,282	186,205	70,048	18,181	2,196,634
2024	64,844	179,804	353,920	402,853	341,140	297,915	287,698	192,612	72,904	18,636	2,212,326
2025	65,202	182,271	353,575	402,622	344,235	296,750	289,288	198,729	76,042	19,127	2,227,839
2026	65,494	184,583	354,007	402,000	347,209	296,156	290,112	204,586	79,426	19,667	2,243,240
2027	65,744	186,682	355,216	401,059	349,988	296,146	290,262	210,182	83,012	20,271	2,258,561
2028	65,967	188,539	357,151	399,890	352,512	296,700	289,858	215,476	86,755	20,948	2,273,796
2029	66,176	190,155	359,719	398,606	354,738	297,767	289,037	220,404	90,611	21,701	2,288,915
2030	66,381	191,547	362,800	397,331	356,634	299,280	287,948	224,900	94,537	22,535	2,303,892
2031	66,586	192,744	366,256	396,195	358,178	301,156	286,738	228,901	98,494	23,457	2,318,705
2032	66,795	193,783	369,946	395,323	359,365	303,306	285,545	232,360	102,446	24,469	2,333,339
2033	67,011	194,699	373,737	394,825	360,200	305,641	284,493	235,249	106,359	25,572	2,347,786
2034	67,233	195,526	377,512	394,790	360,700	308,074	283,683	237,563	110,202	26,760	2,362,044
2035	67,461	196,292	381,177	395,278	360,897	310,526	283,190	239,322	113,944	28,030	2,376,117
2036	67,695	197,020	384,664	396,316	360,838	312,924	283,064	240,567	117,554	29,375	2,390,016
2037	67,933	197,727	387,926	397,900	360,580	315,207	283,328	241,361	121,002	30,786	2,403,752
2038	68,176	198,427	390,944	399,996	360,192	317,324	283,982	241,783	124,260	32,256	2,417,339
2039	68,422	199,127	393,714	402,546	359,753	319,233	285,005	241,921	127,298	33,775	2,430,794
2040	68,672	199,832	396,250	405,473	359,342	320,907	286,361	241,869	130,093	35,335	2,444,133
2041	68,925	200,546	398,573	408,689	359,040	322,327	287,998	241,721	132,627	36,926	2,457,372

**Table 47** Estimated Number of Males with Anxiety by Age From 2011 to 2041

Year	Age Group										Total
	9 - 12	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +	
2011	26,042	89,896	211,293	234,592	182,255	116,095	65,500	28,905	10,869	1,485	966,933
2012	25,908	89,171	214,825	238,067	180,244	118,286	68,007	29,893	11,261	1,635	977,296
2013	25,942	88,306	216,187	241,198	178,425	119,998	70,409	30,986	11,564	1,770	984,785
2014	26,146	87,418	216,389	244,034	176,978	121,184	72,765	32,231	11,826	1,896	990,869
2015	26,505	86,610	215,972	246,607	176,010	121,842	75,090	33,633	12,076	2,019	996,363
2016	26,980	86,015	215,168	248,932	175,559	122,018	77,381	35,167	12,332	2,138	1,001,690
2017	27,523	85,720	214,074	251,004	175,614	121,790	79,623	36,803	12,611	2,256	1,007,016
2018	28,082	85,765	212,754	252,806	176,129	121,252	81,790	38,506	12,929	2,371	1,012,385
2019	28,615	86,172	211,279	254,315	177,043	120,505	83,847	40,246	13,297	2,484	1,017,803
2020	29,093	86,920	209,738	255,512	178,280	119,643	85,739	42,000	13,728	2,593	1,023,245
2021	29,500	87,923	208,238	256,382	179,761	118,754	87,436	43,753	14,227	2,699	1,028,673
2022	29,835	89,106	206,892	256,923	181,407	117,918	88,913	45,491	14,799	2,802	1,034,087
2023	30,104	90,397	205,810	257,140	183,140	117,201	90,143	47,208	15,444	2,905	1,039,492
2024	30,317	91,720	205,085	257,053	184,889	116,652	91,111	48,897	16,157	3,011	1,044,893
2025	30,488	93,012	204,788	256,687	186,593	116,309	91,814	50,549	16,932	3,120	1,050,291
2026	30,627	94,223	204,955	256,077	188,200	116,189	92,264	52,156	17,759	3,238	1,055,688
2027	30,745	95,323	205,592	255,274	189,670	116,297	92,488	53,706	18,629	3,366	1,061,090
2028	30,850	96,295	206,674	254,340	190,972	116,624	92,521	55,186	19,532	3,507	1,066,501
2029	30,947	97,140	208,150	253,348	192,085	117,148	92,409	56,579	20,460	3,662	1,071,929
2030	31,043	97,867	209,949	252,381	192,994	117,842	92,201	57,868	21,403	3,834	1,077,382
2031	31,138	98,492	211,990	251,523	193,695	118,670	91,944	59,038	22,354	4,023	1,082,866
2032	31,236	99,032	214,187	250,854	194,187	119,596	91,686	60,075	23,308	4,228	1,088,389
2033	31,336	99,506	216,457	250,447	194,480	120,582	91,467	60,972	24,259	4,450	1,093,957
2034	31,439	99,933	218,728	250,360	194,588	121,593	91,321	61,725	25,200	4,687	1,099,574
2035	31,545	100,327	220,940	250,629	194,533	122,595	91,274	62,337	26,126	4,939	1,105,245
2036	31,653	100,700	223,047	251,273	194,347	123,560	91,342	62,817	27,029	5,204	1,110,972
2037	31,764	101,062	225,020	252,286	194,063	124,463	91,534	63,180	27,904	5,480	1,116,756
2038	31,877	101,419	226,843	253,645	193,725	125,284	91,849	63,444	28,742	5,767	1,122,596
2039	31,991	101,776	228,513	255,311	193,377	126,009	92,281	63,634	29,537	6,063	1,128,491
2040	32,107	102,135	230,037	257,229	193,066	126,627	92,818	63,772	30,281	6,367	1,134,439
2041	32,225	102,498	231,427	259,343	192,837	127,135	93,443	63,883	30,970	6,676	1,140,436

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 48** Estimated Number and Crude 12-Month Prevalence of Anxiety By Sex for 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Anxiety Disorders in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	2,004,194	11.56%	966,933	5.68%	2,971,127	8.65%
2012	2,021,079	11.55%	977,296	5.69%	2,998,375	8.64%
2013	2,037,206	11.53%	984,785	5.67%	3,021,991	8.63%
2014	2,052,998	11.51%	990,869	5.66%	3,043,866	8.61%
2015	2,068,693	11.49%	996,363	5.63%	3,065,056	8.59%
2016	2,084,457	11.47%	1,001,690	5.61%	3,086,146	8.57%
2017	2,100,430	11.45%	1,007,016	5.59%	3,107,446	8.55%
2018	2,116,596	11.44%	1,012,385	5.57%	3,128,981	8.53%
2019	2,132,792	11.43%	1,017,803	5.55%	3,150,594	8.52%
2020	2,148,927	11.41%	1,023,245	5.53%	3,172,172	8.50%
2021	2,164,946	11.40%	1,028,673	5.52%	3,193,619	8.49%
2022	2,180,843	11.39%	1,034,087	5.50%	3,214,930	8.47%
2023	2,196,634	11.37%	1,039,492	5.48%	3,236,126	8.46%
2024	2,212,326	11.36%	1,044,893	5.47%	3,257,219	8.44%
2025	2,227,839	11.35%	1,050,291	5.45%	3,278,131	8.43%
2026	2,243,240	11.33%	1,055,688	5.44%	3,298,929	8.41%
2027	2,258,561	11.32%	1,061,090	5.43%	3,319,651	8.40%
2028	2,273,796	11.31%	1,066,501	5.41%	3,340,297	8.39%
2029	2,288,915	11.30%	1,071,929	5.40%	3,360,844	8.38%
2030	2,303,892	11.29%	1,077,382	5.39%	3,381,274	8.37%
2031	2,318,705	11.28%	1,082,866	5.38%	3,401,571	8.36%
2032	2,333,339	11.27%	1,088,389	5.37%	3,421,729	8.35%
2033	2,347,786	11.26%	1,093,957	5.36%	3,441,743	8.34%
2034	2,362,044	11.25%	1,099,574	5.35%	3,461,618	8.33%
2035	2,376,117	11.24%	1,105,245	5.34%	3,481,362	8.32%
2036	2,390,016	11.23%	1,110,972	5.34%	3,500,988	8.32%
2037	2,403,752	11.22%	1,116,756	5.33%	3,520,507	8.31%
2038	2,417,339	11.21%	1,122,596	5.33%	3,539,935	8.30%
2039	2,430,794	11.21%	1,128,491	5.32%	3,559,285	8.30%
2040	2,444,133	11.20%	1,134,439	5.32%	3,578,572	8.29%
2041	2,457,372	11.19%	1,140,436	5.32%	3,597,808	8.29%



**Table 49** Estimated Number of Females with Mood Disorders by Age From 2011 to 2041

Year	Age Group										Total
	9 - 12	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +	
2011	40,439	103,079	168,209	143,275	146,767	128,188	77,745	43,479	25,415	6,236	882,832
2012	40,078	101,905	168,615	144,862	145,032	130,408	80,835	44,595	25,663	6,654	888,647
2013	40,011	100,631	168,736	146,510	143,428	132,124	83,844	45,976	25,886	7,042	894,190
2014	40,254	99,425	168,593	148,157	142,125	133,290	86,733	47,609	26,111	7,401	899,698
2015	40,763	98,411	168,198	149,741	141,216	133,906	89,489	49,481	26,364	7,733	905,302
2016	41,464	97,677	167,567	151,218	140,732	134,015	92,111	51,583	26,669	8,040	911,076
2017	42,270	97,279	166,723	152,559	140,660	133,696	94,601	53,870	27,047	8,326	917,030
2018	43,098	97,301	165,709	153,744	140,962	133,040	96,949	56,273	27,521	8,594	923,191
2019	43,883	97,747	164,584	154,760	141,584	132,148	99,136	58,742	28,110	8,849	929,543
2020	44,582	98,570	163,427	155,599	142,468	131,121	101,130	61,242	28,829	9,092	936,062
2021	45,176	99,693	162,327	156,253	143,554	130,056	102,893	63,747	29,691	9,329	942,720
2022	45,662	101,025	161,374	156,719	144,783	129,040	104,393	66,231	30,701	9,564	949,491
2023	46,052	102,469	160,651	156,996	146,099	128,146	105,600	68,675	31,859	9,803	956,351
2024	46,363	103,937	160,225	157,089	147,450	127,435	106,500	71,061	33,158	10,053	963,271
2025	46,611	105,362	160,140	157,010	148,789	126,946	107,093	73,374	34,585	10,321	970,231
2026	46,816	106,693	160,416	156,777	150,078	126,703	107,398	75,596	36,124	10,613	977,214
2027	46,991	107,898	161,046	156,419	151,285	126,709	107,451	77,710	37,755	10,936	984,198
2028	47,148	108,962	162,000	155,970	152,382	126,955	107,296	79,696	39,458	11,296	991,165
2029	47,297	109,887	163,232	155,474	153,351	127,421	106,987	81,536	41,212	11,699	998,095
2030	47,442	110,683	164,683	154,978	154,178	128,076	106,580	83,208	42,997	12,147	1,004,973
2031	47,589	111,368	166,288	154,534	154,853	128,885	106,131	84,695	44,797	12,644	1,011,784
2032	47,739	111,963	167,982	154,190	155,374	129,809	105,691	85,983	46,594	13,190	1,018,516
2033	47,893	112,489	169,708	153,989	155,742	130,811	105,307	87,063	48,374	13,784	1,025,160
2034	48,052	112,963	171,413	153,967	155,965	131,854	105,016	87,933	50,122	14,424	1,031,709
2035	48,216	113,404	173,058	154,146	156,057	132,902	104,845	88,600	51,824	15,109	1,038,162
2036	48,383	113,823	174,616	154,539	156,037	133,927	104,811	89,079	53,466	15,834	1,044,515
2037	48,554	114,231	176,068	155,145	155,931	134,902	104,922	89,391	55,034	16,594	1,050,772
2038	48,727	114,635	177,409	155,951	155,767	135,804	105,182	89,563	56,515	17,387	1,056,939
2039	48,903	115,039	178,637	156,935	155,578	136,617	105,581	89,627	57,897	18,206	1,063,020
2040	49,082	115,447	179,761	158,068	155,401	137,329	106,100	89,617	59,169	19,046	1,069,019
2041	49,263	115,859	180,793	159,315	155,269	137,932	106,720	89,567	60,321	19,904	1,074,944

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 50** Estimated Number of Males with Mood Disorders by Age From 2011 to 2041

Year	Age Group											Total
	9 - 12	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +		
2011	18,035	50,006	92,709	102,112	90,971	59,808	29,815	11,964	6,045	991	462,458	
2012	17,898	49,437	93,537	103,699	89,996	60,918	30,884	12,299	6,229	1,088	465,986	
2013	17,886	48,812	93,784	105,084	89,063	61,773	31,941	12,714	6,383	1,181	468,620	
2014	18,008	48,216	93,719	106,373	88,297	62,331	33,003	13,214	6,523	1,270	470,955	
2015	18,246	47,713	93,463	107,576	87,767	62,594	34,069	13,791	6,659	1,356	473,234	
2016	18,570	47,354	93,065	108,675	87,496	62,604	35,128	14,427	6,800	1,439	475,557	
2017	18,940	47,174	92,552	109,653	87,479	62,429	36,179	15,105	6,953	1,519	477,983	
2018	19,320	47,192	91,949	110,496	87,695	62,112	37,222	15,808	7,128	1,596	480,519	
2019	19,680	47,409	91,286	111,196	88,112	61,700	38,201	16,527	7,334	1,671	483,116	
2020	20,001	47,806	90,605	111,748	88,696	61,242	39,077	17,256	7,588	1,743	485,761	
2021	20,274	48,350	89,954	112,150	89,407	60,781	39,846	17,990	7,885	1,813	488,450	
2022	20,498	48,999	89,383	112,405	90,208	60,355	40,499	18,726	8,222	1,881	491,177	
2023	20,677	49,709	88,938	112,518	91,060	59,998	41,032	19,459	8,596	1,950	493,937	
2024	20,819	50,436	88,660	112,495	91,928	59,732	41,441	20,184	9,004	2,020	496,720	
2025	20,933	51,146	88,574	112,348	92,781	59,575	41,729	20,893	9,442	2,094	499,515	
2026	21,027	51,810	88,694	112,094	93,592	59,533	41,905	21,583	9,902	2,173	502,313	
2027	21,106	52,413	89,018	111,753	94,339	59,609	41,982	22,258	10,381	2,258	505,117	
2028	21,177	52,946	89,532	111,353	95,005	59,796	41,976	22,900	10,873	2,352	507,910	
2029	21,244	53,409	90,210	110,924	95,580	60,082	41,909	23,497	11,373	2,456	510,684	
2030	21,309	53,807	91,021	110,503	96,054	60,452	41,803	24,041	11,878	2,570	513,437	
2031	21,375	54,148	91,926	110,125	96,424	60,889	41,679	24,530	12,386	2,689	516,172	
2032	21,442	54,444	92,890	109,826	96,691	61,372	41,558	24,961	12,896	2,819	518,898	
2033	21,511	54,704	93,876	109,638	96,857	61,883	41,457	25,334	13,407	2,960	521,627	
2034	21,582	54,938	94,855	109,586	96,920	62,403	41,392	25,651	13,916	3,113	524,366	
2035	21,655	55,154	95,803	109,688	96,920	62,916	41,373	25,913	14,421	3,277	527,120	
2036	21,729	55,359	96,701	109,952	96,842	63,407	41,408	26,122	14,919	3,452	529,892	
2037	21,806	55,558	97,539	110,378	96,713	63,863	41,499	26,285	15,404	3,636	532,682	
2038	21,883	55,754	98,312	110,957	96,553	64,277	41,647	26,408	15,871	3,829	535,489	
2039	21,962	55,950	99,019	111,671	96,384	64,639	41,847	26,499	16,316	4,028	538,313	
2040	22,041	56,147	99,663	112,498	96,228	64,946	42,095	26,567	16,734	4,233	541,152	
2041	22,122	56,347	100,252	113,413	96,109	65,196	42,382	26,621	17,120	4,441	544,003	

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 51** Estimated Number and Crude 12-Month Prevalence of Mood Disorders By Sex for 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Mood Disorders in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	882,832	5.09%	462,458	2.72%	1,345,290	3.92%
2012	888,647	5.08%	465,986	2.71%	1,354,633	3.90%
2013	894,190	5.06%	468,620	2.70%	1,362,810	3.89%
2014	899,698	5.04%	470,955	2.69%	1,370,653	3.88%
2015	905,302	5.03%	473,234	2.68%	1,378,535	3.86%
2016	911,076	5.01%	475,557	2.66%	1,386,632	3.85%
2017	917,030	5.00%	477,983	2.65%	1,395,013	3.84%
2018	923,191	4.99%	480,519	2.64%	1,403,710	3.83%
2019	929,543	4.98%	483,116	2.64%	1,412,659	3.82%
2020	936,062	4.97%	485,761	2.63%	1,421,823	3.81%
2021	942,720	4.96%	488,450	2.62%	1,431,170	3.80%
2022	949,491	4.96%	491,177	2.61%	1,440,669	3.80%
2023	956,351	4.95%	493,937	2.61%	1,450,288	3.79%
2024	963,271	4.95%	496,720	2.60%	1,459,990	3.78%
2025	970,231	4.94%	499,515	2.59%	1,469,746	3.78%
2026	977,214	4.94%	502,313	2.59%	1,479,527	3.77%
2027	984,198	4.93%	505,117	2.58%	1,489,315	3.77%
2028	991,165	4.93%	507,910	2.58%	1,499,075	3.77%
2029	998,095	4.93%	510,684	2.57%	1,508,780	3.76%
2030	1,004,973	4.92%	513,437	2.57%	1,518,411	3.76%
2031	1,011,784	4.92%	516,172	2.56%	1,527,955	3.75%
2032	1,018,516	4.92%	518,898	2.56%	1,537,414	3.75%
2033	1,025,160	4.92%	521,627	2.56%	1,546,787	3.75%
2034	1,031,709	4.91%	524,366	2.55%	1,556,075	3.75%
2035	1,038,162	4.91%	527,120	2.55%	1,565,282	3.74%
2036	1,044,515	4.91%	529,892	2.55%	1,574,407	3.74%
2037	1,050,772	4.91%	532,682	2.54%	1,583,454	3.74%
2038	1,056,939	4.90%	535,489	2.54%	1,592,428	3.74%
2039	1,063,020	4.90%	538,313	2.54%	1,601,333	3.73%
2040	1,069,019	4.90%	541,152	2.54%	1,610,171	3.73%
2041	1,074,944	4.90%	544,003	2.54%	1,618,947	3.73%

Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 52** Estimated Number of Females with Schizophrenia by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	7,202	13,697	20,435	24,186	19,209	12,042	7,518	2,038	106,326		
2012	7,182	13,838	20,172	24,612	19,962	12,352	7,597	2,182	107,897		
2013	7,175	13,992	19,934	24,951	20,703	12,735	7,665	2,313	109,467		
2014	7,180	14,149	19,739	25,192	21,423	13,192	7,732	2,431	111,040		
2015	7,190	14,303	19,600	25,331	22,118	13,718	7,808	2,541	112,609		
2016	7,194	14,449	19,521	25,376	22,782	14,302	7,898	2,642	114,164		
2017	7,188	14,582	19,501	25,337	23,414	14,932	8,010	2,736	115,700		
2018	7,169	14,701	19,533	25,231	24,010	15,595	8,150	2,824	117,213		
2019	7,138	14,803	19,610	25,075	24,567	16,277	8,325	2,908	118,703		
2020	7,097	14,889	19,726	24,888	25,075	16,968	8,538	2,988	120,168		
2021	7,052	14,956	19,870	24,689	25,526	17,661	8,793	3,065	121,613		
2022	7,009	15,006	20,037	24,494	25,911	18,348	9,092	3,142	123,038		
2023	6,972	15,037	20,217	24,319	26,224	19,024	9,435	3,218	124,447		
2024	6,945	15,051	20,403	24,175	26,461	19,684	9,820	3,299	125,838		
2025	6,931	15,049	20,590	24,073	26,621	20,323	10,242	3,385	127,214		
2026	6,931	15,031	20,770	24,015	26,710	20,937	10,698	3,480	128,573		
2027	6,946	15,001	20,940	24,006	26,734	21,522	11,181	3,585	129,914		
2028	6,974	14,961	21,096	24,042	26,705	22,070	11,685	3,702	131,237		
2029	7,016	14,916	21,234	24,121	26,635	22,578	12,205	3,834	132,539		
2030	7,069	14,870	21,353	24,237	26,539	23,040	12,734	3,981	133,821		
2031	7,132	14,827	21,451	24,384	26,429	23,450	13,267	4,143	135,082		
2032	7,201	14,792	21,527	24,554	26,320	23,805	13,799	4,323	136,320		
2033	7,274	14,769	21,583	24,741	26,222	24,102	14,326	4,518	137,535		
2034	7,349	14,762	21,618	24,937	26,147	24,341	14,844	4,728	138,725		
2035	7,423	14,774	21,635	25,135	26,099	24,524	15,348	4,954	139,891		
2036	7,494	14,805	21,635	25,331	26,085	24,655	15,834	5,192	141,032		
2037	7,561	14,857	21,623	25,518	26,107	24,740	16,298	5,442	142,148		
2038	7,624	14,929	21,603	25,692	26,166	24,786	16,737	5,703	143,239		
2039	7,681	15,018	21,578	25,850	26,258	24,803	17,146	5,973	144,307		
2040	7,734	15,122	21,553	25,990	26,381	24,800	17,523	6,250	145,352		
2041	7,782	15,238	21,534	26,109	26,530	24,785	17,864	6,533	146,375		

Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 53** Estimated Number of Males with Schizophrenia by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	13,399	20,511	22,767	20,675	13,970	8,022	4,135	734			104,214
2012	13,344	20,788	22,493	21,068	14,505	8,251	4,248	808			105,505
2013	13,327	21,114	22,245	21,387	15,030	8,531	4,348	878			106,859
2014	13,337	21,401	22,046	21,618	15,543	8,863	4,438	944			108,191
2015	13,355	21,630	21,908	21,760	16,043	9,243	4,526	1,008			109,473
2016	13,362	21,805	21,829	21,816	16,527	9,662	4,617	1,070			110,688
2017	13,348	21,938	21,776	21,798	16,995	10,111	4,718	1,129			111,813
2018	13,308	22,065	21,774	21,721	17,444	10,581	4,833	1,187			112,914
2019	13,245	22,191	21,835	21,602	17,872	11,064	4,969	1,242			114,018
2020	13,162	22,296	21,958	21,456	18,270	11,551	5,127	1,296			115,117
2021	13,073	22,376	22,135	21,300	18,632	12,040	5,312	1,348			116,215
2022	12,988	22,427	22,371	21,149	18,949	12,525	5,525	1,399			117,332
2023	12,916	22,450	22,639	21,015	19,215	13,005	5,766	1,450			118,455
2024	12,865	22,446	22,913	20,908	19,424	13,477	6,032	1,501			119,566
2025	12,838	22,418	23,173	20,837	19,577	13,939	6,322	1,555			120,659
2026	12,840	22,368	23,410	20,805	19,676	14,389	6,632	1,612			121,731
2027	12,871	22,301	23,616	20,825	19,725	14,823	6,959	1,674			122,793
2028	12,929	22,222	23,790	20,898	19,733	15,238	7,299	1,742			123,850
2029	13,010	22,137	23,931	21,002	19,711	15,630	7,647	1,818			124,886
2030	13,113	22,053	24,042	21,125	19,668	15,993	8,002	1,902			125,899
2031	13,234	21,977	24,124	21,263	19,615	16,324	8,360	1,994			126,892
2032	13,367	21,917	24,180	21,409	19,561	16,619	8,719	2,094			127,866
2033	13,508	21,879	24,211	21,562	19,514	16,876	9,077	2,203			128,828
2034	13,651	21,867	24,219	21,717	19,482	17,093	9,432	2,319			129,779
2035	13,791	21,887	24,209	21,885	19,470	17,271	9,780	2,442			130,735
2036	13,927	21,938	24,183	22,056	19,478	17,413	10,121	2,572			131,688
2037	14,054	22,022	24,147	22,223	19,511	17,522	10,450	2,708			132,638
2038	14,173	22,136	24,103	22,390	19,573	17,601	10,766	2,850			133,591
2039	14,281	22,277	24,058	22,543	19,662	17,658	11,066	2,995			134,541
2040	14,380	22,441	24,018	22,677	19,778	17,698	11,347	3,145			135,484
2041	14,471	22,623	23,986	22,786	19,916	17,728	11,607	3,297			136,416

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 54** Estimated Number and Crude 12-Month Prevalence of Schizophrenia By Sex for 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Schizophrenia in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	106,326	0.61%	104,214	0.61%	210,540	0.61%
2012	107,897	0.62%	105,505	0.61%	213,402	0.62%
2013	109,467	0.62%	106,859	0.62%	216,326	0.62%
2014	111,040	0.62%	108,191	0.62%	219,231	0.62%
2015	112,609	0.63%	109,473	0.62%	222,081	0.62%
2016	114,164	0.63%	110,688	0.62%	224,852	0.62%
2017	115,700	0.63%	111,813	0.62%	227,513	0.63%
2018	117,213	0.63%	112,914	0.62%	230,127	0.63%
2019	118,703	0.64%	114,018	0.62%	232,721	0.63%
2020	120,168	0.64%	115,117	0.62%	235,285	0.63%
2021	121,613	0.64%	116,215	0.62%	237,828	0.63%
2022	123,038	0.64%	117,332	0.62%	240,370	0.63%
2023	124,447	0.64%	118,455	0.62%	242,901	0.63%
2024	125,838	0.65%	119,566	0.63%	245,405	0.64%
2025	127,214	0.65%	120,659	0.63%	247,873	0.64%
2026	128,573	0.65%	121,731	0.63%	250,304	0.64%
2027	129,914	0.65%	122,793	0.63%	252,708	0.64%
2028	131,237	0.65%	123,850	0.63%	255,087	0.64%
2029	132,539	0.65%	124,886	0.63%	257,425	0.64%
2030	133,821	0.66%	125,899	0.63%	259,720	0.64%
2031	135,082	0.66%	126,892	0.63%	261,974	0.64%
2032	136,320	0.66%	127,866	0.63%	264,187	0.64%
2033	137,535	0.66%	128,828	0.63%	266,363	0.65%
2034	138,725	0.66%	129,779	0.63%	268,505	0.65%
2035	139,891	0.66%	130,735	0.63%	270,626	0.65%
2036	141,032	0.66%	131,688	0.63%	272,720	0.65%
2037	142,148	0.66%	132,638	0.63%	274,785	0.65%
2038	143,239	0.66%	133,591	0.63%	276,831	0.65%
2039	144,307	0.67%	134,541	0.63%	278,848	0.65%
2040	145,352	0.67%	135,484	0.64%	280,836	0.65%
2041	146,375	0.67%	136,416	0.64%	282,790	0.65%

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 55** Estimated Number of Females with Substance Use Disorders by Age From 2011 to 2041

Year	Age Group										Total
	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +		
2011	90,678	192,506	144,878	82,730	35,627	10,172	1,407	56	5	558,058	
2012	89,518	193,413	146,573	81,781	36,166	10,549	1,482	63	5	559,551	
2013	88,005	193,865	148,355	80,960	36,571	10,912	1,566	70	6	560,310	
2014	86,537	193,890	150,077	80,326	36,825	11,266	1,661	74	8	560,663	
2015	85,344	193,557	151,665	79,916	36,925	11,610	1,766	77	9	560,870	
2016	84,527	192,924	153,073	79,743	36,886	11,942	1,881	80	11	561,066	
2017	84,116	192,035	154,283	79,797	36,735	12,258	2,015	83	12	561,334	
2018	84,105	190,937	155,314	80,056	36,501	12,554	2,149	92	14	561,723	
2019	84,463	189,696	156,229	80,486	36,218	12,827	2,244	105	16	562,284	
2020	85,139	188,396	156,993	81,054	35,914	13,071	2,320	116	18	563,021	
2021	86,068	187,137	157,582	81,722	35,614	13,280	2,389	125	20	563,937	
2022	87,172	186,021	157,986	82,456	35,341	13,451	2,458	130	21	565,036	
2023	88,376	185,144	158,200	83,223	35,113	13,581	2,528	132	23	566,320	
2024	89,608	184,587	158,228	83,996	34,943	13,669	2,603	131	24	567,789	
2025	90,811	184,406	158,083	84,750	34,838	13,717	2,680	127	25	569,437	
2026	91,939	184,630	157,787	85,465	34,802	13,730	2,756	124	26	571,260	
2027	92,966	185,260	157,371	86,124	34,836	13,712	2,832	122	27	573,250	
2028	93,878	186,268	156,874	86,716	34,934	13,672	2,903	124	28	575,397	
2029	94,675	187,607	156,344	87,231	35,089	13,617	2,968	131	28	577,689	
2030	95,364	189,213	155,832	87,663	35,292	13,555	3,025	141	28	580,113	
2031	95,959	191,015	155,392	88,007	35,533	13,492	3,073	155	28	582,654	
2032	96,477	192,939	155,073	88,263	35,801	13,436	3,111	172	28	585,299	
2033	96,935	194,916	154,916	88,433	36,086	13,391	3,140	190	27	588,034	
2034	97,348	196,885	154,954	88,522	36,377	13,362	3,160	209	27	590,843	
2035	97,732	198,797	155,206	88,539	36,665	13,350	3,173	228	28	593,716	
2036	98,096	200,615	155,681	88,497	36,943	13,357	3,178	245	28	596,640	
2037	98,450	202,317	156,371	88,411	37,204	13,384	3,179	261	29	599,605	
2038	98,800	203,891	157,258	88,300	37,442	13,428	3,176	275	31	602,602	
2039	99,149	205,337	158,317	88,183	37,654	13,489	3,172	288	33	605,623	
2040	99,501	206,659	159,515	88,081	37,837	13,565	3,168	300	36	608,662	
2041	99,857	207,871	160,815	88,015	37,988	13,652	3,164	311	38	611,711	

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 56** Estimated Number of Males with Substance Use Disorders by Age From 2011 to 2041

Year	Age Group										Total
	13 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +		
2011	211,733	446,231	356,622	254,576	141,805	46,676	10,976	2,316	214	1,471,148	
2012	208,445	446,869	360,687	251,645	144,313	48,335	11,348	2,381	241	1,474,265	
2013	204,598	446,724	364,985	249,051	146,228	49,970	11,789	2,438	267	1,476,051	
2014	201,038	445,927	369,242	247,002	147,487	51,584	12,310	2,491	290	1,477,372	
2015	198,206	444,550	373,256	245,632	148,118	53,174	12,890	2,543	310	1,478,678	
2016	196,286	442,627	376,902	244,988	148,202	54,732	13,506	2,596	326	1,480,164	
2017	195,334	440,202	380,111	245,052	147,818	56,244	14,141	2,655	339	1,481,896	
2018	195,337	437,132	382,847	245,760	147,080	57,693	14,783	2,722	351	1,483,705	
2019	196,224	433,674	385,092	247,024	146,112	59,058	15,423	2,800	363	1,485,770	
2020	197,876	430,249	386,838	248,742	145,029	60,310	16,061	2,890	375	1,488,370	
2021	200,135	427,091	388,079	250,802	143,938	61,422	16,696	2,995	387	1,491,545	
2022	202,816	424,389	388,820	253,094	142,931	62,367	17,326	3,116	401	1,495,261	
2023	205,734	422,328	389,073	255,509	142,086	63,127	17,953	3,252	416	1,499,476	
2024	208,715	421,066	388,862	257,949	141,489	63,694	18,573	3,402	432	1,504,181	
2025	211,615	420,721	388,227	260,328	141,159	64,073	19,183	3,565	449	1,509,320	
2026	214,329	421,350	387,229	262,573	141,095	64,277	19,779	3,739	467	1,514,839	
2027	216,790	422,945	385,946	264,628	141,289	64,333	20,354	3,922	486	1,520,694	
2028	218,966	425,437	384,478	266,450	141,727	64,271	20,901	4,112	507	1,526,850	
2029	220,858	428,704	382,943	268,007	142,384	64,127	21,412	4,308	529	1,533,274	
2030	222,488	432,577	381,468	269,282	143,231	63,936	21,879	4,506	554	1,539,921	
2031	223,889	436,891	380,183	270,265	144,228	63,733	22,295	4,706	580	1,546,771	
2032	225,103	441,479	379,212	270,958	145,339	63,547	22,656	4,907	609	1,553,811	
2033	226,173	446,174	378,661	271,372	146,534	63,406	22,960	5,107	639	1,561,027	
2034	227,138	450,833	378,614	271,527	147,760	63,330	23,210	5,306	672	1,568,389	
2035	228,029	455,342	379,121	271,456	148,973	63,332	23,411	5,500	707	1,575,872	
2036	228,876	459,621	380,203	271,199	150,135	63,420	23,565	5,691	744	1,583,454	
2037	229,697	463,615	381,846	270,807	151,218	63,597	23,678	5,875	782	1,591,115	
2038	230,509	467,301	384,007	270,338	152,197	63,860	23,757	6,051	821	1,598,840	
2039	231,320	470,675	386,619	269,853	153,056	64,201	23,812	6,219	862	1,606,617	
2040	232,137	473,753	389,599	269,419	153,784	64,610	23,851	6,375	903	1,614,432	
2041	232,964	476,566	392,854	269,098	154,377	65,073	23,885	6,520	944	1,622,281	



## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 57** Estimated Number and Crude 12-Month Prevalence of Substance Use Disorders By Sex for 2011 to 2041

<i>Estimated Number and 12-Month Prevalence of SUD in Canada, by Sex, 2011 to 2041</i>						
Year	Females	% of Female Population	Males	% of Male Population	Total	% of Total Population
2011	558,058	3.22%	1,471,148	8.64%	2,029,205	5.91%
2012	559,551	3.20%	1,474,265	8.58%	2,033,816	5.86%
2013	560,310	3.17%	1,476,051	8.51%	2,036,361	5.81%
2014	560,663	3.14%	1,477,372	8.43%	2,038,036	5.76%
2015	560,870	3.12%	1,478,678	8.36%	2,039,548	5.71%
2016	561,066	3.09%	1,480,164	8.29%	2,041,230	5.67%
2017	561,334	3.06%	1,481,896	8.23%	2,043,230	5.62%
2018	561,723	3.04%	1,483,705	8.17%	2,045,428	5.58%
2019	562,284	3.01%	1,485,770	8.11%	2,048,053	5.54%
2020	563,021	2.99%	1,488,370	8.05%	2,051,391	5.50%
2021	563,937	2.97%	1,491,545	8.00%	2,055,482	5.46%
2022	565,036	2.95%	1,495,261	7.95%	2,060,297	5.43%
2023	566,320	2.93%	1,499,476	7.91%	2,065,796	5.40%
2024	567,789	2.92%	1,504,181	7.87%	2,071,970	5.37%
2025	569,437	2.90%	1,509,320	7.84%	2,078,757	5.34%
2026	571,260	2.89%	1,514,839	7.80%	2,086,098	5.32%
2027	573,250	2.87%	1,520,694	7.78%	2,093,944	5.30%
2028	575,397	2.86%	1,526,850	7.75%	2,102,247	5.28%
2029	577,689	2.85%	1,533,274	7.72%	2,110,963	5.26%
2030	580,113	2.84%	1,539,921	7.70%	2,120,033	5.25%
2031	582,654	2.83%	1,546,771	7.68%	2,129,425	5.23%
2032	585,299	2.83%	1,553,811	7.66%	2,139,110	5.22%
2033	588,034	2.82%	1,561,027	7.65%	2,149,061	5.21%
2034	590,843	2.81%	1,568,389	7.63%	2,159,233	5.20%
2035	593,716	2.81%	1,575,872	7.62%	2,169,588	5.19%
2036	596,640	2.80%	1,583,454	7.61%	2,180,095	5.18%
2037	599,605	2.80%	1,591,115	7.60%	2,190,720	5.17%
2038	602,602	2.80%	1,598,840	7.59%	2,201,442	5.16%
2039	605,623	2.79%	1,606,617	7.58%	2,212,240	5.16%
2040	608,662	2.79%	1,614,432	7.57%	2,223,094	5.15%
2041	611,711	2.79%	1,622,281	7.56%	2,233,993	5.15%

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 58** Estimated Number of Females with Cognitive Impairment Including Dementia by Age From 2011 to 2041

<b>Estimated Number of People with Dementia* in Canada, Females by Age Group, 2011 to 2041</b>					
<b>Year</b>	<b>Age Group</b>				<b>Total</b>
	<b>60 - 69</b>	<b>70 - 79</b>	<b>80 - 89</b>	<b>90 +</b>	
2011	39,321	151,006	194,744	67,639	452,710
2012	41,358	154,293	196,597	72,150	464,398
2013	43,370	158,508	198,290	76,359	476,527
2014	45,281	163,671	200,013	80,250	489,214
2015	47,066	169,742	201,950	83,841	502,599
2016	48,734	176,626	204,282	87,169	516,810
2017	50,311	184,194	207,181	90,270	531,956
2018	51,824	192,301	210,811	93,182	548,119
2019	53,290	200,798	215,320	95,940	565,348
2020	54,708	209,545	220,831	98,581	583,665
2021	56,068	218,414	227,432	101,149	603,063
2022	57,348	227,288	235,170	103,698	623,504
2023	58,520	236,072	244,039	106,291	644,923
2024	59,555	244,685	253,988	109,000	667,228
2025	60,426	253,059	264,921	111,899	690,306
2026	61,115	261,137	276,709	115,065	714,026
2027	61,610	268,864	289,202	118,570	738,245
2028	61,912	276,181	302,244	122,477	762,814
2029	62,034	283,028	315,678	126,842	787,581
2030	61,999	289,340	329,356	131,704	812,398
2031	61,838	295,053	343,141	137,089	837,121
2032	61,589	300,112	356,908	143,004	861,613
2033	61,289	304,472	370,541	149,446	885,748
2034	60,977	308,110	383,930	156,393	909,408
2035	60,685	311,025	396,966	163,815	932,491
2036	60,443	313,246	409,543	171,672	954,905
2037	60,273	314,827	421,557	179,920	976,577
2038	60,187	315,846	432,904	188,509	997,446
2039	60,195	316,401	443,489	197,388	1,017,474
2040	60,299	316,605	453,229	206,504	1,036,636
2041	60,494	316,577	462,057	215,802	1,054,929

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**Table 59** Estimated Number of Males with Cognitive Impairment Including Dementia by Age From 2011 to 2041

<b>Estimated Number of People with Dementia* in Canada, Males by Age Group, 2011 to 2041</b>					
<b>Year</b>	<b>Age Group</b>				<b>Total</b>
	<b>60 - 69</b>	<b>70 - 79</b>	<b>80 - 89</b>	<b>90 +</b>	
2011	38,486	120,205	111,486	24,242	294,419
2012	40,489	123,250	114,477	26,540	304,757
2013	42,440	127,059	117,179	28,770	315,449
2014	44,275	131,650	119,702	30,926	326,553
2015	45,978	136,986	122,177	33,010	338,151
2016	47,571	142,975	124,750	35,028	350,323
2017	49,089	149,500	127,569	36,980	363,137
2018	50,566	156,431	130,778	38,865	376,639
2019	52,025	163,642	134,506	40,681	390,854
2020	53,468	171,022	138,860	42,433	405,782
2021	54,882	178,475	143,913	44,132	421,402
2022	56,244	185,925	149,701	45,802	437,672
2023	57,521	193,312	156,221	47,473	454,527
2024	58,678	200,590	163,433	49,184	471,886
2025	59,683	207,724	171,268	50,977	489,653
2026	60,510	214,678	179,637	52,897	507,722
2027	61,144	221,416	188,439	54,985	525,984
2028	61,582	227,892	197,576	57,277	544,327
2029	61,834	234,052	206,955	59,803	562,644
2030	61,921	239,835	216,495	62,583	580,834
2031	61,875	245,177	226,122	65,629	598,802
2032	61,733	250,018	235,772	68,942	616,464
2033	61,533	254,310	245,386	72,518	633,747
2034	61,314	258,021	254,906	76,343	650,584
2035	61,112	261,142	264,268	80,401	666,923
2036	60,956	263,687	273,408	84,670	682,722
2037	60,868	265,697	282,254	89,129	697,948
2038	60,863	267,233	290,733	93,755	712,584
2039	60,951	268,375	298,772	98,526	726,624
2040	61,134	269,218	306,305	103,417	740,074
2041	61,408	269,862	313,276	108,405	752,952

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 60** Estimated Number and Crude Prevalence of Cognitive Impairment Including Dementia By Sex for 2011 to 2041

<b>Estimated Number and Prevalence of Dementia* in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	452,710	2.61%	294,419	1.73%	747,129	2.17%
2012	464,398	2.65%	304,757	1.77%	769,155	2.22%
2013	476,527	2.70%	315,449	1.82%	791,976	2.26%
2014	489,214	2.74%	326,553	1.86%	815,767	2.31%
2015	502,599	2.79%	338,151	1.91%	840,750	2.36%
2016	516,810	2.84%	350,323	1.96%	867,133	2.41%
2017	531,956	2.90%	363,137	2.02%	895,094	2.46%
2018	548,119	2.96%	376,639	2.07%	924,758	2.52%
2019	565,348	3.03%	390,854	2.13%	956,201	2.58%
2020	583,665	3.10%	405,782	2.19%	989,447	2.65%
2021	603,063	3.18%	421,402	2.26%	1,024,465	2.72%
2022	623,504	3.26%	437,672	2.33%	1,061,176	2.80%
2023	644,923	3.34%	454,527	2.40%	1,099,450	2.87%
2024	667,228	3.43%	471,886	2.47%	1,139,113	2.95%
2025	690,306	3.52%	489,653	2.54%	1,179,958	3.03%
2026	714,026	3.61%	507,722	2.62%	1,221,748	3.12%
2027	738,245	3.70%	525,984	2.69%	1,264,229	3.20%
2028	762,814	3.79%	544,327	2.76%	1,307,141	3.28%
2029	787,581	3.89%	562,644	2.83%	1,350,226	3.37%
2030	812,398	3.98%	580,834	2.91%	1,393,232	3.45%
2031	837,121	4.07%	598,802	2.97%	1,435,923	3.53%
2032	861,613	4.16%	616,464	3.04%	1,478,078	3.61%
2033	885,748	4.25%	633,747	3.10%	1,519,495	3.68%
2034	909,408	4.33%	650,584	3.17%	1,559,993	3.75%
2035	932,491	4.41%	666,923	3.22%	1,599,414	3.82%
2036	954,905	4.49%	682,722	3.28%	1,637,627	3.89%
2037	976,577	4.56%	697,948	3.33%	1,674,524	3.95%
2038	997,446	4.63%	712,584	3.38%	1,710,031	4.01%
2039	1,017,474	4.69%	726,624	3.43%	1,744,098	4.07%
2040	1,036,636	4.75%	740,074	3.47%	1,776,710	4.12%
2041	1,054,929	4.81%	752,952	3.51%	1,807,881	4.16%

\*Cognitive Impairment including dementia

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**Table 61** Estimated Number of Females and Males with ADHD by Age From 2011 to 2041

<i>Estimated Number of People with ADHD in Canada, Females by Age Group, 2011 to 2041</i>				<i>Estimated Number of People with ADHD in Canada, Males by Age Group, 2011 to 2041</i>			
Year	Age Group		Total	Year	Age Group		Total
	9 - 12	13 - 19			9 - 12	13 - 19	
2011	6,927	15,196	22,123	2011	46,717	101,768	148,485
2012	6,887	15,087	21,973	2012	46,450	101,087	147,537
2013	6,889	14,941	21,830	2013	46,481	100,180	146,661
2014	6,936	14,787	21,723	2014	46,817	99,170	145,986
2015	7,023	14,651	21,675	2015	47,432	98,218	145,650
2016	7,143	14,558	21,701	2016	48,263	97,573	145,836
2017	7,281	14,524	21,805	2017	49,224	97,349	146,573
2018	7,425	14,556	21,981	2018	50,224	97,579	147,804
2019	7,564	14,651	22,215	2019	51,185	98,245	149,430
2020	7,689	14,800	22,489	2020	52,052	99,283	151,335
2021	7,797	14,990	22,787	2021	52,795	100,601	153,395
2022	7,885	15,206	23,091	2022	53,408	102,090	155,498
2023	7,957	15,432	23,389	2023	53,902	103,647	157,549
2024	8,014	15,655	23,669	2024	54,294	105,183	159,476
2025	8,059	15,866	23,925	2025	54,606	106,628	161,234
2026	8,097	16,057	24,154	2026	54,861	107,940	162,801
2027	8,128	16,226	24,354	2027	55,076	109,098	164,174
2028	8,156	16,373	24,529	2028	55,266	110,099	165,365
2029	8,182	16,498	24,680	2029	55,443	110,955	166,397
2030	8,208	16,605	24,813	2030	55,614	111,683	167,297
2031	8,233	16,697	24,930	2031	55,785	112,307	168,092
2032	8,259	16,777	25,036	2032	55,960	112,851	168,811
2033	8,285	16,849	25,134	2033	56,139	113,336	169,474
2034	8,313	16,915	25,227	2034	56,323	113,780	170,103
2035	8,341	16,977	25,318	2035	56,513	114,199	170,712
2036	8,370	17,037	25,407	2036	56,707	114,605	171,312
2037	8,399	17,097	25,496	2037	56,905	115,004	171,910
2038	8,429	17,156	25,586	2038	57,107	115,404	172,511
2039	8,460	17,217	25,676	2039	57,312	115,807	173,119
2040	8,490	17,278	25,768	2040	57,519	116,215	173,734
2041	8,522	17,339	25,861	2041	57,730	116,629	174,359

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**Table 62** Estimated Number and Crude 12-Month Prevalence of ADHD By Sex for 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of ADHD in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	22,123	0.13%	148,485	0.87%	170,608	0.50%
2012	21,973	0.13%	147,537	0.86%	169,511	0.49%
2013	21,830	0.12%	146,661	0.85%	168,491	0.48%
2014	21,723	0.12%	145,986	0.83%	167,709	0.47%
2015	21,675	0.12%	145,650	0.82%	167,324	0.47%
2016	21,701	0.12%	145,836	0.82%	167,537	0.47%
2017	21,805	0.12%	146,573	0.81%	168,378	0.46%
2018	21,981	0.12%	147,804	0.81%	169,785	0.46%
2019	22,215	0.12%	149,430	0.82%	171,645	0.46%
2020	22,489	0.12%	151,335	0.82%	173,824	0.47%
2021	22,787	0.12%	153,395	0.82%	176,182	0.47%
2022	23,091	0.12%	155,498	0.83%	178,590	0.47%
2023	23,389	0.12%	157,549	0.83%	180,938	0.47%
2024	23,669	0.12%	159,476	0.83%	183,145	0.47%
2025	23,925	0.12%	161,234	0.84%	185,159	0.48%
2026	24,154	0.12%	162,801	0.84%	186,955	0.48%
2027	24,354	0.12%	164,174	0.84%	188,528	0.48%
2028	24,529	0.12%	165,365	0.84%	189,894	0.48%
2029	24,680	0.12%	166,397	0.84%	191,078	0.48%
2030	24,813	0.12%	167,297	0.84%	192,109	0.48%
2031	24,930	0.12%	168,092	0.83%	193,022	0.47%
2032	25,036	0.12%	168,811	0.83%	193,846	0.47%
2033	25,134	0.12%	169,474	0.83%	194,609	0.47%
2034	25,227	0.12%	170,103	0.83%	195,331	0.47%
2035	25,318	0.12%	170,712	0.83%	196,030	0.47%
2036	25,407	0.12%	171,312	0.82%	196,719	0.47%
2037	25,496	0.12%	171,910	0.82%	197,406	0.47%
2038	25,586	0.12%	172,511	0.82%	198,097	0.46%
2039	25,676	0.12%	173,119	0.82%	198,795	0.46%
2040	25,768	0.12%	173,734	0.81%	199,502	0.46%
2041	25,861	0.12%	174,359	0.81%	200,220	0.46%

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**Table 63** Estimated Number of Canadian Youth with ODD by Age From 2011 to 2041

<i>Estimated Number of People with ODD in Canada, Females by Age Group, 2011 to 2041</i>				<i>Estimated Number of People with ODD in Canada, Males by Age Group, 2011 to 2041</i>			
Year	Age Group		Total	Year	Age Group		Total
	9 - 12	13 - 19			9 - 12	13 - 19	
2011	12,276	24,261	36,537	2011	16,055	31,767	47,821
2012	12,205	23,973	36,178	2012	15,964	31,385	47,349
2013	12,210	23,648	35,858	2013	15,977	30,956	46,933
2014	12,295	23,341	35,636	2014	16,094	30,553	46,647
2015	12,451	23,091	35,542	2015	16,306	30,227	46,533
2016	12,663	22,926	35,589	2016	16,593	30,016	46,609
2017	12,909	22,866	35,775	2017	16,924	29,945	46,869
2018	13,164	22,916	36,080	2018	17,268	30,020	47,288
2019	13,410	23,069	36,479	2019	17,598	30,233	47,831
2020	13,632	23,308	36,940	2020	17,895	30,560	48,455
2021	13,822	23,610	37,432	2021	18,150	30,970	49,120
2022	13,979	23,950	37,929	2022	18,360	31,429	49,789
2023	14,105	24,303	38,408	2023	18,529	31,905	50,434
2024	14,206	24,650	38,855	2024	18,663	32,371	51,035
2025	14,286	24,974	39,260	2025	18,770	32,808	51,578
2026	14,352	25,268	39,620	2026	18,858	33,202	52,060
2027	14,407	25,527	39,934	2027	18,931	33,549	52,481
2028	14,457	25,751	40,208	2028	18,997	33,849	52,846
2029	14,503	25,943	40,446	2029	19,057	34,105	53,163
2030	14,548	26,106	40,654	2030	19,116	34,324	53,440
2031	14,593	26,248	40,841	2031	19,175	34,512	53,687
2032	14,639	26,371	41,010	2032	19,235	34,676	53,911
2033	14,686	26,483	41,169	2033	19,296	34,823	54,120
2034	14,735	26,585	41,320	2034	19,360	34,959	54,319
2035	14,784	26,683	41,467	2035	19,425	35,087	54,512
2036	14,836	26,778	41,613	2036	19,492	35,212	54,704
2037	14,888	26,872	41,759	2037	19,560	35,335	54,895
2038	14,941	26,965	41,906	2038	19,629	35,458	55,087
2039	14,995	27,060	42,055	2039	19,700	35,582	55,282
2040	15,050	27,156	42,206	2040	19,771	35,708	55,479
2041	15,105	27,254	42,359	2041	19,843	35,835	55,679

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**Table 64** Estimated Number and Crude 12-Month Prevalence of ODD By Sex for 2011 to 2041

<i>Estimated Number and 12-Month Prevalence of ODD in Canada, by Sex, 2011 to 2041</i>						
Year	Females	% of Female Population	Males	% of Male Population	Total	% of Total Population
2011	36,537	0.21%	47,821	0.28%	84,359	0.25%
2012	36,178	0.21%	47,349	0.28%	83,527	0.24%
2013	35,858	0.20%	46,933	0.27%	82,791	0.24%
2014	35,636	0.20%	46,647	0.27%	82,282	0.23%
2015	35,542	0.20%	46,533	0.26%	82,075	0.23%
2016	35,589	0.20%	46,609	0.26%	82,199	0.23%
2017	35,775	0.20%	46,869	0.26%	82,644	0.23%
2018	36,080	0.20%	47,288	0.26%	83,368	0.23%
2019	36,479	0.20%	47,831	0.26%	84,309	0.23%
2020	36,940	0.20%	48,455	0.26%	85,394	0.23%
2021	37,432	0.20%	49,120	0.26%	86,552	0.23%
2022	37,929	0.20%	49,789	0.26%	87,718	0.23%
2023	38,408	0.20%	50,434	0.27%	88,843	0.23%
2024	38,855	0.20%	51,035	0.27%	89,890	0.23%
2025	39,260	0.20%	51,578	0.27%	90,838	0.23%
2026	39,620	0.20%	52,060	0.27%	91,680	0.23%
2027	39,934	0.20%	52,481	0.27%	92,415	0.23%
2028	40,208	0.20%	52,846	0.27%	93,054	0.23%
2029	40,446	0.20%	53,163	0.27%	93,608	0.23%
2030	40,654	0.20%	53,440	0.27%	94,094	0.23%
2031	40,841	0.20%	53,687	0.27%	94,527	0.23%
2032	41,010	0.20%	53,911	0.27%	94,921	0.23%
2033	41,169	0.20%	54,120	0.27%	95,288	0.23%
2034	41,320	0.20%	54,319	0.26%	95,639	0.23%
2035	41,467	0.20%	54,512	0.26%	95,980	0.23%
2036	41,613	0.20%	54,704	0.26%	96,317	0.23%
2037	41,759	0.19%	54,895	0.26%	96,654	0.23%
2038	41,906	0.19%	55,087	0.26%	96,994	0.23%
2039	42,055	0.19%	55,282	0.26%	97,337	0.23%
2040	42,206	0.19%	55,479	0.26%	97,685	0.23%
2041	42,359	0.19%	55,679	0.26%	98,037	0.23%



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**Table 65** Estimated Number of Canadian Youth with Conduct Disorders by Age From 2011 to 2041

<i>Estimated Number of People with Conduct Disorders in Canada, Females by Age Group, 2011 to 2041</i>				<i>Estimated Number of People with Conduct Disorders in Canada, Males by Age Group, 2011 to 2041</i>			
Year	Age Group		Total	Year	Age Group		Total
	9 - 12	13 - 19			9 - 12	13 - 19	
2011	7,832	16,966	24,798	2011	18,996	41,269	60,265
2012	7,786	16,838	24,625	2012	18,887	40,952	59,839
2013	7,789	16,675	24,464	2013	18,900	40,548	59,448
2014	7,842	16,505	24,348	2014	19,036	40,099	59,135
2015	7,941	16,353	24,294	2015	19,286	39,705	58,992
2016	8,076	16,248	24,324	2016	19,624	39,447	59,071
2017	8,232	16,210	24,442	2017	20,015	39,356	59,371
2018	8,395	16,245	24,640	2018	20,422	39,448	59,870
2019	8,552	16,350	24,903	2019	20,813	39,719	60,531
2020	8,694	16,517	25,211	2020	21,165	40,140	61,305
2021	8,815	16,730	25,545	2021	21,467	40,675	62,142
2022	8,916	16,971	25,887	2022	21,716	41,279	62,995
2023	8,997	17,223	26,220	2023	21,917	41,909	63,826
2024	9,061	17,472	26,533	2024	22,076	42,530	64,606
2025	9,113	17,706	26,819	2025	22,204	43,114	65,317
2026	9,155	17,919	27,074	2026	22,307	43,644	65,951
2027	9,190	18,107	27,297	2027	22,394	44,111	66,505
2028	9,222	18,270	27,492	2028	22,472	44,515	66,987
2029	9,251	18,409	27,660	2029	22,544	44,860	67,403
2030	9,280	18,527	27,807	2030	22,613	45,154	67,767
2031	9,309	18,629	27,938	2031	22,683	45,405	68,088
2032	9,338	18,718	28,056	2032	22,754	45,625	68,379
2033	9,368	18,798	28,166	2033	22,827	45,821	68,647
2034	9,399	18,871	28,270	2034	22,902	46,000	68,902
2035	9,431	18,941	28,372	2035	22,979	46,169	69,148
2036	9,464	19,008	28,471	2036	23,058	46,333	69,391
2037	9,497	19,074	28,571	2037	23,138	46,495	69,633
2038	9,531	19,141	28,672	2038	23,220	46,657	69,877
2039	9,565	19,208	28,773	2039	23,304	46,819	70,123
2040	9,600	19,276	28,876	2040	23,388	46,984	70,372
2041	9,635	19,345	28,980	2041	23,474	47,152	70,625

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**Table 66** Estimated Number and Crude 12-Month Prevalence of Conduct Disorders By Sex for 2011 to 2041

<b>Estimated Number and 12-Month Prevalence of Conduct Disorders in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	24,798	0.14%	60,265	0.35%	85,063	0.25%
2012	24,625	0.14%	59,839	0.35%	84,464	0.24%
2013	24,464	0.14%	59,448	0.34%	83,912	0.24%
2014	24,348	0.14%	59,135	0.34%	83,482	0.24%
2015	24,294	0.13%	58,992	0.33%	83,286	0.23%
2016	24,324	0.13%	59,071	0.33%	83,396	0.23%
2017	24,442	0.13%	59,371	0.33%	83,813	0.23%
2018	24,640	0.13%	59,870	0.33%	84,510	0.23%
2019	24,903	0.13%	60,531	0.33%	85,434	0.23%
2020	25,211	0.13%	61,305	0.33%	86,516	0.23%
2021	25,545	0.13%	62,142	0.33%	87,687	0.23%
2022	25,887	0.14%	62,995	0.34%	88,882	0.23%
2023	26,220	0.14%	63,826	0.34%	90,046	0.24%
2024	26,533	0.14%	64,606	0.34%	91,139	0.24%
2025	26,819	0.14%	65,317	0.34%	92,136	0.24%
2026	27,074	0.14%	65,951	0.34%	93,024	0.24%
2027	27,297	0.14%	66,505	0.34%	93,803	0.24%
2028	27,492	0.14%	66,987	0.34%	94,478	0.24%
2029	27,660	0.14%	67,403	0.34%	95,064	0.24%
2030	27,807	0.14%	67,767	0.34%	95,574	0.24%
2031	27,938	0.14%	68,088	0.34%	96,026	0.24%
2032	28,056	0.14%	68,379	0.34%	96,435	0.24%
2033	28,166	0.14%	68,647	0.34%	96,813	0.23%
2034	28,270	0.13%	68,902	0.34%	97,172	0.23%
2035	28,372	0.13%	69,148	0.33%	97,520	0.23%
2036	28,471	0.13%	69,391	0.33%	97,862	0.23%
2037	28,571	0.13%	69,633	0.33%	98,204	0.23%
2038	28,672	0.13%	69,877	0.33%	98,548	0.23%
2039	28,773	0.13%	70,123	0.33%	98,896	0.23%
2040	28,876	0.13%	70,372	0.33%	99,248	0.23%
2041	28,980	0.13%	70,625	0.33%	99,606	0.23%

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**Table 67** Estimated Number of Females with Heart Disease by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	20,802	28,913	57,271	101,324	139,291	141,309	108,887	29,471	627,268		
2012	21,290	29,525	56,489	103,168	144,999	144,733	109,923	31,437	641,564		
2013	21,716	30,130	55,758	104,661	150,613	149,025	110,869	33,274	656,047		
2014	22,030	30,675	55,146	105,750	156,052	154,192	111,832	34,992	670,670		
2015	22,220	31,123	54,692	106,421	161,265	160,179	112,916	36,589	685,403		
2016	22,299	31,453	54,408	106,694	166,233	166,880	114,219	38,067	700,252		
2017	22,287	31,714	54,290	106,611	170,955	174,157	115,840	39,436	715,291		
2018	22,210	31,945	54,324	106,231	175,425	181,859	117,870	40,712	730,576		
2019	22,093	32,144	54,491	105,624	179,618	189,844	120,391	41,913	746,117		
2020	21,962	32,307	54,771	104,866	183,488	197,986	123,472	43,064	761,916		
2021	21,831	32,434	55,141	104,035	186,974	206,178	127,164	44,183	777,940		
2022	21,710	32,525	55,581	103,207	190,009	214,331	131,490	45,294	794,146		
2023	21,610	32,578	56,069	102,448	192,539	222,370	136,449	46,424	810,486		
2024	21,539	32,596	56,584	101,813	194,524	230,231	142,011	47,604	826,903		
2025	21,505	32,580	57,107	101,343	195,954	237,858	148,124	48,867	843,339		
2026	21,514	32,534	57,620	101,063	196,845	245,197	154,715	50,247	859,734		
2027	21,572	32,463	58,109	100,982	197,240	252,192	161,701	51,774	876,032		
2028	21,678	32,375	58,561	101,096	197,207	258,785	168,993	53,477	892,173		
2029	21,826	32,277	58,968	101,394	196,831	264,913	176,504	55,385	908,098		
2030	22,007	32,180	59,322	101,853	196,211	270,512	184,152	57,513	923,751		
2031	22,214	32,093	59,620	102,446	195,448	275,524	191,859	59,873	939,078		
2032	22,436	32,026	59,858	103,146	194,643	279,901	199,557	62,466	954,033		
2033	22,666	31,988	60,036	103,920	193,888	283,609	207,180	65,290	968,577		
2034	22,896	31,984	60,158	104,739	193,260	286,638	214,665	68,336	982,676		
2035	23,121	32,020	60,226	105,575	192,822	289,003	221,954	71,588	996,308		
2036	23,334	32,097	60,248	106,402	192,617	290,741	228,987	75,030	1,009,456		
2037	23,535	32,217	60,230	107,198	192,671	291,916	235,704	78,642	1,022,112		
2038	23,720	32,375	60,184	107,943	192,991	292,613	242,048	82,400	1,034,275		
2039	23,891	32,568	60,121	108,623	193,571	292,930	247,967	86,283	1,045,954		
2040	24,047	32,790	60,053	109,226	194,391	292,976	253,412	90,267	1,057,162		
2041	24,189	33,035	59,994	109,745	195,419	292,863	258,348	94,327	1,067,920		

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**Table 68** Estimated Number of Males with Heart Disease by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	19,673	26,937	76,221	152,874	189,067	157,391	90,280	15,499		727,944	
2012	20,120	27,554	75,175	155,945	196,568	161,762	92,703	16,969		746,797	
2013	20,504	28,157	74,177	158,517	203,927	167,138	94,891	18,395		765,707	
2014	20,781	28,695	73,333	160,485	211,083	173,521	96,933	19,773		784,604	
2015	20,941	29,131	72,699	161,809	218,005	180,834	98,938	21,106		803,464	
2016	20,999	29,448	72,296	162,506	224,690	188,938	101,021	22,396		822,294	
2017	20,975	29,690	72,115	162,635	231,146	197,656	103,304	23,644		841,165	
2018	20,891	29,899	72,138	162,282	237,363	206,808	105,903	24,849		860,132	
2019	20,770	30,071	72,343	161,551	243,298	216,229	108,922	26,010		879,194	
2020	20,636	30,207	72,702	160,559	248,874	225,786	112,448	27,130		898,342	
2021	20,504	30,305	73,191	159,429	253,986	235,376	116,539	28,217		917,547	
2022	20,382	30,366	73,780	158,279	258,528	244,922	121,227	29,284		936,767	
2023	20,282	30,391	74,441	157,217	262,402	254,364	126,507	30,353		955,955	
2024	20,211	30,382	75,144	156,331	265,543	263,657	132,347	31,446		975,061	
2025	20,177	30,342	75,862	155,688	267,923	272,757	138,692	32,593		994,033	
2026	20,188	30,275	76,568	155,330	269,558	281,616	145,468	33,821		1,012,823	
2027	20,248	30,186	77,238	155,274	270,504	290,179	152,596	35,155		1,031,381	
2028	20,353	30,083	77,855	155,520	270,852	298,374	159,996	36,621		1,049,654	
2029	20,499	29,974	78,403	156,047	270,721	306,123	167,591	38,236		1,067,594	
2030	20,677	29,867	78,873	156,825	270,246	313,339	175,316	40,013		1,085,157	
2031	20,879	29,772	79,258	157,812	269,571	319,938	183,111	41,961		1,102,303	
2032	21,097	29,698	79,557	158,962	268,833	325,847	190,926	44,079		1,118,998	
2033	21,321	29,653	79,770	160,225	268,159	331,012	198,712	46,366		1,135,218	
2034	21,545	29,643	79,902	161,554	267,659	335,405	206,421	48,811		1,150,940	
2035	21,763	29,672	79,959	162,902	267,418	339,032	214,003	51,406		1,166,155	
2036	21,970	29,743	79,951	164,227	267,496	341,929	221,404	54,135		1,180,855	
2037	22,164	29,855	79,889	165,492	267,927	344,165	228,567	56,986		1,195,045	
2038	22,344	30,005	79,788	166,665	268,721	345,833	235,433	59,944		1,208,733	
2039	22,508	30,188	79,664	167,723	269,866	347,051	241,943	62,994		1,221,937	
2040	22,658	30,400	79,535	168,647	271,332	347,943	248,043	66,121		1,234,680	
2041	22,795	30,633	79,418	169,428	273,076	348,643	253,688	69,311		1,246,992	

## Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 69** Estimated Number and Crude Prevalence of Heart Disease By Sex for 2011 to 2041

<b>Estimated Number and Prevalence of Heart Disease in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	627,268	3.62%	727,944	4.28%	1,355,212	3.94%
2012	641,564	3.67%	746,797	4.34%	1,388,362	4.00%
2013	656,047	3.71%	765,707	4.41%	1,421,755	4.06%
2014	670,670	3.76%	784,604	4.48%	1,455,274	4.12%
2015	685,403	3.81%	803,464	4.54%	1,488,867	4.17%
2016	700,252	3.85%	822,294	4.61%	1,522,546	4.23%
2017	715,291	3.90%	841,165	4.67%	1,556,456	4.28%
2018	730,576	3.95%	860,132	4.73%	1,590,709	4.34%
2019	746,117	4.00%	879,194	4.80%	1,625,312	4.39%
2020	761,916	4.05%	898,342	4.86%	1,660,258	4.45%
2021	777,940	4.10%	917,547	4.92%	1,695,487	4.50%
2022	794,146	4.15%	936,767	4.98%	1,730,913	4.56%
2023	810,486	4.20%	955,955	5.04%	1,766,441	4.62%
2024	826,903	4.25%	975,061	5.10%	1,801,964	4.67%
2025	843,339	4.29%	994,033	5.16%	1,837,372	4.72%
2026	859,734	4.34%	1,012,823	5.22%	1,872,557	4.78%
2027	876,032	4.39%	1,031,381	5.27%	1,907,413	4.83%
2028	892,173	4.44%	1,049,654	5.33%	1,941,826	4.88%
2029	908,098	4.48%	1,067,594	5.38%	1,975,692	4.93%
2030	923,751	4.53%	1,085,157	5.43%	2,008,907	4.97%
2031	939,078	4.57%	1,102,303	5.47%	2,041,381	5.02%
2032	954,033	4.61%	1,118,998	5.52%	2,073,031	5.06%
2033	968,577	4.64%	1,135,218	5.56%	2,103,794	5.10%
2034	982,676	4.68%	1,150,940	5.60%	2,133,617	5.14%
2035	996,308	4.71%	1,166,155	5.64%	2,162,463	5.17%
2036	1,009,456	4.74%	1,180,855	5.67%	2,190,311	5.20%
2037	1,022,112	4.77%	1,195,045	5.71%	2,217,156	5.23%
2038	1,034,275	4.80%	1,208,733	5.74%	2,243,008	5.26%
2039	1,045,954	4.82%	1,221,937	5.76%	2,267,891	5.29%
2040	1,057,162	4.84%	1,234,680	5.79%	2,291,842	5.31%
2041	1,067,920	4.86%	1,246,992	5.81%	2,314,912	5.33%

Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 70** Estimated Number of Females with Type II Diabetes by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	21,072	52,566	117,986	223,112	268,152	206,020	128,606	33,306	1,050,821		
2012	21,132	53,092	116,400	227,254	278,933	211,258	129,830	35,528	1,073,428		
2013	21,163	53,674	114,926	230,639	289,534	217,763	130,948	37,602	1,096,250		
2014	21,168	54,280	113,699	233,149	299,822	225,532	132,086	39,523	1,119,260		
2015	21,148	54,880	112,797	234,749	309,704	234,478	133,365	41,299	1,142,420		
2016	21,102	55,452	112,245	235,470	319,139	244,433	134,905	42,940	1,165,686		
2017	21,029	55,979	112,034	235,398	328,111	255,179	136,820	44,467	1,189,017		
2018	20,932	56,451	112,133	234,652	336,594	266,490	139,217	45,901	1,212,370		
2019	20,814	56,861	112,502	233,379	344,530	278,155	142,195	47,259	1,235,695		
2020	20,683	57,204	113,100	231,744	351,823	289,995	145,834	48,559	1,258,942		
2021	20,548	57,478	113,882	229,922	358,350	301,864	150,194	49,824	1,282,061		
2022	20,419	57,682	114,802	228,081	363,988	313,643	155,303	51,079	1,304,998		
2023	20,308	57,818	115,816	226,375	368,635	325,235	161,160	52,356	1,327,702		
2024	20,224	57,886	116,881	224,930	372,227	336,555	167,730	53,690	1,350,123		
2025	20,176	57,890	117,958	223,841	374,753	347,526	174,950	55,118	1,372,211		
2026	20,168	57,837	119,011	223,167	376,256	358,069	182,735	56,676	1,393,918		
2027	20,204	57,733	120,012	222,932	376,830	368,101	190,986	58,402	1,415,199		
2028	20,282	57,591	120,936	223,133	376,614	377,532	199,598	60,326	1,436,013		
2029	20,401	57,424	121,764	223,742	375,781	386,268	208,470	62,476	1,456,325		
2030	20,555	57,248	122,482	224,715	374,518	394,214	217,502	64,870	1,476,103		
2031	20,736	57,080	123,083	225,992	373,024	401,284	226,606	67,521	1,495,327		
2032	20,937	56,940	123,561	227,512	371,485	407,411	235,698	70,434	1,513,978		
2033	21,150	56,842	123,917	229,205	370,072	412,554	244,701	73,606	1,532,048		
2034	21,367	56,802	124,156	231,006	368,929	416,705	253,542	77,027	1,549,535		
2035	21,582	56,831	124,285	232,852	368,167	419,894	262,151	80,681	1,566,444		
2036	21,790	56,935	124,319	234,685	367,862	422,187	270,457	84,551	1,582,786		
2037	21,986	57,117	124,275	236,454	368,056	423,686	278,391	88,612	1,598,577		
2038	22,169	57,375	124,173	238,116	368,759	424,520	285,885	92,842	1,613,838		
2039	22,338	57,702	124,040	239,638	369,951	424,838	292,875	97,214	1,628,595		
2040	22,492	58,091	123,900	240,992	371,590	424,803	299,306	101,703	1,642,876		
2041	22,633	58,528	123,781	242,161	373,617	424,575	305,136	106,281	1,656,712		

Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 71** Estimated Number of Males with Type II Diabetes by Age From 2011 to 2041

Year	Age Group										Total
	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 +			
2011	18,273	52,682	142,663	286,987	333,770	222,436	101,619	16,339	1,174,769		
2012	18,304	53,208	140,770	292,831	346,866	228,906	104,397	17,961	1,203,241		
2013	18,306	53,804	138,989	297,756	359,719	236,782	106,874	19,542	1,231,771		
2014	18,286	54,431	137,498	301,564	372,236	246,060	109,163	21,077	1,260,315		
2015	18,247	55,058	136,399	304,176	384,366	256,623	111,397	22,560	1,288,826		
2016	18,188	55,657	135,725	305,614	396,097	268,257	113,717	23,992	1,317,247		
2017	18,111	56,206	135,464	305,974	407,431	280,698	116,261	25,370	1,345,514		
2018	18,014	56,691	135,581	305,407	418,342	293,682	119,158	26,688	1,373,564		
2019	17,901	57,103	136,031	304,105	428,743	306,981	122,534	27,948	1,401,347		
2020	17,778	57,435	136,764	302,282	438,492	320,418	126,488	29,153	1,428,810		
2021	17,652	57,687	137,728	300,171	447,403	333,860	131,085	30,314	1,455,900		
2022	17,533	57,860	138,868	297,998	455,286	347,211	136,360	31,448	1,482,565		
2023	17,430	57,957	140,129	295,972	461,976	360,404	142,309	32,579	1,508,756		
2024	17,350	57,984	141,456	294,264	467,363	373,382	148,893	33,735	1,534,428		
2025	17,303	57,946	142,798	293,005	471,406	386,089	156,047	34,948	1,559,542		
2026	17,292	57,850	144,106	292,277	474,141	398,457	163,691	36,248	1,584,062		
2027	17,321	57,706	145,339	292,119	475,676	410,399	171,733	37,664	1,607,956		
2028	17,389	57,524	146,466	292,529	476,178	421,810	180,083	39,223	1,631,202		
2029	17,492	57,320	147,460	293,475	475,862	432,570	188,658	40,944	1,653,781		
2030	17,628	57,108	148,305	294,898	474,968	442,553	197,383	42,841	1,675,685		
2031	17,788	56,907	148,991	296,723	473,748	451,637	206,195	44,924	1,696,913		
2032	17,967	56,735	149,515	298,862	472,442	459,721	215,035	47,192	1,717,470		
2033	18,157	56,608	149,880	301,225	471,273	466,734	223,850	49,643	1,737,370		
2034	18,350	56,543	150,093	303,720	470,426	472,649	232,585	52,268	1,756,633		
2035	18,542	56,549	150,170	306,259	470,047	477,482	241,184	55,054	1,775,285		
2036	18,727	56,636	150,128	308,761	470,236	481,297	249,585	57,988	1,793,357		
2037	18,901	56,805	149,991	311,156	471,051	484,202	257,722	61,055	1,810,883		
2038	19,063	57,056	149,787	313,383	472,503	486,341	265,527	64,240	1,827,901		
2039	19,213	57,381	149,546	315,398	474,569	487,884	272,932	67,526	1,844,449		
2040	19,349	57,772	149,304	317,164	477,194	489,013	279,876	70,899	1,860,570		
2041	19,473	58,217	149,093	318,661	480,296	489,918	286,307	74,340	1,876,305		

Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 72** Estimated Number and Crude Prevalence of Type II Diabetes By Sex for 2011 to 2041

<b>Estimated Number and Prevalence of Type II Diabetes in Canada, by Sex, 2011 to 2041</b>						
<b>Year</b>	<b>Females</b>	<b>% of Female Population</b>	<b>Males</b>	<b>% of Male Population</b>	<b>Total</b>	<b>% of Total Population</b>
2011	1,050,821	6.06%	1,174,769	6.90%	2,225,590	6.48%
2012	1,073,428	6.13%	1,203,241	7.00%	2,276,669	6.56%
2013	1,096,250	6.20%	1,231,771	7.10%	2,328,021	6.65%
2014	1,119,260	6.27%	1,260,315	7.19%	2,379,575	6.73%
2015	1,142,420	6.34%	1,288,826	7.29%	2,431,246	6.81%
2016	1,165,686	6.41%	1,317,247	7.38%	2,482,933	6.89%
2017	1,189,017	6.48%	1,345,514	7.47%	2,534,531	6.97%
2018	1,212,370	6.55%	1,373,564	7.56%	2,585,934	7.05%
2019	1,235,695	6.62%	1,401,347	7.65%	2,637,042	7.13%
2020	1,258,942	6.69%	1,428,810	7.73%	2,687,753	7.20%
2021	1,282,061	6.75%	1,455,900	7.81%	2,737,961	7.27%
2022	1,304,998	6.81%	1,482,565	7.89%	2,787,563	7.34%
2023	1,327,702	6.87%	1,508,756	7.96%	2,836,458	7.41%
2024	1,350,123	6.93%	1,534,428	8.03%	2,884,552	7.48%
2025	1,372,211	6.99%	1,559,542	8.10%	2,931,754	7.54%
2026	1,393,918	7.04%	1,584,062	8.16%	2,977,980	7.60%
2027	1,415,199	7.09%	1,607,956	8.22%	3,023,155	7.65%
2028	1,436,013	7.14%	1,631,202	8.28%	3,067,215	7.70%
2029	1,456,325	7.19%	1,653,781	8.33%	3,110,105	7.75%
2030	1,476,103	7.23%	1,675,685	8.38%	3,151,789	7.80%
2031	1,495,327	7.27%	1,696,913	8.43%	3,192,239	7.84%
2032	1,513,978	7.31%	1,717,470	8.47%	3,231,447	7.88%
2033	1,532,048	7.35%	1,737,370	8.51%	3,269,418	7.92%
2034	1,549,535	7.38%	1,756,633	8.55%	3,306,168	7.96%
2035	1,566,444	7.41%	1,775,285	8.58%	3,341,730	7.99%
2036	1,582,786	7.44%	1,793,357	8.62%	3,376,143	8.02%
2037	1,598,577	7.46%	1,810,883	8.65%	3,409,460	8.05%
2038	1,613,838	7.49%	1,827,901	8.67%	3,441,739	8.07%
2039	1,628,595	7.51%	1,844,449	8.70%	3,473,044	8.10%
2040	1,642,876	7.53%	1,860,570	8.72%	3,503,446	8.12%
2041	1,656,712	7.55%	1,876,305	8.74%	3,533,017	8.14%



D.8 ANNUAL ECONOMIC RESULTS

**Table 73** Estimated Annual Direct Costs of All Mental Illnesses excluding Dementia in Future Values from 2011 to 2041

<i>Estimated Prevalence-Based Direct Costs of Any Mental Illness excluding Dementia in Canada, in Future Value Terms (in \$ Millions)</i>							
Year	Income Support	Inpatient Services	Other Services	Prescription Drugs	Physicians	Social Services	Total Direct Costs
2011	\$5,158.0	\$3,587.6	\$2,384.9	\$3,380.3	\$1,941.0	\$6,109.6	\$22,561.4
2012	\$5,425.9	\$3,785.1	\$2,508.8	\$3,545.6	\$2,049.8	\$6,445.8	\$23,760.9
2013	\$5,703.7	\$3,990.5	\$2,637.3	\$3,716.2	\$2,163.2	\$6,795.6	\$25,006.4
2014	\$5,994.2	\$4,206.0	\$2,771.6	\$3,894.0	\$2,282.2	\$7,162.7	\$26,310.7
2015	\$6,299.7	\$4,433.3	\$2,912.8	\$4,080.5	\$2,407.9	\$7,549.7	\$27,683.8
2016	\$6,621.8	\$4,673.6	\$3,061.7	\$4,276.5	\$2,540.8	\$7,958.9	\$29,133.4
2017	\$6,961.8	\$4,927.9	\$3,219.0	\$4,483.0	\$2,681.7	\$8,392.1	\$30,665.5
2018	\$7,320.6	\$5,197.1	\$3,384.9	\$4,700.2	\$2,831.0	\$8,850.4	\$32,284.1
2019	\$7,699.0	\$5,481.7	\$3,559.8	\$4,928.7	\$2,988.9	\$9,335.2	\$33,993.4
2020	\$8,098.0	\$5,782.7	\$3,744.3	\$5,169.0	\$3,156.1	\$9,847.7	\$35,797.8
2021	\$8,518.4	\$6,100.7	\$3,938.7	\$5,421.4	\$3,332.9	\$10,389.2	\$37,701.2
2022	\$8,961.0	\$6,436.4	\$4,143.3	\$5,686.4	\$3,519.7	\$10,961.0	\$39,707.8
2023	\$9,426.7	\$6,790.8	\$4,358.7	\$5,964.4	\$3,717.1	\$11,564.4	\$41,822.1
2024	\$9,916.6	\$7,164.6	\$4,585.2	\$6,256.0	\$3,925.5	\$12,201.0	\$44,048.9
2025	\$10,431.5	\$7,558.7	\$4,823.3	\$6,561.6	\$4,145.5	\$12,872.1	\$46,392.7
2026	\$10,972.7	\$7,974.1	\$5,073.5	\$6,881.8	\$4,377.6	\$13,579.6	\$48,859.4
2027	\$11,541.5	\$8,412.0	\$5,336.5	\$7,217.4	\$4,622.5	\$14,325.3	\$51,455.2
2028	\$12,139.2	\$8,873.5	\$5,612.9	\$7,568.9	\$4,880.8	\$15,111.2	\$54,186.5
2029	\$12,767.1	\$9,359.8	\$5,903.2	\$7,937.1	\$5,153.3	\$15,939.4	\$57,059.8
2030	\$13,426.6	\$9,872.1	\$6,208.1	\$8,322.7	\$5,440.6	\$16,811.8	\$60,081.9
2031	\$14,119.3	\$10,411.8	\$6,528.4	\$8,726.4	\$5,743.7	\$17,730.9	\$63,260.4
2032	\$14,846.8	\$10,980.3	\$6,864.8	\$9,149.2	\$6,063.2	\$18,699.1	\$66,603.4
2033	\$15,610.9	\$11,579.3	\$7,218.1	\$9,591.9	\$6,400.1	\$19,719.0	\$70,119.3
2034	\$16,413.4	\$12,210.2	\$7,589.2	\$10,055.5	\$6,755.4	\$20,793.4	\$73,817.1
2035	\$17,256.3	\$12,874.8	\$7,978.9	\$10,540.9	\$7,130.0	\$21,925.2	\$77,706.1
2036	\$18,141.5	\$13,574.8	\$8,388.2	\$11,049.2	\$7,525.0	\$23,117.3	\$81,796.1
2037	\$19,071.1	\$14,312.2	\$8,818.0	\$11,581.4	\$7,941.5	\$24,373.0	\$86,097.2
2038	\$20,047.3	\$15,088.8	\$9,269.4	\$12,138.6	\$8,380.6	\$25,695.7	\$90,620.5
2039	\$21,072.5	\$15,906.9	\$9,743.4	\$12,722.0	\$8,843.5	\$27,088.8	\$95,377.2
2040	\$22,149.1	\$16,768.5	\$10,241.2	\$13,332.9	\$9,331.6	\$28,556.0	\$100,379.3
2041	\$23,279.6	\$17,676.0	\$10,763.9	\$13,972.4	\$9,846.2	\$30,101.4	\$105,639.5

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 74** Estimated Cumulative Direct Costs of All Mental Illnesses excluding Dementia in 2011 Present Values from 2011 to 2041

<i>Estimated Cumulative Prevalence-Based Direct Costs of Any* Mental Disorder in Canada, in 2011 Present Value Terms (in \$ Millions)</i>							
Year	Income Support	Inpatient Services	Other Services	Prescription Drugs	Physicians	Social Services	Total Direct Costs
2011	\$5,158.0	\$3,587.6	\$2,384.9	\$3,380.3	\$1,941.0	\$6,109.6	\$22,561.4
2012	\$10,425.9	\$7,262.4	\$4,820.7	\$6,822.6	\$3,931.1	\$12,367.6	\$45,630.3
2013	\$15,802.2	\$11,023.9	\$7,306.5	\$10,325.5	\$5,970.1	\$18,773.2	\$69,201.3
2014	\$21,287.7	\$14,873.0	\$9,842.9	\$13,889.1	\$8,058.6	\$25,328.0	\$93,279.3
2015	\$26,884.9	\$18,811.9	\$12,430.9	\$17,514.5	\$10,198.0	\$32,035.8	\$117,876.0
2016	\$32,596.9	\$22,843.4	\$15,072.0	\$21,203.5	\$12,389.7	\$38,901.3	\$143,006.7
2017	\$38,427.3	\$26,970.4	\$17,767.8	\$24,957.9	\$14,635.6	\$45,929.5	\$168,688.6
2018	\$44,379.6	\$31,196.1	\$20,520.0	\$28,779.6	\$16,937.4	\$53,125.7	\$194,938.5
2019	\$50,457.3	\$35,523.5	\$23,330.2	\$32,670.4	\$19,296.9	\$60,495.0	\$221,773.2
2020	\$56,663.7	\$39,955.4	\$26,199.9	\$36,632.0	\$21,715.8	\$68,042.4	\$249,209.2
2021	\$63,002.2	\$44,494.9	\$29,130.7	\$40,666.0	\$24,195.8	\$75,772.9	\$277,262.4
2022	\$69,475.8	\$49,144.7	\$32,123.9	\$44,773.9	\$26,738.5	\$83,691.4	\$305,948.2
2023	\$76,087.5	\$53,907.6	\$35,181.0	\$48,957.3	\$29,345.6	\$91,802.4	\$335,281.4
2024	\$82,840.2	\$58,786.4	\$38,303.3	\$53,217.3	\$32,018.7	\$100,110.7	\$365,276.5
2025	\$89,736.6	\$63,783.6	\$41,492.0	\$57,555.3	\$34,759.3	\$108,620.7	\$395,947.6
2026	\$96,779.6	\$68,901.9	\$44,748.5	\$61,972.5	\$37,569.1	\$117,337.0	\$427,308.5
2027	\$103,971.9	\$74,144.0	\$48,074.1	\$66,470.1	\$40,449.7	\$126,264.0	\$459,373.7
2028	\$111,316.3	\$79,512.6	\$51,469.9	\$71,049.4	\$43,402.6	\$135,406.6	\$492,157.5
2029	\$118,815.6	\$85,010.5	\$54,937.4	\$75,711.6	\$46,429.7	\$144,769.3	\$525,674.1
2030	\$126,472.6	\$90,640.4	\$58,477.8	\$80,457.9	\$49,532.4	\$154,356.8	\$559,937.9
2031	\$134,290.1	\$96,405.2	\$62,092.5	\$85,289.5	\$52,712.5	\$164,174.0	\$594,963.7
2032	\$142,271.0	\$102,307.7	\$65,782.6	\$90,207.6	\$55,971.7	\$174,225.6	\$630,766.3
2033	\$150,418.2	\$108,350.8	\$69,549.7	\$95,213.6	\$59,311.9	\$184,516.8	\$667,361.0
2034	\$158,734.8	\$114,537.6	\$73,395.1	\$100,308.6	\$62,734.8	\$195,052.7	\$704,763.6
2035	\$167,223.7	\$120,871.1	\$77,320.1	\$105,494.1	\$66,242.3	\$205,838.4	\$742,989.8
2036	\$175,888.2	\$127,354.5	\$81,326.4	\$110,771.2	\$69,836.3	\$216,879.4	\$782,056.1
2037	\$184,731.4	\$133,991.0	\$85,415.3	\$116,141.5	\$73,518.7	\$228,181.0	\$821,978.9
2038	\$193,756.5	\$140,783.8	\$89,588.2	\$121,606.2	\$77,291.6	\$239,748.9	\$862,775.2
2039	\$202,966.8	\$147,736.4	\$93,846.9	\$127,166.7	\$81,156.9	\$251,588.8	\$904,462.4
2040	\$212,365.7	\$154,852.0	\$98,192.7	\$132,824.4	\$85,116.7	\$263,706.5	\$947,058.0
2041	\$221,956.6	\$162,134.3	\$102,627.3	\$138,580.9	\$89,173.2	\$276,107.9	\$990,580.1

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 75** Estimated Annual Direct Costs of Cognitive Impairment including Dementia in Future Values from 2011 to 2041

<b>Estimated Direct Costs Associated with Cognitive Impairment including Dementia in Canada, in Future Value Terms (in \$ Millions)</b>										
<b>Year</b>	<b>Administrative Costs</b>	<b>Care Staff</b>	<b>Medication</b>	<b>Out of Pocket</b>	<b>Hospital</b>	<b>Physicians and Purchased Services</b>	<b>Support Staff</b>	<b>User Fees</b>	<b>Total Direct Costs</b>	
2011	\$2,855.8	\$9,844.4	\$23.1	\$1,988.0	\$773.1	\$369.5	\$1,705.4	\$2,181.5	\$19,740.9	
2012	\$3,047.6	\$10,650.5	\$24.8	\$2,150.0	\$842.9	\$402.8	\$1,819.9	\$2,328.0	\$21,266.6	
2013	\$3,253.9	\$11,515.7	\$26.7	\$2,325.0	\$918.1	\$438.5	\$1,943.2	\$2,485.6	\$22,906.7	
2014	\$3,476.5	\$12,447.5	\$28.7	\$2,514.7	\$999.2	\$477.0	\$2,076.1	\$2,655.6	\$24,675.2	
2015	\$3,717.4	\$13,454.9	\$30.9	\$2,720.8	\$1,087.2	\$518.5	\$2,220.0	\$2,839.7	\$26,589.3	
2016	\$3,979.0	\$14,547.9	\$33.2	\$2,945.4	\$1,183.0	\$563.6	\$2,376.2	\$3,039.5	\$28,667.7	
2017	\$4,263.6	\$15,737.1	\$35.7	\$3,190.7	\$1,287.4	\$612.6	\$2,546.1	\$3,256.9	\$30,930.1	
2018	\$4,573.5	\$17,033.5	\$38.5	\$3,458.8	\$1,401.6	\$666.1	\$2,731.2	\$3,493.6	\$33,396.8	
2019	\$4,911.0	\$18,448.6	\$41.5	\$3,752.1	\$1,526.7	\$724.5	\$2,932.8	\$3,751.5	\$36,088.7	
2020	\$5,278.4	\$19,994.2	\$44.8	\$4,072.8	\$1,663.8	\$788.4	\$3,152.1	\$4,032.1	\$39,026.6	
2021	\$5,677.7	\$21,682.2	\$48.3	\$4,423.0	\$1,814.2	\$858.3	\$3,390.6	\$4,337.1	\$42,231.4	
2022	\$6,110.8	\$23,524.5	\$52.2	\$4,804.7	\$1,979.0	\$934.8	\$3,649.3	\$4,668.0	\$45,723.4	
2023	\$6,579.5	\$25,532.9	\$56.4	\$5,220.1	\$2,159.6	\$1,018.5	\$3,929.2	\$5,026.0	\$49,522.2	
2024	\$7,085.3	\$27,718.5	\$61.0	\$5,670.8	\$2,357.1	\$1,109.8	\$4,231.2	\$5,412.4	\$53,646.1	
2025	\$7,629.5	\$30,091.8	\$65.9	\$6,158.6	\$2,572.7	\$1,209.4	\$4,556.2	\$5,828.1	\$58,112.2	
2026	\$8,213.1	\$32,662.8	\$71.2	\$6,684.9	\$2,807.6	\$1,317.7	\$4,904.7	\$6,273.9	\$62,935.7	
2027	\$8,836.9	\$35,440.6	\$76.9	\$7,251.0	\$3,062.8	\$1,435.2	\$5,277.2	\$6,750.4	\$68,131.0	
2028	\$9,501.6	\$38,433.5	\$83.0	\$7,858.1	\$3,339.5	\$1,562.3	\$5,674.2	\$7,258.2	\$73,710.4	
2029	\$10,207.8	\$41,649.2	\$89.6	\$8,507.4	\$3,638.5	\$1,699.5	\$6,095.9	\$7,797.6	\$79,685.5	
2030	\$10,955.9	\$45,094.6	\$96.5	\$9,199.8	\$3,960.9	\$1,847.0	\$6,542.7	\$8,369.1	\$86,066.6	
2031	\$11,746.3	\$48,776.2	\$104.0	\$9,936.3	\$4,307.5	\$2,005.4	\$7,014.7	\$8,972.9	\$92,863.1	
2032	\$12,579.3	\$52,699.9	\$111.8	\$10,717.6	\$4,679.1	\$2,174.9	\$7,512.1	\$9,609.1	\$100,083.7	
2033	\$13,455.1	\$56,871.1	\$120.1	\$11,544.7	\$5,076.6	\$2,355.7	\$8,035.1	\$10,278.2	\$107,736.5	
2034	\$14,374.0	\$61,294.9	\$128.9	\$12,418.3	\$5,500.7	\$2,548.2	\$8,583.9	\$10,980.1	\$115,829.1	
2035	\$15,336.4	\$65,976.3	\$138.1	\$13,339.4	\$5,952.2	\$2,752.7	\$9,158.6	\$11,715.3	\$124,368.9	
2036	\$16,342.5	\$70,920.0	\$147.8	\$14,308.8	\$6,431.8	\$2,969.3	\$9,759.4	\$12,483.9	\$133,363.5	
2037	\$17,392.9	\$76,130.8	\$157.9	\$15,327.5	\$6,940.3	\$3,198.4	\$10,386.7	\$13,286.3	\$142,820.9	
2038	\$18,488.3	\$81,614.1	\$168.6	\$16,396.6	\$7,478.4	\$3,440.2	\$11,040.8	\$14,123.0	\$152,750.0	
2039	\$19,629.4	\$87,375.5	\$179.7	\$17,517.5	\$8,047.0	\$3,695.0	\$11,722.3	\$14,994.6	\$163,161.0	
2040	\$20,817.4	\$93,421.7	\$191.3	\$18,691.7	\$8,647.0	\$3,963.1	\$12,431.7	\$15,902.1	\$174,066.0	
2041	\$22,003.5	\$99,728.0	\$203.3	\$19,940.5	\$9,280.8	\$4,246.5	\$13,140.1	\$16,808.2	\$185,350.9	

# Life at Risk Analysis of The Impact of Mental Illness in Canada

**Table 76** Estimated Cumulative Direct Costs of Cognitive Impairment including Dementia in 2011 Present Values from 2011 to 2041

Year	Costs	Care Staff	Medication	Out of Pocket	Hospital	Services	Support Staff	User Fees	Total Direct Costs
2011	\$2,855.8	\$9,844.4	\$23.1	\$1,988.0	\$773.1	\$369.5	\$1,705.4	\$2,181.5	\$19,740.9
2012	\$5,814.6	\$20,184.7	\$47.2	\$4,075.4	\$1,591.5	\$760.6	\$3,472.4	\$4,441.7	\$40,388.1
2013	\$8,881.7	\$31,039.3	\$72.3	\$6,267.0	\$2,456.9	\$1,174.0	\$5,304.0	\$6,784.6	\$61,979.8
2014	\$12,063.2	\$42,430.5	\$98.6	\$8,568.3	\$3,371.3	\$1,610.5	\$7,203.9	\$9,214.9	\$84,561.1
2015	\$15,366.0	\$54,385.0	\$126.0	\$10,985.7	\$4,337.3	\$2,071.2	\$9,176.3	\$11,737.9	\$108,185.4
2016	\$18,798.4	\$66,934.2	\$154.6	\$13,526.4	\$5,357.7	\$2,557.3	\$11,226.0	\$14,359.8	\$132,914.4
2017	\$22,369.0	\$80,113.7	\$184.6	\$16,198.5	\$6,435.9	\$3,070.4	\$13,358.3	\$17,087.4	\$158,817.9
2018	\$26,087.7	\$93,963.5	\$215.9	\$19,010.9	\$7,575.6	\$3,611.9	\$15,579.0	\$19,928.1	\$185,972.6
2019	\$29,964.5	\$108,527.0	\$248.7	\$21,972.9	\$8,780.8	\$4,183.8	\$17,894.2	\$22,889.5	\$214,461.3
2020	\$34,009.9	\$123,850.9	\$283.0	\$25,094.3	\$10,056.0	\$4,788.1	\$20,310.0	\$25,979.8	\$244,371.9
2021	\$38,234.6	\$139,984.4	\$318.9	\$28,385.4	\$11,405.9	\$5,426.7	\$22,833.0	\$29,207.0	\$275,796.0
2022	\$42,649.2	\$156,979.0	\$356.7	\$31,856.5	\$12,835.6	\$6,102.1	\$25,469.3	\$32,579.2	\$308,827.6
2023	\$47,264.0	\$174,887.3	\$396.2	\$35,517.8	\$14,350.3	\$6,816.4	\$28,225.1	\$36,104.4	\$343,561.5
2024	\$52,088.8	\$193,762.2	\$437.8	\$39,379.3	\$15,955.3	\$7,572.2	\$31,106.4	\$39,790.0	\$380,091.9
2025	\$57,132.8	\$213,656.5	\$481.3	\$43,450.8	\$17,656.2	\$8,371.7	\$34,118.5	\$43,643.0	\$418,510.9
2026	\$62,404.4	\$234,621.5	\$527.0	\$47,741.6	\$19,458.3	\$9,217.5	\$37,266.7	\$47,670.0	\$458,906.9
2027	\$67,911.3	\$256,706.9	\$575.0	\$52,260.2	\$21,366.9	\$10,111.8	\$40,555.2	\$51,876.6	\$501,363.9
2028	\$73,659.9	\$279,959.8	\$625.2	\$57,014.5	\$23,387.3	\$11,057.1	\$43,988.2	\$56,267.9	\$545,959.9
2029	\$79,655.9	\$304,424.3	\$677.8	\$62,011.7	\$25,524.6	\$12,055.3	\$47,568.9	\$60,848.2	\$592,766.7
2030	\$85,903.9	\$330,141.1	\$732.9	\$67,258.2	\$27,783.4	\$13,108.7	\$51,300.1	\$65,621.0	\$641,849.3
2031	\$92,407.6	\$357,147.3	\$790.4	\$72,759.7	\$30,168.4	\$14,219.0	\$55,183.9	\$70,589.0	\$693,265.3
2032	\$99,169.5	\$385,476.1	\$850.5	\$78,520.9	\$32,683.6	\$15,388.1	\$59,222.0	\$75,754.4	\$747,065.2
2033	\$106,191.6	\$415,156.7	\$913.2	\$84,546.0	\$35,333.1	\$16,617.5	\$63,415.5	\$81,118.5	\$803,292.1
2034	\$113,474.8	\$446,214.3	\$978.5	\$90,838.3	\$38,120.2	\$17,908.7	\$67,764.9	\$86,682.0	\$861,981.8
2035	\$121,019.3	\$478,670.3	\$1,046.5	\$97,400.4	\$41,048.4	\$19,262.8	\$72,270.3	\$92,445.2	\$923,163.0
2036	\$128,824.6	\$512,542.0	\$1,117.0	\$104,234.4	\$44,120.2	\$20,681.0	\$76,931.4	\$98,407.5	\$986,858.2
2037	\$136,889.6	\$547,843.5	\$1,190.3	\$111,341.6	\$47,338.4	\$22,164.1	\$81,747.7	\$104,568.3	\$1,053,083.4
2038	\$145,212.8	\$584,585.3	\$1,266.2	\$118,723.2	\$50,705.1	\$23,712.8	\$86,718.1	\$110,926.3	\$1,121,849.9
2039	\$153,792.3	\$622,775.1	\$1,344.7	\$126,379.7	\$54,222.3	\$25,327.8	\$91,841.7	\$117,480.1	\$1,193,163.7
2040	\$162,626.1	\$662,418.3	\$1,425.9	\$134,311.4	\$57,891.6	\$27,009.6	\$97,117.0	\$124,228.1	\$1,267,028.0
2041	\$171,691.3	\$703,504.8	\$1,509.6	\$142,526.6	\$61,715.2	\$28,759.1	\$102,530.5	\$131,152.9	\$1,343,390.1

Life at Risk Analysis of The Impact of Mental Illness in Canada

Table 77 Estimated Total Economic Costs from Mental Illnesses in Canada from 2011 to 2041

Year	Direct Costs				Indirect Costs				Total Costs			
	Annual Future Value	Annual Present Value	Cumulative Present Value	Annual Future Value	Annual Present Value	Cumulative Present Value	Annual Future Value	Annual Present Value	Cumulative Present Value	Annual Future Value	Annual Present Value	Cumulative Present Value
	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
2011	\$42,302.3	\$42,302.3	\$42,302.3	\$6,382.9	\$6,382.9	\$6,382.9	\$48,685.2	\$48,685.2	\$48,685.2	\$48,685.2	\$48,685.2	\$48,685.2
2012	\$45,027.5	\$43,716.1	\$86,018.4	\$6,771.6	\$6,382.9	\$12,765.7	\$51,799.1	\$50,098.9	\$98,784.1	\$51,799.1	\$50,098.9	\$98,784.1
2013	\$47,913.1	\$45,162.7	\$131,181.1	\$6,974.7	\$6,382.9	\$19,148.6	\$54,887.8	\$51,545.6	\$150,329.7	\$54,887.8	\$51,545.6	\$150,329.7
2014	\$50,985.9	\$46,659.4	\$177,840.4	\$7,184.0	\$6,382.9	\$25,531.5	\$58,169.9	\$53,042.2	\$203,371.9	\$58,169.9	\$53,042.2	\$203,371.9
2015	\$54,273.2	\$48,221.0	\$226,061.4	\$7,399.5	\$6,382.9	\$31,914.3	\$61,672.7	\$54,603.9	\$257,975.8	\$61,672.7	\$54,603.9	\$257,975.8
2016	\$57,801.1	\$49,859.7	\$275,921.2	\$7,621.5	\$6,382.9	\$38,297.2	\$65,422.6	\$56,242.6	\$314,218.4	\$65,422.6	\$56,242.6	\$314,218.4
2017	\$61,595.5	\$51,585.3	\$327,506.5	\$7,850.1	\$6,382.9	\$44,680.1	\$69,445.7	\$57,968.2	\$372,186.6	\$69,445.7	\$57,968.2	\$372,186.6
2018	\$65,680.9	\$53,404.6	\$380,911.1	\$8,085.6	\$6,382.9	\$51,062.9	\$73,766.5	\$59,787.5	\$431,974.0	\$73,766.5	\$59,787.5	\$431,974.0
2019	\$70,082.0	\$55,323.4	\$436,234.5	\$8,328.2	\$6,382.9	\$57,445.8	\$78,410.2	\$61,706.3	\$493,680.3	\$78,410.2	\$61,706.3	\$493,680.3
2020	\$74,824.3	\$57,346.6	\$493,581.1	\$8,578.0	\$6,382.9	\$63,828.7	\$83,402.4	\$63,729.5	\$557,409.8	\$83,402.4	\$63,729.5	\$557,409.8
2021	\$79,932.5	\$59,477.3	\$553,058.4	\$8,835.4	\$6,382.9	\$70,211.6	\$88,767.9	\$65,860.2	\$623,270.0	\$88,767.9	\$65,860.2	\$623,270.0
2022	\$85,431.2	\$61,717.3	\$614,775.8	\$9,100.4	\$6,382.9	\$76,594.4	\$94,531.7	\$68,100.2	\$691,370.2	\$94,531.7	\$68,100.2	\$691,370.2
2023	\$91,344.3	\$64,067.1	\$678,842.8	\$9,373.5	\$6,382.9	\$82,977.3	\$100,717.8	\$70,449.9	\$761,820.1	\$100,717.8	\$70,449.9	\$761,820.1
2024	\$97,695.0	\$66,525.6	\$745,368.4	\$9,654.7	\$6,382.9	\$89,360.2	\$107,349.7	\$72,908.4	\$834,728.5	\$107,349.7	\$72,908.4	\$834,728.5
2025	\$104,504.9	\$69,090.0	\$814,458.4	\$9,944.3	\$6,382.9	\$95,743.0	\$114,449.2	\$75,472.9	\$910,201.4	\$114,449.2	\$75,472.9	\$910,201.4
2026	\$111,795.1	\$71,757.1	\$886,215.5	\$10,242.6	\$6,382.9	\$102,125.9	\$122,037.8	\$78,139.9	\$988,341.4	\$122,037.8	\$78,139.9	\$988,341.4
2027	\$119,586.2	\$74,522.1	\$960,737.6	\$10,549.9	\$6,382.9	\$108,508.8	\$130,136.1	\$80,905.0	\$1,069,246.4	\$130,136.1	\$80,905.0	\$1,069,246.4
2028	\$127,896.9	\$77,379.7	\$1,038,117.3	\$10,866.4	\$6,382.9	\$114,891.6	\$138,763.3	\$83,762.6	\$1,153,009.0	\$138,763.3	\$83,762.6	\$1,153,009.0
2029	\$136,745.3	\$80,323.4	\$1,118,440.8	\$11,192.4	\$6,382.9	\$121,274.5	\$147,937.7	\$86,706.3	\$1,239,715.3	\$147,937.7	\$86,706.3	\$1,239,715.3
2030	\$146,148.5	\$83,346.4	\$1,201,787.2	\$11,528.2	\$6,382.9	\$127,657.4	\$157,676.6	\$89,729.3	\$1,329,444.5	\$157,676.6	\$89,729.3	\$1,329,444.5
2031	\$156,123.5	\$86,441.8	\$1,288,228.9	\$11,874.0	\$6,382.9	\$134,040.2	\$167,997.5	\$92,824.7	\$1,422,269.2	\$167,997.5	\$92,824.7	\$1,422,269.2
2032	\$166,687.1	\$89,602.5	\$1,377,831.5	\$12,230.2	\$6,382.9	\$140,423.1	\$178,917.3	\$95,985.4	\$1,518,254.6	\$178,917.3	\$95,985.4	\$1,518,254.6
2033	\$177,855.8	\$92,821.6	\$1,470,653.2	\$12,597.1	\$6,382.9	\$146,806.0	\$190,453.0	\$99,204.5	\$1,617,459.1	\$190,453.0	\$99,204.5	\$1,617,459.1
2034	\$189,646.2	\$96,092.2	\$1,566,745.3	\$12,975.1	\$6,382.9	\$153,188.8	\$202,621.2	\$102,475.0	\$1,719,934.2	\$202,621.2	\$102,475.0	\$1,719,934.2
2035	\$202,075.0	\$99,407.5	\$1,666,152.9	\$13,364.3	\$6,382.9	\$159,571.7	\$215,499.3	\$105,790.4	\$1,825,724.6	\$215,499.3	\$105,790.4	\$1,825,724.6
2036	\$215,159.6	\$102,761.4	\$1,768,914.2	\$13,765.2	\$6,382.9	\$165,954.6	\$228,924.8	\$109,144.3	\$1,934,868.8	\$228,924.8	\$109,144.3	\$1,934,868.8
2037	\$228,918.1	\$106,148.1	\$1,875,062.3	\$14,178.2	\$6,382.9	\$172,337.4	\$243,096.3	\$112,531.0	\$2,047,399.8	\$243,096.3	\$112,531.0	\$2,047,399.8
2038	\$243,370.4	\$109,562.7	\$1,984,625.1	\$14,603.5	\$6,382.9	\$178,720.3	\$257,974.0	\$115,945.6	\$2,163,345.4	\$257,974.0	\$115,945.6	\$2,163,345.4
2039	\$258,538.2	\$113,001.0	\$2,097,626.1	\$15,041.6	\$6,382.9	\$185,103.2	\$273,579.8	\$119,383.9	\$2,282,729.3	\$273,579.8	\$119,383.9	\$2,282,729.3
2040	\$274,445.3	\$116,459.9	\$2,214,085.9	\$15,492.9	\$6,382.9	\$191,486.0	\$289,938.2	\$122,842.7	\$2,405,572.0	\$289,938.2	\$122,842.7	\$2,405,572.0
2041	\$290,990.4	\$119,884.2	\$2,333,970.0	\$15,957.7	\$6,382.9	\$197,868.9	\$306,948.1	\$126,267.1	\$2,531,838.9	\$306,948.1	\$126,267.1	\$2,531,838.9

## E ECONOMIC SENSITIVITY ANALYSIS

The total direct costs from Jacobs *et al.* (2010) contained some gaps in the data. In order to better estimate the total costs due to mental illness in Canada, the gaps were estimated based on the average per capita values present. However, if the provinces for which costs were available were higher or lower than other regions, the estimation procedure may not be accurate. To investigate the sensitivity of the total costs to the estimation procedure, the total costs were estimated using the lowest provincial per capita costs, the highest provincial per capita costs, and the average provincial per capita costs. Table 78 compares the total direct costs estimates using the three methods. At the lower end, direct costs due to all mental illnesses except dementia could be 10% lower than the average values used in the report. Using the upper estimates, the total costs could be about 6% higher. Given the relatively small range, the approximation method seems reliable.

In addition to the estimation of the gaps the future and present value costs depend upon inflation and discount rate assumptions. Total direct costs were estimated using inflation rates of 2% and 4%, and discount rates of 0% (nominal dollars), 3% and 5%. By 2041, the difference between cumulative present values differs by less than a factor of 4.

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**Table 78** Sensitivity of Total Direct Costs to Estimation Method

\$MILLIONS - 2007/08	Estimation Method			
	Reported Costs Only	Lowest of Reported Provincial Costs	Average of Reported Provincial Costs	Highest of Reported Provincial Costs
Inpatient	\$2,773.30	\$2,331.66	\$2,918.37	\$2,728.80
Inpatient -- general hospitals	\$1,717.40	\$1,432.09	\$1,717.40	\$1,717.40
Inpatient -- psychiatric hospitals	\$1,011.40	\$899.57	\$1,011.40	\$1,011.40
Long term care	\$44.50	\$166.36	\$189.57	\$190.59
Physicians	\$1,427.00	\$1,466.97	\$1,572.78	\$1,609.35
General practitioners -- fee for service	\$326.20	\$326.20	\$326.20	\$326.20
Specialists -- fee for service	\$638.90	\$600.40	\$638.90	\$638.90
Psychiatrist -- alternative payments	\$461.90	\$540.37	\$607.68	\$644.25
Community and social	\$2,946.60	\$3,988.67	\$4,969.78	\$5,784.04
Outpatient -- emergency rooms	\$65.20	\$124.62	\$130.29	\$335.77
Community mental health	\$1,463.50	\$1,165.57	\$1,725.09	\$1,820.18
Supportive housing	\$156.90	\$1,142.61	\$1,188.67	\$1,188.95
Employment support	\$15.80	\$29.61	\$53.27	\$322.75
Other community / social support	\$586.70	\$827.02	\$1,125.47	\$1,209.54
Addictions services	\$511.10	\$563.55	\$599.60	\$759.43
First Nations -- mental health & addictions	\$147.40	\$135.70	\$147.40	\$147.40
Pharmaceuticals	\$2,814.90	\$2,814.90	\$2,814.90	\$2,814.90
Public	\$1,275.50	\$1,275.50	\$1,275.50	\$1,275.50
Private	\$1,539.40	\$1,539.40	\$1,539.40	\$1,539.40
Other services	\$657.00	\$1,964.57	\$1,962.84	\$1,964.57
Non profits exc. prov. government)	\$249.10	\$249.10	\$249.10	\$249.10
Other housing (shelters, temporary)	\$50.60	\$383.47	\$382.03	\$383.47
Educational mental health services	\$118.00	\$1,092.70	\$1,092.40	\$1,092.70
Employee assistance plans	\$239.30	\$239.30	\$239.30	\$239.30
Income support	\$3,728.70	\$3,808.52	\$4,245.08	\$4,460.41
Canada Pension Plan -- Disability	\$894.40	\$894.40	\$894.40	\$894.40
Workers Compensation	\$35.30	\$35.30	\$35.30	\$35.30
Provincial income support	\$1,259.00	\$1,338.82	\$1,775.38	\$1,990.71
Private Insurance -- disability payments				
Long term disability	\$1,300.00	\$1,300.00	\$1,300.00	\$1,300.00
Short term disability	\$240.00	\$240.00	\$240.00	\$240.00
<b>Totals (millions)</b>	<b>\$14,347.50</b>	<b>\$16,541.65</b>	<b>\$18,483.75</b>	<b>\$19,552.67</b>

**Table 79** Sensitivity of Total Direct Costs to Inflation and Discount Rates

Inflation Rate	Cumulative Direct Costs						
	2%			4%			
	Discount Rate	0%	3%	5%	0%	3%	5%
<b>2011</b>		\$42,302	\$42,302	\$42,302	\$42,302	\$42,302	\$42,302
<b>2021</b>		\$650,419	\$553,058	\$500,007	\$736,783	\$622,553	\$560,497
<b>2031</b>		\$1,827,689	\$1,288,229	\$1,043,271	\$2,411,914	\$1,663,167	\$1,326,826
<b>2041</b>		\$4,075,376	\$2,333,970	\$1,681,362	\$6,368,851	\$3,494,971	\$2,440,890