# OPENING EYES, OPENING MINDS:
## The Ontario Burden of Mental Illness and Addictions Report

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## OPENING EYES, OPENING MINDS: THE ONTARIO BURDEN OF MENTAL ILLNESS AND ADDICTIONS REPORT

**An ICES/PHO Report**

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The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding sources. No endorsement by the Institute for Clinical Evaluative Sciences (ICES), Public Health Ontario (PHO) or the Ontario Ministry of Health and Long-Term Care (MOHLTC) is intended or should be inferred.

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## OTHER STUDIES

This report was produced through a partnership between the Institute for Clinical Evaluative Sciences (ICES) and Public Health Ontario (PHO). It is the final report in a three-part series on the burden of disease and ill health in Ontario. The first report, *The Ontario Burden of Infectious Disease Study*, was released in December 2010. The second report, *Seven More Years: The Impact of Smoking, Alcohol, Diet, Physical Activity and Stress on Health and Life Expectancy in Ontario*, was released in April 2012.

# Executive Summary

Most Ontarians are affected, either directly or indirectly, by mental illness and addiction issues. According to the Mental Health Commission of Canada, one in five Canadians is affected by a mental illness or addiction issue every year. Onset often occurs at a young age and can persist throughout life, with a significant impact on social connections, educational goals and workforce participation. The impact of mental illness and addiction on life expectancy, quality of life and health care utilization is significant—in many cases, more so than with other medical conditions—yet is often under-recognized.

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. Mental health is a critical component of overall health. Measuring the burden of mental illness and addiction is an important step in ensuring that the needs of people who suffer from these conditions are understood and can be addressed. This study quantifies the burden and allows for comparison with other diseases and conditions.

The methods used in this study are conservative; they are based on a group of selected conditions and addictions that are highly prevalent and readily measured. Therefore, the findings do not reflect the total burden of mental illness and addictions in Ontario.

## About This Report

The Ontario Burden of Mental Illness and Addictions Report is the most thorough evaluation of the impact of mental illness and addictions on Ontarians to date. A joint project of the Institute for Clinical Evaluative Sciences (ICES) and Public Health Ontario (PHO), the study seeks to estimate the relative impact of a wide range of mental illnesses and addictions to inform priority setting, planning and decision-making by those involved in public health and mental health care planning.

## Methods

The study used health-adjusted life years (HALYs), a composite health gap measure that incorporates both premature death (mortality) and reduced functioning or suboptimal states of health (morbidity) associated with disease or injury. HALYs quantify the amount of "healthy" life lost by estimating the difference between the health experienced within a defined population and some specified norm or goal. HALYs incorporate aspects of quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs). HALYs are calculated by combining years of life lost due to premature death (YLL) and year-equivalents of reduced functioning from living with the disease (YERF).

Disease burden was estimated for nine mental illnesses and addictions for which reliable and valid Ontario data were available. Data on the nine conditions were acquired from a variety of data sources, including population health surveys and health administrative data. Deaths were obtained from vital statistics data.

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**Burden of mental illness and addictions (MI&A) compared to cancers and infectious diseases in Ontario, by years of life lost due to premature mortality (YLL) and year-equivalents of reduced functioning (YERF)**



Legend: YLL, YERF

Health-adjusted life years (HALYs)

MI&A:
- All MI&A examined
- Major depression
- Bipolar disorder
- Alcohol use disorders
- Social phobia
- Schizophrenia
- Panic disorder
- Agoraphobia
- Cocaine use disorders
- Prescription opioid misuse

Cancers:
- All cancers
- Lung cancer
- Colorectal cancer
- Breast cancer
- Prostate cancer

Infectious Diseases:
- All infectious diseases
- Hepatitis C
- *Streptococcus pneumoniae*
- Human papillomavirus
- *Escherichia coli*
- Hepatitis B
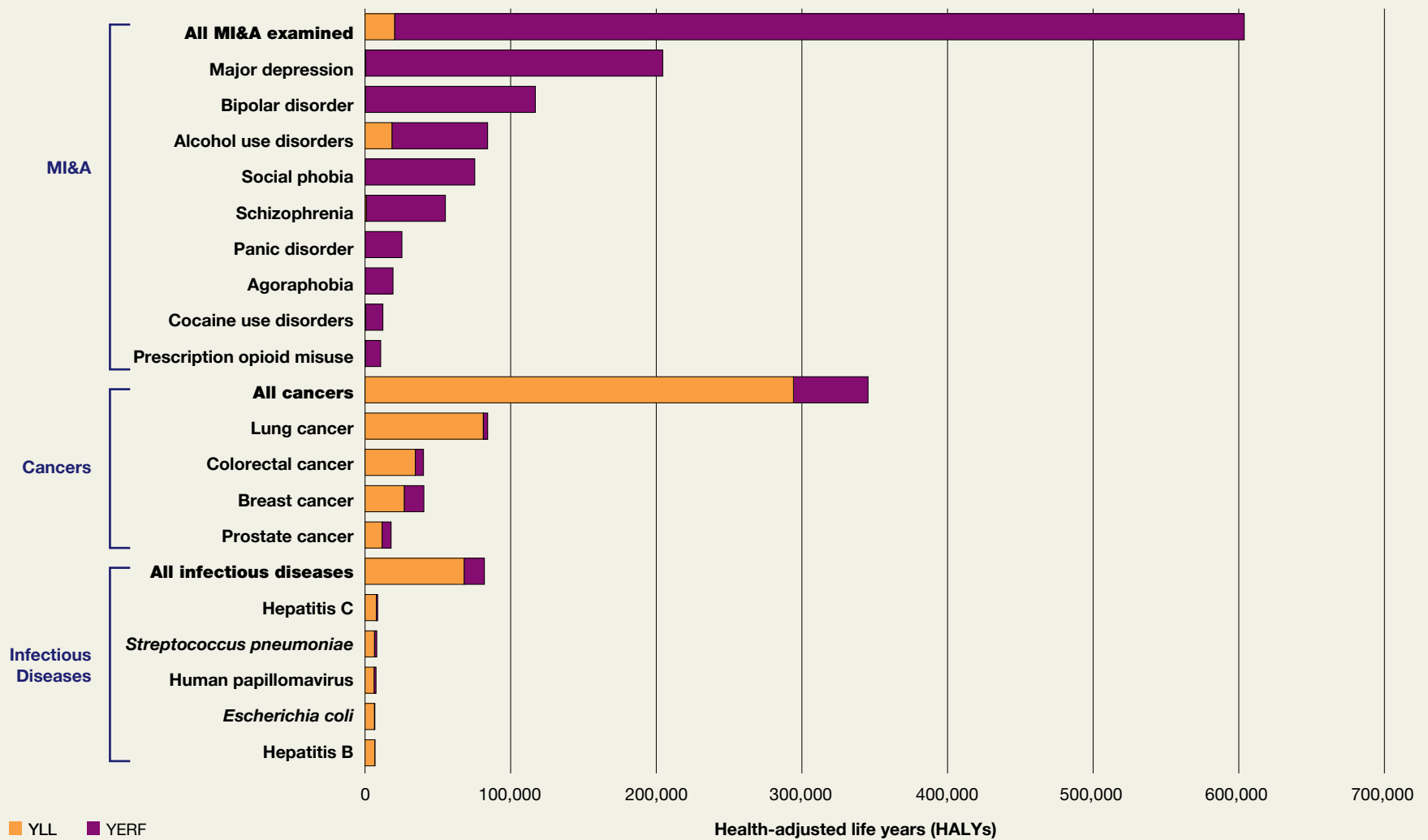
## Findings

- The burden of mental illness and addictions in Ontario is more than 1.5 times that of all cancers, and more than seven times that of all infectious diseases.

- The nine conditions identified in this report contributed to the loss of more than 600,000 health-adjusted life years (HALYs), a combination of years lived with less than full function and years lost to early death in Ontario.

- Five conditions have the highest impact on the life and health of Ontarians: depression, bipolar disorder, alcohol use disorders, social phobia and schizophrenia.

- Depression is the most burdensome condition, with twice the impact of bipolar disorder, the next highest condition. The burden of depression alone is more than the combined burden of lung, colorectal, breast and prostate cancers.

- In terms of deaths, alcohol use disorders contributed to 88% of the total number of deaths attributed to these conditions and 91% of the years of life lost to dying early.

## Conclusions and Recommendations

Ontarians experience a high burden of illness related to mental illness and addictions. Individuals may be encumbered by these illnesses at a young age, experiencing the disruption of important life transitions, and challenged by their ongoing burden over a long period of time.

The findings of this study underscore the need for effective collaboration between health care providers, practitioners, policy-makers and researchers to identify effective mental health promotion and mental illness and addiction prevention interventions and improve access to treatment for those suffering from mental illness and addiction. Early detection and timely intervention are critical in reducing the lifelong burden of these conditions.

While effective treatments exist for mental illness and addiction, only a small proportion of affected individuals receive them. Given the significant burden, there is a need to consider population-based prevention, promotion and treatment strategies aimed at reducing the burden of mental illness and addiction in Ontario.

8 | **ABOUT ICES**

Since its inception in 1992, ICES has played a key role in providing unique scientific insights to help policymakers, managers, planners, practitioners and other researchers shape the future direction of the Ontario health care system. Our unbiased, evidence-based knowledge and recommendations, profiled in atlases, investigative reports, and peer-reviewed journals, are used to guide decision-making and inform changes in health care delivery.

**ABOUT PHO**

Public Health Ontario (PHO) is a Crown corporation dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. As a hub organization, PHO links public health practitioners, frontline health workers and researchers to the best scientific intelligence and knowledge from around the world.

PHO provides expert scientific and technical support relating to communicable and infectious diseases; health promotion, chronic disease and injury prevention; environmental and occupational health; emergency preparedness; and public health laboratory services to support health providers, the public health system and partner ministries in making informed decisions to improve the health and security of Ontarians. PHO's work also includes surveillance and epidemiology, research, professional development and knowledge services.

## LIST OF ACRONYMS

| | |
|---|---|
| CAMH | Centre for Addiction and Mental Health |
| CCHS 1.2 | Canadian Community Health Survey Cycle 1.2 |
| CIHI-DAD | Canadian Institute for Health Information Discharge Abstract Database |
| CIHI-SDS | Canadian Institute for Health Information Same-Day Surgery database |
| CLAMES | Classification and Measurement System of Functional Health |
| DALY | Disability-adjusted life year |
| DSM-IV | Diagnostic and Statistical Manual of Mental Disorders, 4th Edition |
| GBD | Global Burden of Disease study |
| HALY | Health-adjusted life year |
| ICD-10 | International Classification of Diseases, 10th Revision |
| ICES | Institute for Clinical Evaluative Sciences |
| MI&A | Mental illness and addiction |
| NACRS | National Ambulatory Care Reporting System |
| OHIP | Ontario Health Insurance Plan |
| OMHRS | Ontario Mental Health Reporting System |
| ONBOIDS | Ontario Burden of Infectious Disease Study |

| | |
|---|---|
| QALY | Quality-adjusted life year |
| PHI | Population Health Impact of Disease in Canada |
| PHO | Public Health Ontario |
| WMH-CIDI | World Mental Health–Composite International Diagnostic Interview |
| WHO | World Health Organization |
| YERF | Year-equivalents of reduced functioning from living with a disease or disability |
| YLL | Years of life lost due to premature mortality |
| YLD | Years of life lost due to disease or disability |

## LIST OF EXHIBITS

# Introduction

The World Health Organization (WHO) defines health as a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity, and as "a resource for everyday life."[1,2]

This well accepted characterization positions mental health as a critical component of overall health.[3] If there is "no health without mental health,"[4] it follows that public health and mental health professionals may wish to act together to reduce the burden of mental illness and addiction (MI&A). A shared understanding of this burden in Ontario presents an excellent starting point for coordinated action across systems and sectors. The purpose of this study is to measure the burden of MI&A in Ontario using a consistent methodology that allows for comparison with other diseases and conditions.

In the original Global Burden of Disease study (conducted jointly by WHO and The World Bank), methodologies were developed to measure and compare disease burden across different conditions. From the study's earliest publications, there was a recognition that illness burden from neuropsychiatric disorders generally, and unipolar major depression specifically, was highly prevalent and significant, but under-recognized. Moreover, WHO has projected that depression will be the second leading cause of disability by 2020,[5] and other mental illnesses, such as schizophrenia, bipolar disorder and substance use disorders, are among the top ten causes of disability worldwide. Measuring the rising burden related to MI&A is an important step toward ensuring that the needs of people who suffer from these conditions are understood and can be addressed.

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The Institute for Clinical Evaluative Sciences (ICES) is an independent, non-profit organization, whose core business is to conduct research that contributes to the effectiveness, quality, equity and efficiency of health care and health services in Ontario. Public Health Ontario (PHO) has a mandate to support health care providers, the public health system and partner Ministries in making informed decisions and taking informed action to improve the health and security of all Ontarians through the transparent and timely provision of credible scientific advice and practical tools.[6]

In 2009, ICES and PHO began a collaboration focused on the burden of disease in Ontario, a three-year initiative to produce three comprehensive reports on aspects of the burden of disease in Ontario. The first report, the *Ontario Burden of Infectious Disease Study*, was released in December 2010.[7] It estimated the burden of 51 agents of infectious disease on the life and health of Ontarians. The second report, *Seven More Years: The Impact of Smoking, Alcohol, Diet, Physical Activity and Stress on Health and Life Expectancy in Ontario*, was published in April 2012.[8] It examined the role of various modifiable risk factors on the life expectancy of Ontarians. *Opening Eyes, Opening Minds*, the present study, is the final report of the series. It evaluates the burden of selected mental illnesses and addictions in Ontario.

**The objectives of this study are to:**

1. Determine the burden of disease related to mental illness and addictions in Ontario;

2. Inform priority setting, planning and decision-making;

3. Establish a baseline for future evaluation of interventions that impact on the burden of mental illness and addictions;

4. Engage those working in public health in Ontario in a discussion on how to promote positive mental health and prevent mental illness and addictions and their associated health and social harms;

5. Foster a dialogue between those working directly in mental health and public health on the mutual goal of promoting health and wellness for individuals with mental illness and addictions.

Across the health care sector, mental illness and addictions continue to be under-recognized and under-treated.[9] The public health sector in Ontario has not been as active in addressing the burden of mental illness and addictions as it has in responding to infectious diseases, and more recently, chronic diseases. This may be due in part to the historic separation between mental and physical illness and in part to the lack of attention that mental illness has received from society in general. Mental illness is often perceived as not preventable and, with a few exceptions, there has been neither the resources nor the mandate for public health agencies to work in the area of mental health. As our understanding of the burden of mental illness and addictions comes into focus, the case for a broad mental health promotion and mental illness and addictions prevention strategy becomes stronger. Measuring the burden of illness also provides valuable information for health systems planning and resource allocation to sustain effective treatment, support and secondary prevention programs.

# Methods

To compare the relative impacts of diseases/conditions on a population, a method is needed to quantify the burden of each condition using a summary measure of population health. The burden of disease method creates a composite measure that incorporates the burden of morbidity and mortality resulting from each disease, agent or condition.

An Expert Scientific Group of advisors with clinical and research expertise in mental illness and addictions (MI&A) reviewed the methods, data collected and results to ensure plausibility and clinical accuracy. In addition, a Stakeholder Advisory Group provided expertise and contextual insight from the mental health and public health fields in Ontario. Membership in the Stakeholder Advisory Group included frontline public health staff, practicing psychiatrists and researchers. This group also reviewed the methods and results, and was involved in formulating the messaging of the report.

The methods used in this report were adapted from the Ontario Burden of Infectious Disease Study (ONBOIDS),[7] which incorporated methods from the Global Burden of Disease (GBD) Study and the Population Health Impact of Disease in Canada (PHI) research program.[10,11]

## 2.1 DISEASE LIST AND INCLUSION/EXCLUSION CRITERIA

Only those mental illnesses and addictions highly prevalent in the Ontario population were considered for this study. However, the main criterion for inclusion was availability of appropriate data to calculate health-adjusted life years (HALYs). Thus, only conditions that could be readily identified using surveys (the Canadian Community Health Survey Cycle 1.2 or the CAMH Monitor) or health care utilization data were included. This means that some high-prevalence conditions such as anxiety (beyond social phobia and panic disorders) were not included in the study.

This study is not meant to provide a comprehensive measure of the burden of all MI&A in Ontario. It is a review of a group of selected mental illnesses and addictions that are both readily measured and highly prevalent (Exhibit 2.1). Furthermore, this study examined the burden from incident cases aged 18 to 64 years only, due to limited data measuring the incidence of MI&A in those younger than 18 years. Incident cases in those aged 65 years and older were excluded because the MI&A examined in this study are rarely seen to manifest in the elderly.[21] The methods used in this study also likely underestimated the mortality attributable to MI&A and do not account for the impact of comorbidity. For all these reasons, the burden estimates for MI&A in this study are conservative and do not reflect the total burden of MI&A in Ontario.

## 2.2 OUTCOME MEASURES

The health-adjusted life year (HALY) is the unit of measure used in this study. It is a composite health gap measure that allows for the simultaneous description of mortality and morbidity by incorporating deaths occurring before a pre-specified life expectancy (premature mortality) and the reduced functioning or suboptimal state of health associated with disabilities or diseases.

HALYs are made up of years of life lost due to premature mortality (YLL) and year-equivalents of reduced functioning due to disease or disability (YERF).

### Years of Life Lost Due to Premature Mortality (YLL)

YLL measures the years of life lost due to premature mortality (Equation 2.1). It is calculated for each condition by age group and sex. To obtain the YLL for each condition, the number of deaths in an age group and sex from a particular cause is multiplied by L, the standard loss function. L is the life expectancy of each age group and sex. The YLL for each age group is added to yield the YLL for each condition by sex.

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**Exhibit 2.1**

**Mental illnesses and addictions examined and their associated health states**

| MENTAL ILLNESS/ ADDICTION | HEALTH STATE |
|---|---|
| Agoraphobia | Mild, moderate, severe |
| Bipolar disorder | Mild, moderate, severe |
| Major depression | Mild, moderate, severe |
| Panic disorder | Overall |
| Schizophrenia | Overall |
| Social phobia | Mild, moderate, severe |
| Alcohol use disorders | Overall |
| Cocaine use disorders | Overall |
| Prescription opioid misuse | Overall |

---

**Equation 2.1:**

$$YLL_{c,a,s} = N_{c,a,s} * L_{a,s}$$

**Where:**

| | | |
|---|---|---|
| $N_{c,a,s}$ | = | number of deaths due to cause (c) for given age (a) and sex (s) |
| $L_{a,s}$ | = | standard loss function in years (life expectancy for the age and sex stratum) |

## Year-Equivalents of Reduced Functioning (YERF)

YERF measures the years of healthy life lost due to reduced functioning as a result of a disease or disability (Equation 2.2). The calculation of YERF for each condition required the following steps:

1. A detailed description of the natural history of each condition and its associated health states was created. (Each condition can have multiple health states.)

2. The data needed to calculate each element of YERF were identified and obtained.

   a) Incidence: The incidence of each condition was estimated using various sources (see Section 2.5 for details). The disease modelling software DisMod II was used to calculate age- and sex-specific incidence rates for conditions where they were not directly available. The incidence rates were calculated using prevalence, case fatality, background mortality and remission rates. Information on the distribution of incident cases by health state was collected from scientific literature.[12]

   b) Duration: DisMod II was used to estimate the duration using prevalence, case fatality, background mortality and remission rates. Duration estimates were age and sex specific.

   c) Severity weight: Severity weights were calculated for each health state. They were assumed to be uniform across age groups and by sex. The weights were determined by experts in the field using the Classification and Measurement System of Functional Health (CLAMES).[13] The CLAMES tool was developed for the PHI study. (See Appendix A for a description of how severity weights were ascertained.)

3. The YERF for each health state (for each age group and sex) was calculated by multiplying the incident cases by the severity weight and duration and then adding the YERF for the age groups and sexes within each health state.

4. The YERF for each condition was ascertained by adding the YERF from each health state associated with the condition.

**Equation 2.2:**

$$YERF_{c,h,a,s} = I_{c,h,a,s} * D_{c,h,a,s} * SW_{c,h}$$

**Where:**

| | | |
|---|---|---|
| $I_{c,h,a,s}$ | = | incident cases by cause ($c$), health state ($h$), age ($a$) and sex ($s$) |
| $D_{c,h,a,s}$ | = | average duration by cause ($c$), health state ($h$), age ($a$) and sex ($s$) |
| $SW_{c,h}$ | = | severity weight associated with health state |

## Health-Adjusted Life Years (HALYs)

HALYs for each condition were calculated by adding the YLL and YERF for the condition.

**Equation 2.3:**

$$HALY = YLL + YERF$$

The HALY measures future healthy years of life lost due to each incident case of disease in an average year. It is thus an incidence-based measure rather than a prevalence-based measure.

## Social Value Choices

The calculation of HALYs requires several social value choices (life expectancy, age weighting, discounting and severity weights). The main social value choices were made by the research team in collaboration with the Expert Scientific Group. Since the social value choices differed from traditionally calculated disability-adjusted life years (DALYs) (as seen in the GBD studies), we calculated DALYs in the sensitivity analyses where data for comparison was available. More details can be found in the DALY analysis in Appendix D.

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### 1. Life expectancy

Life expectancy is the number of years a person could be expected to live from a given age. As detailed in Equation 2.1, the calculation of YLL requires the definition of a standard loss function (L) that represents the average life expectancy for that age group and sex. The standard loss function, and subsequent calculation of YLL, will vary depending on the life expectancy measure used.

In the GBD study, the same predefined life expectancy (by age group and sex) was used for all countries. This was based on the highest attainable life expectancy at the time using the Coale and Demeny West Level 26 model life table.[14] For females, the highest life expectancy at birth was 82.5 years (the life expectancy for females in Japan). For males, a life expectancy at birth was assigned to be 80 years, based on what is thought to be the biological difference between the two sexes (2.5 years).

In this study, the 2001 life expectancy for the Ontario population (82.0 years for females and 77.4 years for males at birth) was used to account for the local demographic profile and to allow comparison with other Ontario burden of disease studies.[15]

### 2. Age weighting

Age weighting is applied in some studies because individuals have different roles and changing levels of dependency and productivity with age.

Therefore, it may be appropriate to consider valuing the time lived at a particular age unequally.[16] The use of age weighting is highly debated and the exact quantitative implementation is controversial[16]; ultimately, it was not used in the main analysis of this report.

### 3. Discounting

When the principle of discounting is applied, future years are assigned less value than those lived today. This is based on the economic concept that one prefers benefits now rather than in the future.[17] However, there are ethical and methodological issues related to discounting. Discounting is disputed because its application results in the apparent lower efficiency of prevention programs. As a result of this debate, studies often present both discounted and undiscounted results. Further, it is unknown if Canadians prefer having access to health benefits in the present as opposed to the future. As such, discounting was not used in this study's main analysis but was used in the calculation of DALYs (in Appendix D).

### 4. Severity weights

Severity weights (or health state valuations) quantify societal preferences for different health states. These weights do not represent the lived experience of any disability or health state. Rather they quantify societal preferences for health states in relation to the societal 'ideal' of optimal health.[18] The weights for HALY calculation are expressed on a scale from zero to one, with zero representing a state of optimal health and one representing a state equivalent to death.

Severity weights were developed based on standardized descriptions of disease states using the Classification and Measurement System of Function Health (CLAMES).[19] This methodology was previously developed as part of the PHI study for generating preference scores for the Canadian population.[13] It used the Standard Gamble methodology with predominantly lay panels (town hall meetings) to capture "society's preferences" for various marker conditions. The results were then used to develop a scoring algorithm. The CLAMES was used as the basic descriptor because its attributes better incorporate the impact of MI&A than other available tools.[18] For example, CLAMES includes attributes, such as emotional state, memory and thinking, social relationships and anxiety, that are important when defining the impact of MI&A.

### Disability-Adjusted Life Years (DALYs)

To assess the impact of using HALYs as opposed to DALYs for our study, we computed DALYs (incorporating age weighting, 3% discounting, standard GBD life expectancy and disability weights from previous studies) for the conditions where data were available. The results are found in Appendix D.

## 2.3 AGE GROUPS

In this study, we did not include incident cases among children under 18 years of age or adults aged 65 years and older. The primary data source for prevalence was the Canadian Community Health Survey Cycle 1.2—Mental Health Focus,[20] which only includes those aged 15 years and older. Incident cases in individuals aged 15 to 18 years were excluded because the sample size of the survey data for that age group is quite small. In addition, the CAMH Monitor only includes those 18 years and older. Incident cases among those aged 65 years and older were excluded because the MI&A examined in this study generally develop in young adulthood and are rarely seen to manifest in the elderly.[21]

The following age groups were used for YLL, YERF and HALY calculations: 18–24, 25–34, 35–44, 45–54, 55–64 and 65+.* Although attempts were made to obtain data stratified by these age groups, this was not always possible due to limitations in availability. In such cases, age groups were aggregated.

* In this incident-based methodology, we followed incident cases until death or recovery; thus, cases that developed in younger age groups may still have a burden past age 65 years.

## 2.4 TIME FRAME

Burden of disease studies generally identify a single year of study for which data are collected and estimates generated. These cases are then theoretically followed into the future to identify the health states they develop and to estimate when they die. In general, MI&A do not have substantial year-to-year variability[12,22]; however, we obtained average estimates across multiple years (whenever possible) to account for slight annual variations. As seen in Exhibit 2.2, we used the most current years of available data.

## 2.5 DATA SOURCES

The calculation of HALYs required information concerning mortality, disease incidence, health state distribution, health state duration, and severity weights associated with each health state. These estimates were collected from the following data sources.

### Exhibit 2.2
**Data sources by year**

| DATA SOURCE | YEAR(S) |
| --- | --- |
| CAMH Monitor | 2009 |
| Canadian Community Health Survey, Cycle 1.2 | 2002 |
| Health care utilization data from: <br>• Ontario Health Insurance Plan <br>• Canadian Institute for Health Information <br>  • Discharge Abstract Database <br>  • Same-Day Surgery Database <br>  • National Ambulatory Care Reporting System <br>  • Ontario Mental Health Reporting System | 2000–2010 |
| Vital statistics mortality data | 2005–2007 |
| National Epidemiologic Survey of Alcohol and Related Conditions (U.S.) | 2001–2005 |
| National Survey on Drug Use and Health (U.S.) | 2008 |

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The Census of Canada is administered in five-year intervals by Statistics Canada, which collects demographic and socio-economic data on the population.[23] Census data from 2001 for Ontario were used to create estimates of life expectancy for the population by the age groups specified in Section 2.3.

## Vital Statistics

The Ontario Office of the Registrar General collects mortality data from death certificates completed by physicians. In accordance with legal reporting requirements, registration of deaths is considered to be virtually complete with regard to the fact of death, but the accuracy of the cause of death is variable. Only a single cause of death (also called the underlying cause)—coded using the International Classification of Diseases, 10th Revision (ICD-10)—was available for this study. Unfortunately, unless a disease or condition is identified as the single underlying cause of death, its contribution to a death is not captured.

Mortality records for Ontario residents who died outside of the province are not available. We also excluded deaths of non-residents that occurred in Ontario. The codes used for extracting the mortality data are listed in Appendix B.

Biases in coding of deaths may lead to an under-reporting of deaths due to MI&A. For schizophrenia and bipolar disorder we were able to examine the risk of death in those with and without each condition. This analysis was not part of our main analysis, but served to supplement our knowledge on the risk of death in those with these conditions.

## Health Care Utilization Data

Health care utilization data (i.e., records of hospitalizations and emergency department visits, physician billing claims) were used to estimate the prevalence of bipolar disorder and the incidence of schizophrenia. In Ontario, all hospitalizations and medically necessary physician services are freely available under public health care insurance to nearly the entire resident population. New immigrants and migrants, as well as Canadians who have been out of the country for seven months or more, are not covered by Ontario's health insurance plan until three months after moving or returning to Ontario, so their burden may not be fully captured.

Health care utilization data were collected from several large validated databases. Data on hospitalizations and same-day surgeries were extracted from the Canadian Institute for Health Information's Discharge Abstract Database (CIHI–DAD) and Same-Day Surgery (CIHI–SDS) Database, which contain detailed information on diagnoses and procedures for all acute care hospitalizations and same-day surgeries, respectively. Diagnoses are identified using ICD-10 codes.

Data on visits to emergency departments were obtained from the National Ambulatory Care Reporting System (NACRS). Diagnoses in this dataset were identified using ICD-10 codes.

Data on physician visits were collected from the Ontario Health Insurance Plan (OHIP) physician billing claims database, which contains claims for outpatient clinic visits from approximately 98% of Ontario physicians. The diagnostic codes used in OHIP are generally similar to ICD-9 codes.

Data on hospitalizations in designated mental health beds were collected from the Ontario Mental Health Reporting System (OMHRS) using ICD-10 codes. A list of all ICD-10 and OHIP codes used in this study are listed in Appendix B. A unique identifier (encrypted health card number) allows for de-identified linkage of individuals across datasets.

## Canadian Community Health Survey Cycle 1.2

The Canadian Community Health Survey (CCHS) is a cross-sectional survey that collects information related to health status, health care utilization and health determinants for the Canadian population.[20] The content for Cycle 1.2 is partly based on a selection of mental disorders from the WMH–CIDI (World Mental Health—Composite International Diagnostic Interview

Instrument). The WMH–CIDI is a lay-administered psychiatric interview of patients aged 15 years and older that generates a profile of those with a disorder according to the definitions of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM–IV).[24]

Results from Ontario respondents were weighted to reflect the total Ontario population.

CCHS Cycle 1.2 was used to estimate prevalence rates for agoraphobia, major depression, panic disorder, social phobia, alcohol use disorders and cocaine use disorders.

## CAMH Monitor

The Centre for Addiction and Mental Health's CAMH Monitor is the longest ongoing representative survey of adult substance use in Canada.[25] The survey is based on the institutional experience of previous monitoring studies, including the Adult Drug Use series (1977–1991) and the Ontario Alcohol and Other Drugs Opinion Survey series (1992–1995). To enhance comparability, the CAMH Monitor has been designed to maintain many of the features of previous surveys. The survey is administered by the Institute for Social Research at York University.

The 2009 cycle of the CAMH Monitor was based on telephone interviews with 2,037 Ontario adults aged 18 years and older (response rate, 57% of those eligible).

The CAMH Monitor sample design employs a stratified (by six regional area codes), two-stage (telephone number; respondent) list-assisted, random digit dialing, rolling monthly probability selection procedure, which interviews English-speaking household residents of Ontario aged 18 years and older. For each calendar year, the 12 monthly non-overlapping samples are cumulated to provide a single annual data file.

In this study, the CAMH Monitor was used to estimate the prevalence of prescription opioid misuse.

## DisMod II

The disease modelling software program DisMod II was used to generate consistent estimates of epidemiological indicators (i.e., prevalence, incidence, remission rates and duration).[26] The model is described in Appendix C.

## National Epidemiologic Survey of Alcohol and Related Conditions (NESARC)

NESARC is a longitudinal survey with its first wave of interviews fielded in 2001–2002, followed by a second wave in 2004–2005. NESARC is a representative sample of the non-institutionalized U.S. population aged 18 years and older. The first-wave sample comprised 43,093 respondents.[27]

**NESARC collected data on:**

- demographic variables
- alcohol consumption
- alcohol abuse and dependence
- alcohol treatment utilization
- family history of alcoholism
- tobacco use and dependence
- medicine use
- drug abuse and dependence
- drug treatment utilization
- family history of drug abuse
- major depression
- family history of major depression
- dysthymia
- mania and hypomania
- panic disorder and agoraphobia
- social phobia
- specific phobia
- anxiety disorder
- personality disorders
- antisocial personality disorder
- family history of antisocial personality disorder
- pathological gambling
- medical conditions
- victimization.

20 | All diagnoses were established with the a priori-validated Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS) instrument.[28] Incidence, remission and duration data were obtained from the National Institute on Alcohol Abuse and Alcoholism using the standard definitions. Overall, the results of NESARC have been published in several hundred scientific papers.

NESARC utilizes a validated tool (the AUDADIS) for diagnosis and is a large population-based study undertaken in a developed nation similar to Canada. Thus, the results should be similar to what we would expect to find in Canada. For most mental illnesses, empirical estimates of prevalence, duration, case fatality and remission were obtained from NESARC.

### National Survey on Drug Use and Health (NSDUH)

The NSDUH provides national and state-level data on mental illnesses and the use of tobacco, alcohol and illicit drugs (including non-medical use of prescription drugs) in the United States. NSDUH is an annual, nationwide survey involving interviews with approximately 70,000 randomly selected individuals aged 12 years and older living in a random sample of households. A professional interviewer makes a personal visit to each one.[29]

### Evidence from Epidemiologic Studies

In order to calculate HALYs, estimates of the incidence of each health state are needed. The list of health states can be found in Exhibit 2.1. If the distribution of cases by health states was not empirically available, epidemiologic studies were used to supplement the data.

# Results and Interpretation

The mental illnesses and addictions (MI&As) selected for this report contributed to more than 600,000 health-adjusted life years (HALYs) lost in Ontario. This is an estimate of future HALYs lost resulting from incident cases of the selected MI&As in an average year.

22 As illustrated in Exhibit 3.1, the largest contributor to HALYs was major depression (more than 200,000), followed by bipolar disorder (more than 100,000) and alcohol use disorders (more than 80,000). The smallest contributor, among the conditions examined, was prescription opioid misuse; however, it is important to note that deaths due to this condition were not well captured by the mortality data sources (see Section 4.8 for details).

The vast majority of HALYs were due to YERF; YLL contributed 20,283 (3%) and YERF contributed 583,488 (97%) to overall HALYs. The only condition for which YLL had a significant contribution was alcohol use disorders, where it contributed 22% of HALYs.

**Exhibit 3.1**

**Health-adjusted life years (HALYs) lost for selected mental illnesses and addictions in Ontario, by years of life lost due to premature mortality (YLL) and year-equivalents of reduced functioning (YERF)**
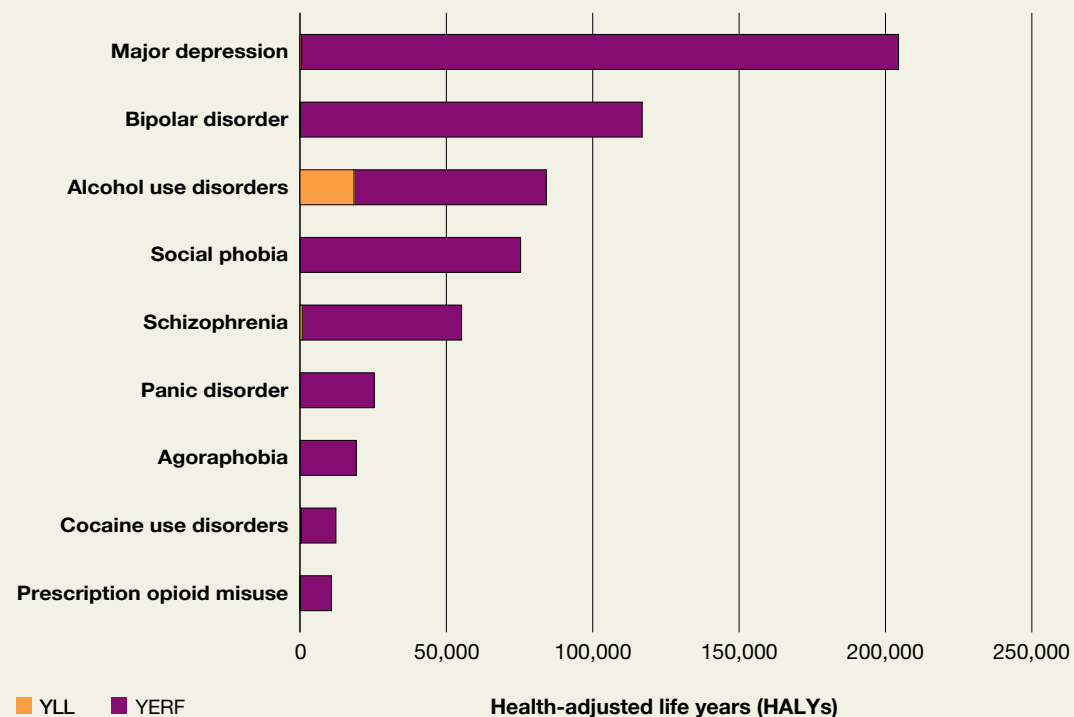
## 3.1 MORTALITY

Alcohol use disorders contributed to the greatest number of deaths (88% of total deaths) and in turn, YLL (91% of total YLL) of the conditions examined (Exhibit 3.2). Overall, YLL and number of deaths were directly correlated; however, there were exceptions. Major depression had a slightly higher average number of deaths than schizophrenia, but schizophrenia had almost twice as many YLL. Compared to major depression, deaths in those with schizophrenia occurred at younger ages, resulting in a greater number of future years of life lost (i.e., higher YLL). Likewise, 87% of deaths due to depression were among those aged 70 years and older, compared to 62% of deaths due to schizophrenia in that age group.

No deaths were attributed to panic disorder, social phobia or agoraphobia. Only two deaths were attributed to prescription opioid misuse, but this outcome is thought to be an under-report of the true mortality burden.[30] In the vital statistics data, only the 'underlying cause of death' is readily available. Because some conditions are more likely to be recorded than others, there are biases in how the data is coded. Investigators with the Ontario Drug Policy Research Network reported an average of 383 deaths per year between 2004 and 2006 where the level of opioid in the person's system was high enough to cause death.[30]

**Exhibit 3.2**

Number and proportion of deaths and years of life lost due to premature mortality (YLL) for selected mental illnesses and addictions in Ontario, by YLL ranking

| RANK | MENTAL ILLNESS/ ADDICTION | NUMBER OF YLL | PERCENTAGE OF YLL | AVERAGE NO. OF DEATHS PER YEAR (2005-2007) | PERCENTAGE OF TOTAL DEATHS |
|---|---|---|---|---|---|
| 1 | Alcohol use disorders | 18,465 | 91.0 | 762 | 88.0 |
| 2 | Schizophrenia | 787 | 3.9 | 41 | 4.7 |
| 3 | Major depression | 493 | 2.4 | 46 | 5.3 |
| 4 | Cocaine use disorders | 354 | 1.7 | 8 | 0.9 |
| 5 | Bipolar disorder | 107 | 0.5 | 6 | 0.7 |
| 6 | Prescription use disorders | 77 | 0.4 | 2 | 0.2 |
| 7 | Agoraphobia | 0 | 0.0 | 0 | 0.0 |
| 8 | Panic disorder | 0 | 0.0 | 0 | 0.0 |
| 9 | Social phobia | 0 | 0.0 | 0 | 0.0 |
| | **Total** | **20,283** | **100.0** | **865** | **100.0** |

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In addition, suicides in the reporting period were not redistributed to mental illnesses, as it would be difficult to determine the contribution of each MI&A to suicides.

## 3.2 MORBIDITY

Major depression contributed to the greatest number of YERF among the examined conditions and addictions. However, alcohol use disorders affected the greatest number of individuals, accounting for 42% of incident cases. The difference in ranking occurs because of how YERF is calculated using incidence, duration and severity weights. Major depression has a longer duration and higher severity weights (see Section 4.3 for details), which lead to a higher YERF. Similarly, panic disorder accounted for the second highest number of incident cases but was ranked sixth based on YERF because of its shorter duration and lower severity weight.

## 3.3 EFFECT OF GENDER

Overall, women contributed a greater number of total HALYs than did men: 320,739 HALYs and 283,033 HALYs, respectively. Further, women contributed a greater number of HALYs for each mental illness, with the exception of schizophrenia (Exhibit 3.4). The opposite was seen for the addictions examined. Compared to women, men contributed approximately 1.5 times the number of HALYs for both prescription opioid misuse and cocaine use

**Exhibit 3.3**

Number and proportion of incident cases and year-equivalents of reduced functioning (YERF) for selected mental illnesses and addictions in Ontario, by YERF ranking

| YERF RANK | MENTAL ILLNESS/ ADDICTION | NUMBER OF YERF | PERCENTAGE OF YERF | NUMBER OF INCIDENT CASES | PERCENTAGE OF TOTAL INCIDENT CASES |
|---|---|---|---|---|---|
| 1 | Major depression | 203,970 | 35.0 | 55,587 | 13.8 |
| 2 | Bipolar disorder | 116,814 | 20.0 | 42,231 | 10.5 |
| 3 | Social phobia | 75,368 | 12.9 | 20,091 | 5.0 |
| 4 | Alcohol use disorders | 65,734 | 11.3 | 168,834 | 42.0 |
| 5 | Schizophrenia | 54,409 | 9.3 | 5,735 | 1.4 |
| 6 | Panic disorder | 25,351 | 4.3 | 62,796 | 15.6 |
| 7 | Agoraphobia | 19,235 | 3.3 | 4,695 | 1.2 |
| 8 | Cocaine use disorders | 11,923 | 2.0 | 17,282 | 4.3 |
| 9 | Prescription opioid misuse | 10,684 | 1.8 | 24,308 | 6.1 |
| | **Total** | **583,488** | **100.0** | **401,559** | **100.0** |

**Exhibit 3.4**

Health-adjusted life years (HALYs) lost for selected mental illnesses and addictions among Ontario men and women

**Health-adjusted life years (HALYs)**



Legend: ■ MEN  ■ WOMEN  ● TOTAL
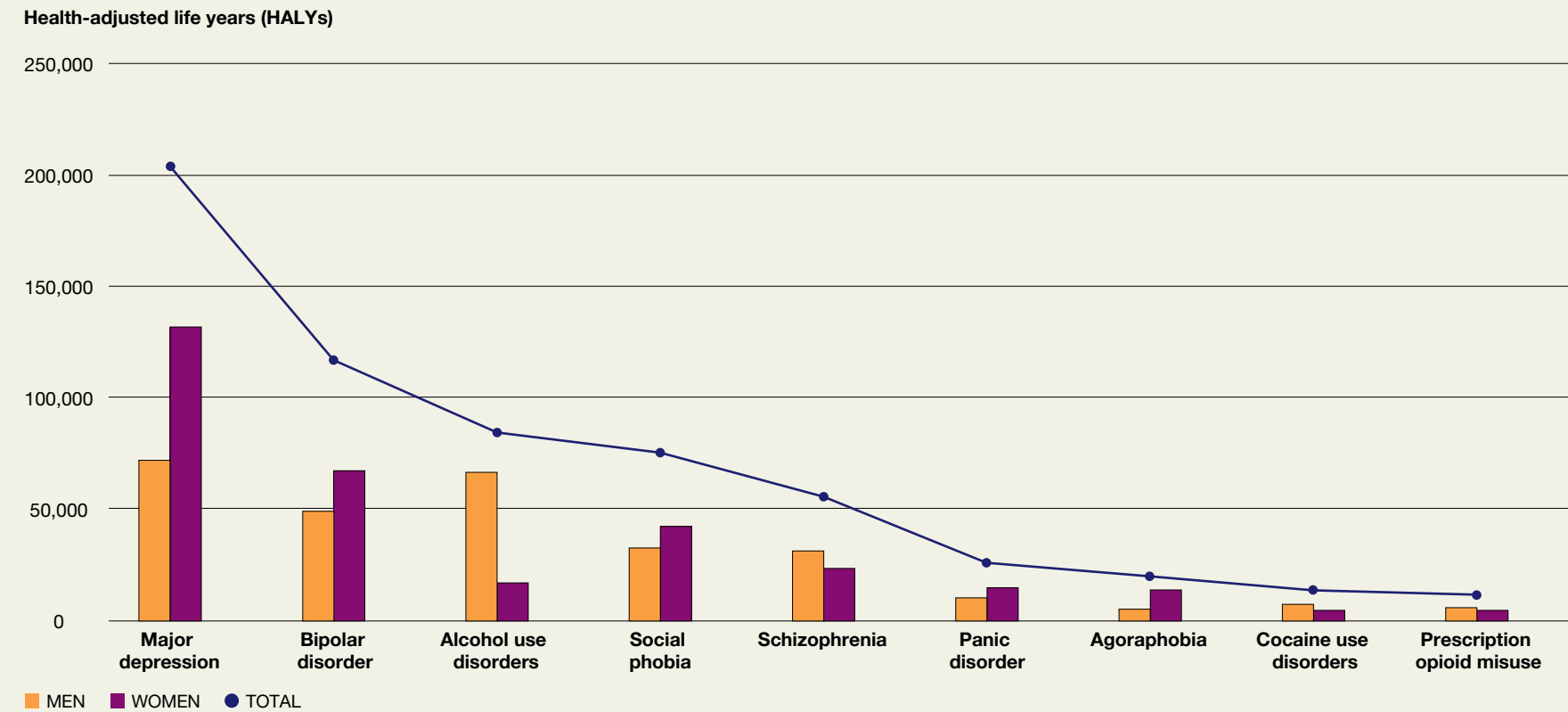
26

disorders. For alcohol use disorders, men contributed more than three times the number of HALYs as women did.

One would expect a slightly higher contribution of women to HALYs, as their life expectancy is higher. However, life expectancy has an impact on YLL rather than YERF. For the conditions examined, YERF was the predominant factor contributing to HALYs, and the differences between the sexes were due primarily to differences in incidence rather than duration or severity weight (see Exhibit 3.1).

Although the magnitude of HALYs (YLL and YERF) for MI&A was different for men and women, the rankings were similar. The most notable differences were the higher number of HALYs related to depression in women and to alcohol use disorders in men (Exhibits 3.5 and 3.6).

### 3.4 EFFECT OF AGE

The burden related to MI&A as a function of age is presented in Exhibit 3.7. In general, there appears to be a decline in burden with increasing age. This results in the greatest overall burden from incident cases in those aged 18 to 24 years and the lowest burden in those aged 55 years and older. Bipolar disorder had the greatest impact in the 35- to 44-year age group.

**Exhibit 3.5**

**Number of deaths, years of life lost due to premature mortality (YLL), year-equivalents of reduced functioning (YERF) and health-adjusted life years (HALYs) lost for selected mental illnesses and addictions among Ontario men**

| MENTAL ILLNESS/ ADDICTION | DEATHS | YLL | INCIDENT CASES | YERF | HALYS |
|---|---|---|---|---|---|
| Major depression | 15 | 174 | 19,316 | 72,377 | 72,551 |
| Alcohol use disorders | 573 | 13,263 | 138,368 | 53,854 | 67,117 |
| Social phobia | 0 | 0 | 9,055 | 32,968 | 32,968 |
| Bipolar disorder | 1 | 19 | 16,834 | 49,484 | 49,503 |
| Schizophrenia | 17 | 400 | 3,264 | 31,213 | 31,613 |
| Panic disorder | 0 | 0 | 21,276 | 10,443 | 10,443 |
| Cocaine use disorders | 6 | 244 | 10,071 | 7,275 | 7,519 |
| Prescription opioid misuse | 1 | 50 | 13,555 | 5,953 | 6,003 |
| Agoraphobia | 0 | 0 | 1,465 | 5,316 | 5,316 |
| **Total** | **613** | **14,150** | **233,204** | **268,883** | **283,033** |

**Exhibit 3.6**

Number of deaths, years of life lost due to premature mortality (YLL), year-equivalents of reduced functioning (YERF) and health-adjusted life years (HALYs) lost for selected mental illnesses and addictions among Ontario women

| MENTAL ILLNESS/ ADDICTION | DEATHS | YLL | INCIDENT CASES | YERF | HALYS |
|---|---|---|---|---|---|
| Major depression | 31 | 319 | 36,271 | 131,593 | 131,912 |
| Bipolar disorder | 5 | 88 | 25,397 | 67,330 | 67,417 |
| Social phobia | 0 | 0 | 11,036 | 42,400 | 42,400 |
| Schizophrenia | 25 | 387 | 2,471 | 23,196 | 23,583 |
| Alcohol use disorders | 190 | 5,202 | 30,466 | 11,880 | 17,082 |
| Panic disorder | 0 | 0 | 41,521 | 14,908 | 14,908 |
| Agoraphobia | 0 | 0 | 3,230 | 13,919 | 13,919 |
| Cocaine use disorders | 2 | 110 | 7,211 | 4,648 | 4,759 |
| Prescription opioid misuse | 1 | 27 | 10,753 | 4,731 | 4,759 |
| **Total** | **254** | **6,133** | **165,126** | **314,605** | **320,739** |

## 3.5 COMPARING THE BURDEN OF MENTAL ILLNESS AND ADDICTION IN ONTARIO TO OTHER BURDEN OF DISEASE STUDIES IN CANADA

Both the Ontario Burden of Infectious Disease Study (ONBOIDS) and the Population Health Impact of Disease in Canada (PHI) research program calculated HALYs using methods similar to this study. However, the PHI results, which were based on the burden of cancer in Canada in 2001, were national.[11] To compare these results to this study, the Ontario-specific results were estimated by adjusting the PHI-reported HALYs to reflect the proportion of the Canadian population living in Ontario (40%).

In Exhibit 3.8, YLL and YERF resulting from MI&A are compared to results from other provincial burden of disease studies. Overall, incident MI&A in an average year accounted for over 600,000 future HALYs lost. The PHI group estimated 905,000 HALYs attributable to cancers diagnosed in 2001 in Canada,[11] of which approximately 362,000 HALYs were attributable to Ontario. The conditions that were examined in the present study account for more than 1.5 times the burden of all cancers in a similar reporting period. The burden of lung cancer, the largest contributor to HALYs among the cancers examined, resulted in approximately the same number of HALYs as alcohol use disorders.

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## Exhibit 3.7

Health-adjusted life years (HALYs) lost for selected mental illnesses and addictions in Ontario, by age group

**Health-adjusted life years (HALYs)**



Age group

- Schizophrenia
- Bipolar disorder
- Agoraphobia
- Panic disorder
- Social phobia
- Depression
- Alcohol use disorders
- Prescription opioid misuse
- Cocaine use disorders
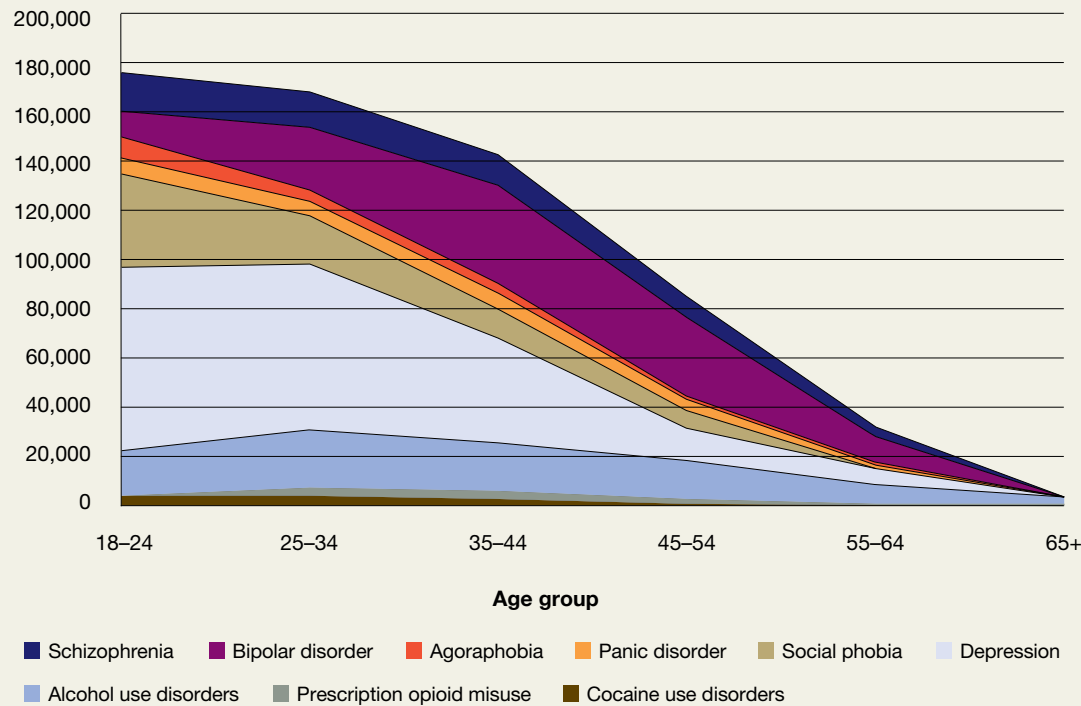
The top five infectious diseases shown in Exhibit 3.8 account for fewer HALYs than any of the MI&As examined. The (more than 51) infectious agents examined in ONBOIDS accounted for approximately 85,000 HALYs, equivalent to the HALYs from social phobia alone. Major depression, the largest contributor, accounted for over 200,000 HALYs.

Compared to cancers and infectious diseases, it is clear that there is a significant burden associated with MI&A in Ontario. As shown in Exhibit 3.8, unlike cancers and infectious diseases where mortality contributes significantly to overall HALYs, mortality plays a minor role in the burden of MI&A; the burden is primarily due to the duration and incidence of MI&A. Health states associated with various cancers and infectious diseases may be more severe and have higher mortality rates but do not usually have the high incidence and long durations found in MI&A. For instance, in comparing terminal AIDS and severe depression, the former has a higher severity weight (0.801 vs. 0.558) and a higher mortality rate.[7] However, severe depression accounts for almost 17,000 incident cases per year, while terminal AIDS contributes just over 300. This difference results in a much higher burden of illness associated with severe depression. The same comparison can be made for most of the cancers and infectious diseases examined.

**Exhibit 3.8**

Health-adjusted life years (HALYs) lost for selected mental illnesses, addictions, cancers and infectious diseases in Ontario, by years of life lost to premature mortality (YLL) and year-equivalents of reduced functioning (YERF)



Legend: ■ YLL ■ YERF

Health-adjusted life years (HALYs)
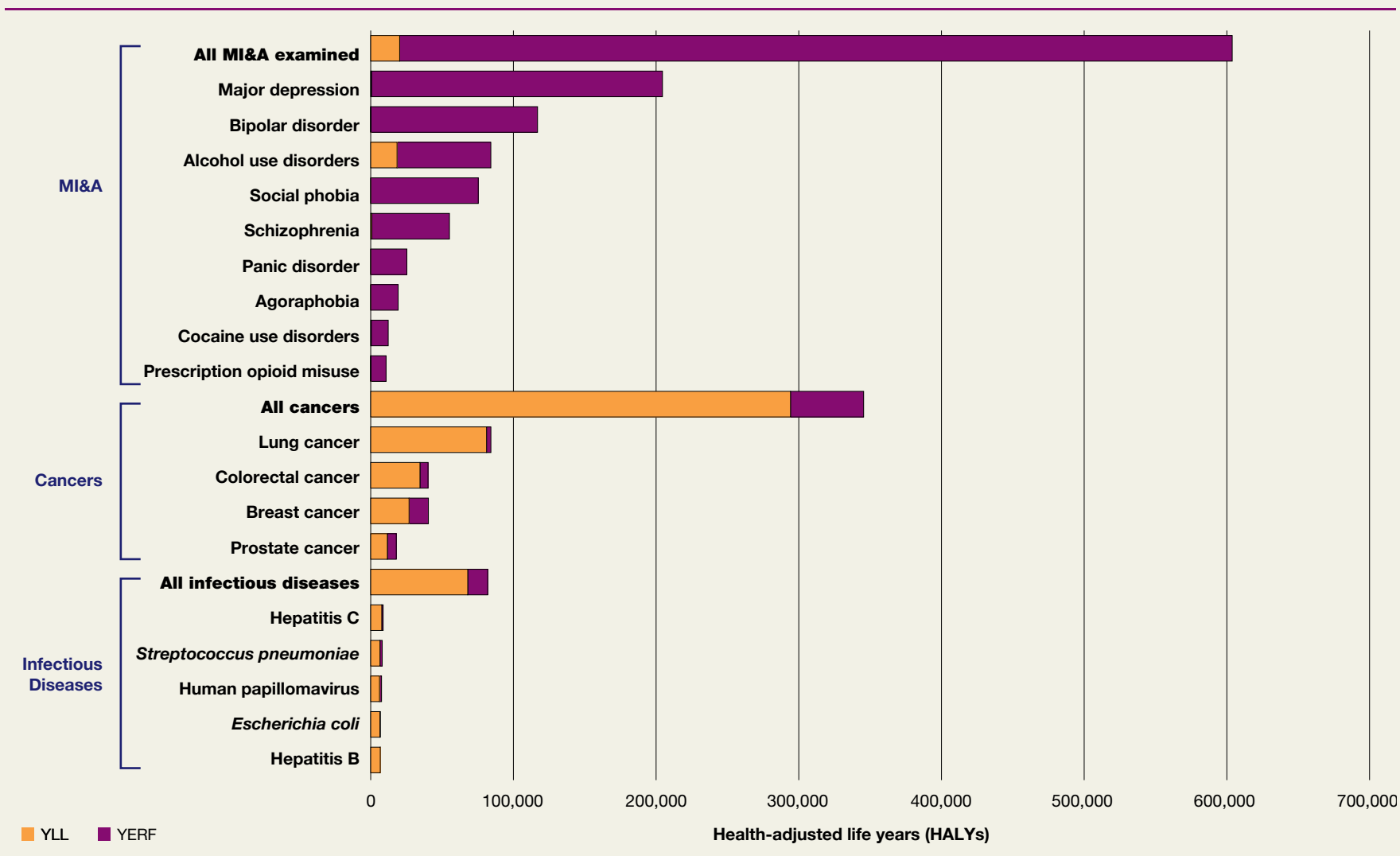
# Specific Methods and Results by Mental Illness and Addiction

To simplify presentation of the main methods and findings, methods and results by specific conditions are provided separately.

## 4.1 AGORAPHOBIA

Agoraphobia is an anxiety disorder characterized by a fear of being in an open space or situation from which it may be difficult to escape. Individuals who suffer from agoraphobia often avoid leaving their living environments. Agoraphobia is a common co-occurring condition with panic disorder.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** Vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 code (F40.0 for agoraphobia) was listed as the underlying cause of death. No deaths were attributed to agoraphobia in the time frame examined.

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Cases of agoraphobia were categorized as mild, moderate and severe. Distribution of cases among health states was determined by Kessler et al. as: mild, 28.7%; moderate, 30.7%; and severe, 40.6%.[12]

**Exhibit 4.1**

**Health-adjusted life years (HALYs) lost due to agoraphobia in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 5,770 | 3,121 | 8,891 |
| 25–34 | 3,650 | 869 | 4,519 |
| 35–44 | 3,172 | 863 | 4,035 |
| 45–54 | 1,127 | 377 | 1,504 |
| 55–64 | 200 | 86 | 286 |
| 65+ | 0 | 0 | 0 |
| **Total HALYs** | **13,919** | **5,316** | **19,235** |

Kessler's population-based survey used the same diagnostic tool as the Canadian Community Health Survey Cycle 1.2 (used to obtain prevalence estimates): the World Mental Health Survey Initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (WMH-CIDI).[12]

**Age groups/** Only incident cases in those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of agoraphobia was measured using the Canadian Community Health Survey Cycle 1.2.[20] The prevalence data were converted into incidence estimates using DisMod II (see Appendix C for details). In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions, 2001 to 2005.[27] The 2005 Ontario population was used to standardize the incidence rates across conditions. Among those aged 18 to 64 years, the average number of incident cases of agoraphobia per year totalled 3,230 among women and 1,465 among men.

32 | **Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration of agoraphobia was not health state-specific. The duration ranged from 15 to 22 years in women and from 13 to 19 years in men.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. Utility weights were converted to severity weights. The severity weights for agoraphobia were: mild, 0.127; moderate, 0.190; and severe, 0.366.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.1, the burden of agoraphobia among women was almost triple that of men: 13,919 HALYs and 5,316 HALYs, respectively. The burden was highest in young adults and decreased with increasing age.

## 4.2 BIPOLAR DISORDER

A first presentation of either a manic (type 1) or hypomanic (type 2) episode is required for a diagnosis of bipolar disorder. Manic episodes are associated with grandiose thoughts that can become delusional in intensity, a decreased need for sleep, an increased energy level, rapid speech and thought patterns, increased irritability, a heightened level of activity (e.g., taking on a large number of projects/goals) and an increase in impulsive or risky behavior. Individuals with bipolar disorder can experience both manic/hypomanic episodes and depressive episodes (see Section 4.3 on major depression for characteristics).[24]

**Exhibit 4.2**

**Health-adjusted life years (HALYs) lost due to bipolar disorder in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 2,309 | 8,039 | 10,348 |
| 25–34 | 12,189 | 13,107 | 25,296 |
| 35–44 | 21,399 | 17,955 | 39,354 |
| 45–54 | 21,895 | 9,522 | 31,417 |
| 55–64 | 9,582 | 871 | 10,453 |
| 65+ | 43 | 9 | 52 |
| **Total HALYs** | **67,417** | **49,503** | **116,921** |

## Data Sources and HALY Calculation

### Years of Life Lost Due to Premature Mortality (YLL)

**Mortality/** Vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 codes (F30, F31 for bipolar disorder) were listed as the underlying cause of death. There was an average of 6 deaths per year (5 among women and 1 among men) in the time frame examined.

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

### Year-Equivalents of Reduced Functioning (YERF)

**Health states/** Cases of bipolar disorder were categorized as mild, moderate or severe. Distribution of cases among health states was determined by Kessler et al.[12] as follows: mild, 0%; moderate, 17.1%; and severe, 82.9%.

Kessler's population-based survey used the World Mental Health Survey Initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (WMH-CIDI).[12]

**Age groups/** Only incident cases among those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of bipolar disorder was measured using health care utilization data. Ontarians were considered to have bipolar disorder if they had a single health care interaction in the hospitalization data (CIHI-DAD or OMHRS) or ambulatory visit data (NACRS) or at least two physician billings (OHIP) within two years for

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bipolar disorder (see Appendix B for details on diagnostic codes used). A detailed description of the health administrative databases is provided in the Methods section.

The prevalence data were converted into incidence estimates using DisMod II (see Appendix C for details). In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions, 2001 to 2005. The 2005 Ontario population was used to standardize incidence rates across conditions. Among those aged 18 to 64 years, the average number of incident cases of bipolar disorder per year totalled 25,397 among women and 16,833 among men.

**Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration of bipolar disorder was not health state-specific. The duration ranged from 2 to 13 years in women and from 3 to 12 years in men.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES). See Appendix A for details. These were then converted to severity weights. The severity weights for bipolar disorder are the same as those for major depression as the functional limitations resulting from bipolar disorder are due to the depressive episodes. The severity weights were: mild, 0.122; moderate, 0.439; and severe, 0.558.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.2, the burden of bipolar disorder among women was greater than among men: 67,417 HALYs and 49,503 HALYs, respectively. The burden peaked in those aged 35 to 44 years and was lower in younger and older adults.

## 4.3 MAJOR DEPRESSION

Major depression is a common mental illness. Depressive episodes are characterized by a depressed/sad mood, loss of interest, reduced or excessive sleep, loss of energy, anhedonia, impaired concentration, slowed thoughts and motor activity, low motivation and suicidal thoughts.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 codes (F32, F33 for major depression) were listed as the underlying cause of death. There was an average of 46 deaths per year in the time period examined (31 among women, 15 among men).

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Cases of major depression were categorized as mild, moderate or severe. The distribution of cases by health state was determined by Kessler et al.[12] as follows: mild, 19.5%; moderate, 50.1%; and serious, 30.4%.

**Exhibit 4.3**

**Health-adjusted life years (HALYs) lost due to major depression in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 50,296 | 23,652 | 73,948 |
| 25–34 | 43,339 | 23,621 | 66,960 |
| 35–44 | 24,914 | 18,326 | 43,240 |
| 45–54 | 8,989 | 4,915 | 13,904 |
| 55–64 | 4,129 | 1,946 | 6,075 |
| 65+ | 245 | 91 | 336 |
| **Total HALYs** | **131,912** | **72,551** | **204,463** |

Kessler's population-based survey used the same diagnostic tool as the Canadian Community Health Survey Cycle 1.2: the World Mental Health Survey Initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (WMH-CIDI).[12]

**Age groups/** Only incident cases in those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood,[21,31] those aged 65 years and older were excluded.

**Incidence/** The prevalence of major depression was measured using the Canadian Community Health Survey Cycle 1.2.[20] The prevalence data were converted into incidence estimates using DisMod II. In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), 2001 to 2005.[27] The 2005 Ontario population was used to standardize the incidence rates across conditions. Among those aged 18 to 64 years, the average number of incident cases of major depression per year totalled 36,271 among women and 19,316 among men.

**Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration of major depression was not health state-specific. The duration ranged from 6 to 15 years in women and from 6 to 14 years in men.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weights were: mild, 0.122; moderate, 0.439; and severe, 0.559.

### Health-Adjusted Life Years (HALYs)

HALYs were calculated for each health state and then combined to obtain the overall HALY. As shown in Exhibit 4.3, the burden of major depression in women was almost double that of men: 131,912 HALYs and 72,551 HALYs, respectively. The burden was highest in young adults and decreased with age.

## 4.4 PANIC DISORDER

Panic disorder occurs when individuals have severe, recurrent panic attacks characterized by a cluster of physical and psychological symptoms, such as intense fear of dying, having a heart attack or "losing one's mind," as well as heart palpitations, nausea, tremulousness and sweatiness. The panic attacks associated with panic disorder are typically unpredictable, which leads to changes in behavior, such as avoidance of a variety of activities. These changes in behavior can be disabling. Panic disorder is often, but not always, associated with agoraphobia.[24]

**Exhibit 4.4**

**Health-adjusted life years (HALYs) lost due to panic disorder in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 4,254 | 2,147 | 6,401 |
| 25–34 | 4,125 | 2,056 | 6,181 |
| 35–44 | 3,402 | 3,139 | 6,541 |
| 45–54 | 2,059 | 2,275 | 4,334 |
| 55–64 | 1,068 | 826 | 1,894 |
| 65+ | 0 | 0 | 0 |
| **Total HALYs** | **14,908** | **10,443** | **25,351** |

### Data Sources and HALY Calculation

### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 code (F41.0 for panic disorder) was listed as the underlying cause of death. There were no deaths attributed to panic disorder in the time frame examined.

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Panic disorder was not broken down into health states, but rather considered as a whole.

**Age groups/** Only incident cases among those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of panic disorder was measured using the Canadian Community Health Survey Cycle 1.2.[20] The prevalence data was converted into incidence estimates using DisMod II (see Appendix C). In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions, 2001 to 2005.[27] The 2005 Ontario population was used to standardize the incidence rates across conditions. Among those aged 18 to 64 years, the average number of incident cases of panic disorder per year was 41,521 for women and 21,276 for men.

38 | **Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration for panic disorder ranged from 1.3 to 2.5 years in women and from 1.2 to 5.1 years in men.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weight for panic disorder was 0.19.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.4, the burden of panic disorder was greater among women than men (14,908 HALYs and 10,443 HALYs, respectively). The burden was fairly consistent from ages 18 to 44 years and then declined with increasing age.

## 4.5 SCHIZOPHRENIA

Schizophrenia is a chronic, severe mental illness. The age of onset is typically in the late teenage years for males and in the mid-twenties for females. Individuals with schizophrenia can suffer from "positive symptoms," such as hallucinations, delusions and disordered thought or speech, as well as "negative symptoms," including deficits in motivation, ability to experience pleasure, interest in social relationships and poverty of speech.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 codes (F20, F259 for schizophrenia) were listed as the underlying cause of death. In the time period examined, the average number of deaths per year was 41 (25 women and 16 men).

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

**Exhibit 4.5**

**Health-adjusted life years (HALYs) lost due to schizophrenia in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 4,376 | 11,073 | 15,449 |
| 25–34 | 5,806 | 8,436 | 14,242 |
| 35–44 | 6,039 | 6,473 | 12,512 |
| 45–54 | 4,692 | 3,898 | 8,590 |
| 55–64 | 2,469 | 1,625 | 4,094 |
| 65+ | 201 | 108 | 309 |
| **Total HALYs** | **23,583** | **31,613** | **55,196** |

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Schizophrenia was not broken down into health states but rather considered as a whole, as the vast majority of cases are paranoid schizophrenia.

**Age groups/** Only incident cases among those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** A cohort of those with schizophrenia was created using health care utilization data. Ontarians were considered to have schizophrenia if they had a single health care interaction in the hospitalization data (CIHI–DAD, OMHRS) or ambulatory visit data (NACRS) or at least two physician billings (OHIP) within two years for schizophrenia (see Appendix B for details on codes used). A detailed description of the health administrative databases is provided in the Methods section. A look-back window of two years was applied to each data source to exclude cases that first appeared in our data holdings within the first two years of data collection. This helped to ensure that the cases included were incident

cases and not just prevalent cases. The 2005 Ontario population was used to standardize incidence rates across conditions. Among patients aged 18 to 64 years, the number of incident cases of schizophrenia per year averaged 2,470 for women and 3,264 for men.

**Duration/** Schizophrenia, unlike the other conditions examined in this study, is lifelong. However, it does have an impact on an individual's life expectancy. Hennekens et al. found that those with schizophrenia had a 20% shorter life expectancy compared to the general population.[32] The adjusted life expectancy was used to determine the duration of illness.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weight for schizophrenia was 0.25.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.5, the burden of schizophrenia in men was larger than in women: 31,613 HALYs and 23,583 HALYs, respectively. The burden was highest in young adults and decreased with age.

## 4.6 SOCIAL PHOBIA

Individuals with social phobia have an irrational fear of being scrutinized or humiliated in public. These individuals often describe the onset of panic attacks at the thought of speaking publically or meeting new people. The avoidance of situations that cause anxiety is a cause of significant impairment.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 code (F40.1 for social phobia) was listed as the underlying cause of death. There were no deaths attributed to social phobia in the time frame examined.

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Social phobia was not broken down into health states but considered as a whole.

**Exhibit 4.6**

**Health-adjusted life years (HALYs) lost due to social phobia in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 19,853 | 17,521 | 37,374 |
| 25–34 | 11,434 | 7,706 | 19,140 |
| 35–44 | 5,667 | 5,523 | 11,190 |
| 45–54 | 5,030 | 2,188 | 7,218 |
| 55–64 | 416 | 30 | 446 |
| 65+ | 0 | 0 | 0 |
| **Total HALYs** | **42,400** | **32,968** | **75,368** |

**Age groups/** Only incident cases in those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of social phobia was measured using the Canadian Community Health Survey Cycle 1.2.[20] The prevalence data were converted into incidence estimates using DisMod II (see Appendix C for details). In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions, 2001 to 2005.[27] The 2005 Ontario population was used to standardize the incidence rates across conditions. Among those aged 18 to 64 years, the number of incident cases of social phobia per year averaged 11,036 among women and 9,055 among men.

**Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration ranged from 14 to 21 years in women and from 11 to 18 years in men.

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**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weight for social phobia was 0.229.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.6, the burden of social phobia was higher among women than men at 42,400 HALYs and 32,968 HALYs, respectively. The burden was highest in young adults and decreased with age.

## 4.7 ALCOHOL USE DISORDERS

Alcohol use disorders are a general category of disorders that captures a range of problematic alcohol use. Alcohol abuse is characterized by problematic behaviours, such as an inability to fulfill work/school obligations, difficulties with interpersonal relationships, drinking in dangerous situations (e.g., drinking and driving) or legal problems, all related to alcohol use. Alcohol dependence is characterized by physiological dependence—the development of tolerance (requiring larger quantities of alcohol to become inebriated) and withdrawal symptoms (a characteristic set of symptoms including alcohol withdrawal seizures in the extreme when an individual stops drinking) with persistent and high-volume alcohol intake.[24]

### Data Sources and HALY Calculation

#### Years of Life Lost Due to Premature Mortality (YLL)

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 codes (F10 for conditions related to alcohol use and K70 for alcoholic liver disease) were listed as the underlying cause of death. In total, 763 deaths were attributed to alcohol use disorders: 190 among women and 573 among men.

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for women and 77.4 years for men.[15]

**Exhibit 4.7**

**Health-adjusted life years (HALYs) lost due to alcohol use disorders in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 3,444 | 13,622 | 17,066 |
| 25–34 | 4,412 | 18,360 | 22,772 |
| 35–44 | 3,579 | 14,789 | 18,368 |
| 45–54 | 2,853 | 11,723 | 14,576 |
| 55–64 | 1,848 | 5,810 | 7,658 |
| 65+ | 946 | 2,813 | 3,759 |
| **Total HALYs** | **17,082** | **67,117** | **84,199** |

### Year-Equivalents of Reduced Functioning (YERF)

**Health states/** Alcohol use disorders were broken down into the following health states of alcohol dependence using proportions obtained from Harris and Barraclough[33]: low to medium, 85%; and severe, 15%.

**Age groups/** Only incident cases in those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset that appears primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of alcohol use disorders was measured using the Canadian Community Health Survey Cycle 1.2.[20] Prevalence data were converted into incidence estimates using DisMod II (see Appendix C for details). In addition to the prevalence data, background mortality, remission rates and case fatality rates were needed. Both remission rates and case fatality rates were obtained from the National Epidemiologic Survey on Alcohol and Related Conditions, 2001 to 2005.[27] The 2005 Ontario population was used to standardize incidence rates across conditions. Among those aged 18 to 64 years, the number of incident cases of alcohol use disorders per year averaged 30,466 for women and 138,368 for men.

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**Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration ranged from 1.5 to 2 years for both sexes.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weights for alcohol use disorders were: low to medium, 0.187; and severe, 0.252.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.7, the burden of alcohol use disorders among women was approximately one-third that of men: 17,082 HALYs and 67,117 HALYs, respectively. The burden was highest in young adults and decreased with age.

## 4.8 COCAINE USE DISORDERS

Cocaine use disorders are a category of disorders that capture a range of dependence. Cocaine use often includes: substance abuse; continuation of use despite related problems; increase in tolerance (more of the drug is needed to achieve the same effect); and withdrawal symptoms. The prognosis is variable. Cocaine use disorders is difficult to treat and often involves a cycle of abstinence from the substance and substance use.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 code (F14 for conditions related to cocaine use) was listed as the underlying cause of death. There was an average of 8 deaths per year in the time frame examined (2 among women and 6 among men).

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

**Exhibit 4.8**

**Health-adjusted life years (HALYs) lost due to cocaine use disorders in Ontario, by age group and sex**

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 1,701 | 2,195 | 3,896 |
| 25–34 | 1,805 | 2,700 | 4,505 |
| 35–44 | 899 | 1,829 | 2,728 |
| 45–54 | 281 | 537 | 818 |
| 55–64 | 73 | 258 | 331 |
| 65+ | 0 | 0 | 0 |
| **Total HALYs** | **4,759** | **7,519** | **12,278** |

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Cocaine use disorders were not broken down into health states but considered as a whole.

**Age groups/** Only incident cases in those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of cocaine use disorders was measured using the Canadian Community Health Survey Cycle 1.2.[20] The prevalence data were converted into incidence estimates using DisMod II. In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Both remission rates and case fatality rates were obtained from the 2008 National Survey on Drug Use and Health.[29] The 2005 Ontario population was used to standardize the incidence rates across conditions. Among those aged 18 to 64 years, the average number of incident cases of cocaine use disorders per year was 7,211 among women and 10,071 among men.

46 | **Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration ranged from 2.5 to 3.5 years among women and from 2.0 to 2.5 years among men.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weight for cocaine use disorders was 0.31.

### Health-Adjusted Life Years (HALYs)

As shown in Exhibit 4.8, the burden of cocaine use disorders in women was approximately two-thirds that of men: 4,759 HALYs and 7,519 HALYs, respectively. The burden was highest in young adults and decreased with age.

## 4.9 PRESCRIPTION OPIOID MISUSE

Prescription opioid misuse is a special category of addiction. Over the past decade, prescription opioids have become more prevalent and are now a much more common indication for methadone treatment than heroin use.[24]

### Data Sources and HALY Calculation

#### *Years of Life Lost Due to Premature Mortality (YLL)*

**Mortality/** The vital statistics data from 2005 to 2007 were examined to identify deaths where the relevant ICD-10 code (F11 for opioid misuse) was listed as the underlying cause of death. There was an average of 2.0 deaths per year in the time frame examined (0.7 among women and 1.3 among men). Data from an alternative source, the Ontario Drug Policy Research Network (ODPRN), suggest this is a substantial underestimate of the number of actual deaths resulting from prescription opioid misuse. According to ODPRN researchers, from 2004 to 2006 an annual average of more than 350 deaths were opioid-related (i.e., levels of prescription opioids in patients' systems were high enough to lead to overdose and subsequently death).[30]

**Life expectancy/** Calculated using the 2001 Ontario life tables, life expectancy at birth was 82.0 years for females and 77.4 years for males.[15]

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**Exhibit 4.9**

Health-adjusted life years (HALYs) lost due to prescription opioid misuse in Ontario, by age group and sex

| AGE GROUP (YEARS) | WOMEN | MEN | TOTAL |
|---|---|---|---|
| 18–24 | 491 | 628 | 1,119 |
| 25–34 | 1,360 | 1,707 | 3,067 |
| 35–44 | 1,557 | 1,995 | 3,552 |
| 45–54 | 965 | 1,204 | 2,169 |
| 55–64 | 386 | 469 | 855 |
| 65+ | 0 | 0 | 0 |
| **Total HALYs** | **4,759** | **6,003** | **10,762** |

#### *Year-Equivalents of Reduced Functioning (YERF)*

**Health states/** Prescription opioid misuse was not broken down into health states but considered as a whole.

**Age groups/** Only incident cases among those aged 18 to 64 years were included in our analysis. The groups were then followed until death or remission. The data for children were not available, and because the conditions examined have an onset primarily in early adulthood, those aged 65 years and older were excluded.[21,31]

**Incidence/** The prevalence of prescription opioid misuse was measured using the CAMH Monitor.[25] The prevalence data were converted into incidence estimates using DisMod II. In addition to the prevalence data, remission rates, case fatality rates and background mortality were needed. Remission rates and case fatality rates were obtained from the 2008 National Survey on Drug Use and Health.[29] The 2005 Ontario population was used to standardize incidence rates across conditions. Among those aged 18 to 64 years, the number of incident cases of prescription opioid misuse per year averaged 10,753 for women and 13,555 for men.

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**Duration/** Duration estimates were obtained by age group and sex using DisMod II and the sources described above. The duration for both men and women across age groups was approximately two years.

**Severity weights/** Utility weights were developed using the Classification and Measurement System of Functional Health (CLAMES).[13] See Appendix A for details. These were then converted to severity weights. The severity weight for prescription opioid misuse was 0.225.

### Health-Adjusted Life Years (HALYs)

As depicted in Exhibit 4.9, the burden of prescription opioid misuse among women was lower than among men: 4,759 HALYs and 6,003 HALYs, respectively. The burden was highest in adults aged 25 to 44 years.

# Discussion

Burden of disease information is essential for optimal health systems planning and resource allocation. Beyond the health sector, this information can help to guide priority setting and consideration of mental illness and addictions in public policy. Estimating the burden of disease gives insight into the magnitude by which Ontarians are affected by specific health conditions. It can provide the impetus for the implementation of interventions demonstrated to be effective, as well as guide research to identify promising new interventions.

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This study estimates that the burden of disease in Ontario arising from the mental illnesses and addictions examined totals more than 600,000 health-adjusted life years (HALYs). Although high, this estimate represents only a portion of the total burden of mental illness and addictions in Ontario as a result of data limitations, the conservative methodology utilized, and the inability to include all mental illnesses and addictions. Still, the burden of mental illness and addiction in Ontario is more than 1.5 times the burden of all cancers,[10] and seven times the burden of all infectious diseases[7] (see Exhibit 3.8).

Most of the burden resulting from the mental illnesses and addictions examined in this study was associated with morbidity and not mortality. This study was not able to incorporate suicides into its analysis. Our method of estimating mortality is conservative for other reasons as well, and therefore likely underestimates the impact on mortality of the conditions/addictions examined (see limitations section below).

Alcohol-related disorders are the exception to the finding that the burden of illness is largely unrelated to deaths. Deaths related to alcohol-related disorders accounted for 25% of the burden of illness, a much greater proportion than for other conditions. Deaths due to alcohol-related disorders accounted for 88% of all deaths caused by the conditions/addictions we

examined. The prolonged use of alcohol is associated with a number of chronic medical diseases, including cirrhosis of the liver, that likely explain a substantial portion of the increase in mortality associated with its use.[34]

These findings provide evidence that the high burden of mental illness and addictions is largely due to the emergence of these conditions early in life, their prolonged duration and relatively high prevalence. For example, the prevalence of depression increases rapidly in the population in early adolescence.[35] The early onset of mental illness and addictions coincides with a time of major life transitions, such as completion of high school, transition to higher education, entry into the labour force, and marriage. The disruption of these transitions exacts a significant personal and social cost to individuals and society as a whole. Mental illness and addictions are also chronic and recurrent, meaning people often experience repeated episodes over many decades. This is exacerbated when no treatment is sought, which is all too frequent.[36,37] Finally, the lifetime prevalence of disorders, especially mood and anxiety disorders, is high, affecting approximately one in five individuals.[22] The fact that most individuals with MI&A do not usually die directly from these disorders (except for alcohol-use disorders) means that individuals with these problems live a long time in a state of relatively poor health.

The burden of mental illness and addiction in Ontario is more than 1.5 times the burden of all cancers, and seven times the burden of all infectious diseases.

The burden of MI&A to individuals, their families and society as a whole has been shown to be large in other studies.[38,39] This study provides additional evidence of this burden and begins to quantify it in Ontario. The findings in this report are worthy of consideration by practitioners and policy-makers. The MI&A included in this report are treatable, with effective interventions reducing illness burden at minimum, and in many cases leading to cure; for example, the use of cognitive therapy can be curative for patients with social phobia, panic disorder, or agoraphobia. Reducing stigma, increasing the awareness and recognition of MI&A and making the public aware that effective treatments exist are critical to reducing the burden of MI&A.

## 5.1 RELATIONSHIP TO MEDICAL COMORBIDITIES

Burden of disease was measured in this study using estimates of disability and years of life lost due to premature mortality. This study did not incorporate the effects of comorbidity in the analysis. The measurement of premature mortality relied on cause-specific mortality, which is much more complicated to measure with mental illnesses compared to other illnesses. For example, the likelihood that premature mortality in an individual diagnosed with a cancer will be attributable to the cancer is high. Individuals with MI&A tend to have a higher mortality rate, but identifying this

relationship at the individual level is not always possible. For example, when an individual with schizophrenia dies of cardiovascular disease related to risk factors associated with mental illness such as smoking and obesity, it is not usually possible to positively identify that schizophrenia is an underlying cause of death.

This problem was exacerbated by the fact that only one cause of death (the underlying cause) was available for this study. Given that MI&A is often part of a complex causal pathway and may easily be missed as an underlying cause, many deaths related to MI&A were not captured by this study. Consequently, the estimates of MI&A-related deaths presented here are likely conservative. In order to help describe the importance of this gap in these results, this chapter will briefly review some of the medical implications of schizophrenia, major depression and alcohol use disorders.

### Schizophrenia and Comorbid Medical Conditions

Schizophrenia is a chronic, severe mental illness with a typical onset occurring in young adulthood. Individuals with schizophrenia have a life span that is, on average, 20% shorter than that of the general population.[32,40] While suicide contributes to early mortality in a subset of individuals, the majority of deaths among individuals with schizophrenia are due to cardiovascular and chronic respiratory diseases.[41]

The high rates of cardiovascular and chronic respiratory diseases are in part due to the prevalence of risk factors for these illnesses among people with schizophrenia. Individuals with schizophrenia have high rates of obesity[42,43] and cigarette smoking.[44,45] They also have higher rates of diabetes, likely exacerbated by treatment with certain antipsychotics.[46] There is evidence that individuals with schizophrenia are less likely to receive adequate care in the event of cardiovascular events, such as acute myocardial infarction.[47,48]

Addressing the management of chronic medical illnesses among individuals with schizophrenia is challenging. However, most of the underlying risk factors, including obesity, cigarette smoking and diabetes, that impact on the early mortality observed in this population are either modifiable or treatable.

### Depression and Comorbid Medical Conditions

Depression is one of the most prevalent mental illnesses in Ontario, affecting approximately 4% of individuals in any given year, with a prevalence that is two times greater in women.

A higher prevalence of depression has been observed in a very large number of chronic medical illnesses. There has been a great deal of attention paid to the relationship between depression and cardiovascular diseases. Depressed individuals have a 64% increased risk of developing any

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cardiovascular disease[49,50] and a 60% increased risk of acute myocardial infarction.[51,52] Following myocardial infarction, depressed individuals have a threefold greater risk of dying.[51,52] The relationship between depression and mortality following coronary events is unclear, but may be due to a greater severity of cardiovascular illness.[53] Depressed individuals are less likely to adhere to cardiovascular treatment recommendations[9,54] and to follow lifestyle recommendations following acute cardiac events.[55]

The co-occurrence of depression worsens the course of illness for individuals with diabetes,[56,57] chronic obstructive pulmonary disease[58] and different types of cancer.[59,60] Thus, while depression, per se, does not often lead directly to death, depressed individuals have an increased risk of mortality related to these conditions when they co-occur. Addressing the increased risk of mortality related to depression is challenging, and likely requires active management of depression in addition to the modifiable risk factors that contribute to the increased mortality. For example, a depressed individual who is also obese is likely less motivated to engage in weight loss and exercise regimens that would be required to address the obesity than an individual who is obese but not depressed.

## Alcohol Use Disorders and Medical Comorbidity

Alcohol abuse and dependence are the most common types of addiction. The consumption of alcohol has been linked to the development of more than 65 medical conditions ranging from injuries (e.g., increased risk of trauma secondary to motor vehicle accidents) to chronic medical conditions. Excessive alcohol use has been strongly associated with heart disease and stroke. Excessive alcohol intake has also been linked to an increased risk of developing type 2 diabetes. Specific cancers are associated with alcohol use, including esophageal, laryngeal, colon and liver cancers. The increased risk of cancer observed amongst heavy alcohol users is likely exacerbated by a strong association between heavy alcohol use and smoking.

Unlike schizophrenia and depression, the burden associated with alcohol use disorders had a component that was due to premature death. The types of deaths that were attributable to alcohol use were limited and specific to certain types of liver failure and liver cancer. As discussed in the paragraph above, alcohol use disorders can be a significant factor in premature deaths in ways beyond those captured by the specific conditions we associated with alcohol-related deaths. For example, a number of motor vehicle-

related deaths occur each year that are "caused" by alcohol intoxication. We were not able to account for these deaths, but they would have a significant impact on years of life lost because many of these deaths would occur in individuals at a young age. Thus, similar to depression and schizophrenia, the mortality estimates for alcohol and other addiction disorders in this study are likely underestimates.

## Summary of Relationship to Medical Comorbidities

This study relied on cause-specific mortality to estimate the years-of-life-lost contribution to the estimates of disease burden. While there were relatively few individuals whose cause of death was attributed to depression, schizophrenia or excessive alcohol use, there is clearly a broader association between these conditions and mortality. Moreover, the increased mortality observed among individuals with these conditions is largely preventable and attributable to chronic disease and injury-related risk factors well known to the public health field. Because these illnesses affect individuals at a young age, there is a tremendous opportunity to intervene both to reduce the risk of early mortality and to address the reduced quality of life caused by these conditions.

## 5.2 SUMMARY OF THE DALY/HALY COMPARISON

The main analysis of this report utilized methods used in previous Canadian burden of disease reports and calculated HALYs.[10,11,61] However, most burden of disease studies internationally have used the standard GBD methods. In order to be able to contextualize our results globally, a sensitivity analysis was carried out. In this analysis, disability-adjusted life years (DALYs) are calculated (see Appendix D for details). DALYs are conceptually similar to HALYs, but are informed by different social value choices (i.e., measure of life expectancy, use of age weighting and discounting, and source of health state valuations).

In this sensitivity analysis, the majority of the rankings remained the same in the two methods. Further, the overall burden was similar using the two methods (approximately 604,000 using HALYs and approximately 606,000 using DALYs). However, the contribution of YLL in the HALY methods was double the contribution using the DALY methods. This is most likely due to discounting future years in the DALY methods. The distribution of burden is similar in both methods.

## 5.3 STUDY LIMITATIONS

It is important to note that even though this study shows that the burden of MI&A in Ontario is high, these estimates are conservative, and may substantially underestimate the true burden of these conditions in Ontario. For example, the type of data we were able to access did not allow us to evaluate and account for psychiatric co-morbidity or the additive burden of co-morbid medical conditions. In both cases, co-morbidity is the rule not the exception. Co-morbidity with MI&A is very high.[22] There is also emerging evidence of a link between specific MI&A and a number of chronic diseases, especially between depression and cardiovascular disease and cancers.[62,63] Evidence is mounting that the burden of disease may be much higher in individuals with co-morbid psychiatric disorders and/or co-morbid chronic physical health problems.

In relation to mortality, we were only able to access the underlying cause of death in the mortality records, which identify the most proximal attributable cause of death. As a consequence, even though MI&A can be associated with the onset of chronic diseases that confer higher risk of mortality, such as cardiovascular disease, death from physical health problems is more likely to be recorded as cause of death (proximal cause). There are also more general concerns regarding death

records as a data source including: (1) the accuracy of coding cause of death on records, (2) the failure to capture undiagnosed conditions, and (3) the inability, in general with death records, to fully capture the health state of the deceased individual.[64] Together, these methodological limitations may account for the relatively low rates of mortality for mental illnesses included in this study.

Our analysis was also dependent on the use of non-Canadian (i.e., U.S.) data in some instances. Although the use of external data is often necessary and accepted in this type of analysis, Canada-specific data would have been preferred. Similarly, the use of the CLAMES tool[13] to derive severity weights, while well accepted in burden of disease studies, relies to some degree on a clinician's valuations of various conditions using the available attributes (see Appendix A for details).

Finally, the impact of these conditions on others, such as family members, and their indirect economic and societal burden were not considered (and could not be with this method), so we know that the total burden is even greater than these estimates suggest. Likewise, this document does not report on the burden of MI&A across risk factors known to be associated with poor health outcomes such as low income and low educational attainment.

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## 5.4 PUBLIC HEALTH'S ROLE IN REDUCING THE BURDEN OF MENTAL ILLNESS AND ADDICTIONS

The estimates of high burden associated with MI&A in Ontario create an opportunity for an evidence-based, proactive and coordinated health system response. While an in-depth discussion of this response is beyond the scope of this report, an appropriate next step would be to review the evidence of intervention effectiveness in the areas of mental health promotion, prevention of mental illness and substance misuse, and general health promotion for those living with MI&A. Jurisdictional scans to clarify the potential role(s) of public health and other partners in addressing the burden of MI&A would also be helpful, recognizing the principles of need, impact, capacity and collaboration.

In Ontario, public health is active in several areas aligned with the World Health Organization's (WHO) definition of mental health promotion as "actions to create living conditions and environments that support mental health and allow people to adopt and maintain healthy lifestyles."[65] According to WHO,[5] these actions recognize the broader determinants that impact mental health and include:

- early childhood interventions
- support to children

- socio-economic empowerment of women
- social support for elderly populations
- programs targeted at vulnerable groups, including minorities, indigenous people, migrants and people affected by conflicts and disasters
- mental health promotional activities in schools
- mental health interventions at work
- housing policies
- violence prevention programs
- community development programs

Within these action areas, Public Health Units contribute to mental health promotion through, for example, the integration of mental health promotion into general health promotion programs provided within the scope of the Ontario Public Health Standards,[66] such as School Health, and Healthy Babies, Healthy Children. Within the Ontario Public Health Standards, Public Health Units are mandated to work with partners to foster supportive environments and healthy public policies to address risk factors and prevent chronic diseases and injuries. Given the significant medical comorbidity for people with MI&A, a focus by Public Health Units on risk factor reduction and general health promotion for this priority population is warranted. Reducing the harms associated with alcohol use receives a specific

focus in the Ontario Public Health Standards, and action in the area is supported by Public Health Ontario and the Centre for Addiction and Mental Health, among other organizations.

Many of the tools and strategies used by public health have potential value in addressing MI&A, including population health assessment and disease surveillance, comprehensive health promotion, outreach to priority populations, knowledge exchange, research and evaluation, action on the determinants of health, and partnerships and collaboration. Mental health assessment and surveillance would entail measuring, monitoring and reporting on the mental health status of Ontarians, including key determinants of mental health inequities. Developing key indicators of mental health and its determinants would be a necessary first step.

Many of the major determinants of poor mental health, such as poverty, inadequate housing, social isolation, unemployment, stress and built environment, are similar to the determinants of poor health in general. Thus, interventions targeting the determinants of health may impact both mental health and general health in the community. Local public health provides services and programs that impact the determinants of mental health throughout the life course. These may be delivered through the regular work of public health units, community health and related partners.

There is ample evidence that treatment for prevalent psychiatric disorders such as depression[67] and anxiety disorders[68] can be effective. Treatment[69] and provision of supports[70,71] for individuals with severe mental illnesses such as schizophrenia, can have a profound effect on quality of life. There is also a disturbing trend in the abuse of opioids[72,73] that could benefit from effective health interventions. Nonetheless, treatment rates for mental illnesses remain very low.[74] The low treatment rates, early age of onset and relatively chronic course of illness present many opportunities for intervention. Efforts by public health to reduce stigma, raise awareness of these conditions and support screening and early diagnosis may increase use of effective treatment services.

Finally, there is evidence that non-health related interventions and policy options can prevent mental illness and promote good mental health.[65] Interventions such as investment in high quality early childhood programs can reduce child maltreatment that is associated with mental illness and poor mental health, and approaches such as supportive housing can improve quality of life and prevent many of the consequences of severe MI&A. Public health has a key role to play in supporting the development, implementation and/or evaluation of these kinds of interventions.

## 5.5 OVERALL SUMMARY

In summary, this report demonstrates a high burden of illness related to mental illness and addictions in Ontario. Individuals are burdened by these illnesses at a young age, thus disrupting important life transitions, and may experience ongoing burden over a long period of time. While effective treatments exist for mental illness and addictions, only a small proportion of affected individuals receive them. Given the significant burden, there is a need to consider population-based promotion, prevention and treatment strategies aimed at reducing the burden of mental illness and addictions in Ontario. We hope that this report will be a catalyst for change.

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There is a need to consider population-based promotion, prevention and treatment strategies aimed at reducing the burden of mental illness and addictions in Ontario.

# Conclusions

The mental illnesses and addictions examined in this report inflict a burden that is conservatively estimated at more than 1.5 times that of all cancers combined and seven times that of all infectious diseases (see Exhibit 3.8). These findings point to the need for a comprehensive review of the evidence on effectiveness of interventions in the areas of mental health promotion and mental illness and addiction (MI&A) prevention, and may have implications for priority setting and resource allocation.

While an in-depth discussion of the role of public health in mental health is beyond the scope of this report, the epidemiological expertise and population health lens that are at the core of public health may be of value in raising the profile of issues like MI&A within the health sector and beyond. The work of public health on the determinants of health presents a natural opportunity for collaboration. Many of the determinants of poor mental health (e.g., poverty, inadequate housing, social isolation, stress) are similar to the determinants of poor health in general. As the evidence base for addressing the determinants of health improves, there will be greater potential for knowledge exchange and collaborative action between public health, mental health and other partners.

There is ample evidence that treatment for high-prevalence psychiatric disorders, such as depression[67] and anxiety disorders,[68] are effective[69] and that the provision of supports[70,71] for individuals with more severe mental illnesses, such as schizophrenia, can have a profound effect on quality of life. Nonetheless, the treatment rates for mental illnesses remains very low.[74] The low treatment rates, early age of onset and relatively chronic course of illness represents an opportunity and imperative for interventions with a potential to reduce the burden of illness.

In summary, despite the conservative nature of the methods employed, this report demonstrates a high burden of illness due to MI&A in Ontario. Individuals are burdened by these illnesses at a young age, thus disrupting major life course transitions, and can experience ongoing burden over a long period of time. Effective treatment interventions exist for MI&A but are underutilized, and the effectiveness of mental health promotion and MI&A prevention interventions may not be well understood. We hope that this study will serve as a baseline from which to measure the impact of future interventions to reduce the burden associated with MI&A in Ontario.

# Appendix A

## Development of Severity Weights

Severity weights were developed using the Classification and Measurement System of Function Health (CLAMES). This tool was created as part of the Population Health Impact of Disease (PHI) in Canada study to elicit Canada-specific preferences for health states associated with various diseases. The methods have been described in detail previously.[13]

The process included three steps:

1. The development of the CLAMES tool. The investigators of the PHI study adapted and combined the Health Utilities Index Mark III (HUI3),[75] the Medical Outcomes Study Short Form 36 (SF-36), and the European Quality of Life Five Dimensions Index Plus (EQ-5D)[76] to create a new instrument—CLAMES—containing 11 health status attributes with the theoretical capacity to describe 10,240,000 possible health states.

2. A subset of 238 health states was selected to develop a scoring function. A total of 14 lay panels, each consisting of 8 to 11 participants, were assembled for preference measurement exercises in nine communities across Canada. The investigators used the standard gamble technique to elicit participants' preferences for sets of health states that were blinded to minimize participant biases. The investigators generated the scoring function by fitting these preferences scores with a log-linear model.

3. In our study, a medical panel evaluated each health state across the 11 CLAMES attributes to assign scores. Using the scoring function developed in the initial study, we were able to determine utility weights for each health state. Utility weights were then converted to severity weights.

## Exhibit A.1
Health state of selected mental illnesses and addictions by severity weight and CLAMES attribute

| MENTAL ILLNESS | HEALTH STATE | SEVERITY WEIGHT | Pain or discomfort (4) | Physical functioning (4) | Emotional state (5) | Fatigue (4) | Memory and thinking (4) | Social relationships (5) | Anxiety (4) | Speech (4) | Hearing (4) | Vision (4) | Use of hands and fingers (5) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | CLAMES ATTRIBUTE (Maximum value) | | | | | |
| Agoraphobia | Mild | 0.127 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 |
| | Moderate | 0.190 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 |
| | Severe | 0.366 | 2 | 1 | 3 | 2 | 2 | 4 | 4 | 1 | 1 | 1 | 1 |
| Bipolar disorder (based on depressive episodes) | Mild | 0.122 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| | Moderate | 0.439 | 2 | 2 | 4 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 |
| | Severe | 0.559 | 3 | 3 | 5 | 4 | 4 | 4 | 3 | 1 | 1 | 1 | 1 |
| Major depression | Mild | 0.122 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| | Moderate | 0.440 | 2 | 2 | 4 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 |
| | Severe | 0.558 | 3 | 3 | 5 | 4 | 4 | 4 | 3 | 1 | 1 | 1 | 1 |
| Panic disorder | | 0.190 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| Schizophrenia (using paranoid schizophrenia) | | 0.250 | 1 | 1 | 3 | 1 | 4 | 4 | 3 | 1 | 2 | 1 | 1 |
| Social phobia | | 0.229 | 2 | 1 | 3 | 2 | 2 | 4 | 3 | 1 | 1 | 1 | 1 |
| **ADDICTION** | | | | | | | | | | | | | |
| Alcohol dependence | Low to medium | 0.187 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| | Severe | 0.252 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 1 | 1 | 2 |
| Cocaine use disorders | | 0.310 | 3 | 2 | 3 | 3 | 4 | 4 | 3 | 1 | 1 | 1 | 1 |
| Prescription opioid misuse | | 0.225 | 3 | 3 | 2 | 1 | 4 | 4 | 3 | 1 | 1 | 1 | 1 |

CLAMES = Classification and Measurement System of Functional Health

# Appendix B

Diagnostic Codes and Indicators Used in HALY Calculation

## Exhibit B.1

### Diagnostic codes used to identify episodes of health care use

| MENTAL ILLNESS | OHIP CODE* | ICD-10 CODE[†] | DSM-IV CODE[‡] | DESCRIPTION |
|---|---|---|---|---|
| Bipolar disorder | 296 (except 296.2, 296.3) | F30, F31 | 296.00–296.06, 296.40–296.89 | Manic episode, bipolar disorder |
| Schizophrenia | 295, Q021 (fee code for primary care enrollment groups) | F20, F25 | 295 | Schizophrenia, schizophrenia affective disorder |

*Used to identify episodes in the Ontario Health Insurance Plan claims database.

[†] Used to identify episodes in the CIHI Discharge Abstract Database.

[‡] Used to identify episodes in the Ontario Mental Health Reporting System database.[24]

## Exhibit B.2

### ICD-10 codes used to identify deaths in the Ontario vital statistics data

| MENTAL ILLNESS | ICD-10 CODE | DESCRIPTION[77] |
|---|---|---|
| Agoraphobia | F40.0 | Agoraphobia |
| Bipolar disorder | F30 | Manic episode |
| | F31 | Bipolar disorder |
| Major depression | F32 | Major depressive episode, single episode |
| | F33 | Major depressive episode, recurrent |
| Panic disorder | F41.0 | Panic disorder, without agoraphobia |
| Schizophrenia | F20 | Schizophrenia |
| | F25 | Schizophrenia affective disorder |
| Social phobia | F40.1 | Social phobias |
| **ADDICTION** | | |
| Alcohol use disorders | F10, K70 | Mental and behavioral disorders due to the use of alcohol |
| Cocaine use disorders | F14 | Cocaine-related disorders |
| Prescription opioid misuse | F11 | Opioid-related disorders |

**Exhibit B.3**

Canadian Community Health Survey Cycle 1.2 and CAMH Monitor indicators used to identify selected mental illnesses and addictions

| MENTAL ILLNESS | CCHS CYCLE 1.2 INDICATOR[20] | CAMH MONITOR INDICATOR[25] |
|---|---|---|
| **Agoraphobia** | AGPBDPY: WMH-CIDI criteria for agoraphobia in the 12 months prior to interview | N/A |
| **Major depression** | DEPBDDY: WMH-CIDI criteria for major depressive episode in the 12 months prior to interview | N/A |
| **Panic disorder** | PADBDDY: Identifies whether respondents meet or fail to meet the CCHS Cycle 1.2/WMH-CIDI criteria for panic disorder in the 12 months prior to interview | N/A |
| **Social phobia** | SOPBDPY: WMH-CIDI criteria for social phobia in the 12 months prior to interview | N/A |
| **ADDICTION** | | |
| **Alcohol use disorders** | ALDBDPP: Probability of caseness to respondents (respondents with a short-form score of 3 or more were identified as cases) | N/A |
| **Cocaine use disorders** | IDGB_05: Used – cocaine, crack – 12 months | N/A |
| **Prescription opioid misuse** | N/A | Non-medical use of prescription opioids: Percentage using prescription-type opioid pain relievers for non-medical purposes in the past 12 months |

WMH-CIDI: World Mental Health–Composite International Diagnostic Interview

# Appendix C

## Disease Modelling

As input to a study on the burden of mental health and addictions in Ontario, we needed consistently estimated epidemiologic indicators for mental health and substance use disorders by age and sex. "Consistently estimated" means that prevalence, incidence, duration, remission, the relative risk of mortality of people with the substance under consideration compared to a matched general population of same age and sex, and case fatality have all been entered into one statistical disease model, which ensures that the indicators correspond to each other. In many epidemiological reviews this is not the case, which means that some indicators in the review are impossible to quantify, given the value of other indicators reported. For this reason, the software tool DisMod II was developed by WHO for the consistent estimation of key population health-relevant epidemiological parameters.[26,79] Consistency analysis has been used in all subsequent Global Burden of Disease (GBD) studies.

**Consistent estimates were derived for the following parameters:**

- Incidence
- Prevalence
- Mortality
- Duration/remission (these two indicators are interchangeable where duration is one over remission in years)

DisMod II was used to generate consistent estimates.[26] The methodology followed the guidelines of the Global Burden of Disease and Injury Study.[79] For a general introduction, see the Global Burden of Disease and Risk Factors report.[14] Exhibit C.1 presents the disease model used to generate the consistent estimates.

For all substance use disorders, the procedures were identical to the estimates made for the Mental Health Commission of Canada except that the prevalence for Ontario was used instead of the prevalence for Canada.[80]

Exhibit C.2 outlines the epidemiological data sources used to model the different conditions.

Mortality associated with various mental and addictive disorders was taken from Harris and Barraclough,[33] akin to the procedure used by the Global Burden of Disease Study.

**Exhibit C.1**
**Disease model used for DisMod II**



HEALTHY

All other mortality

DEAD FROM
ANY OTHER CAUSE

Remission

Incidence

All other mortality

DISEASED
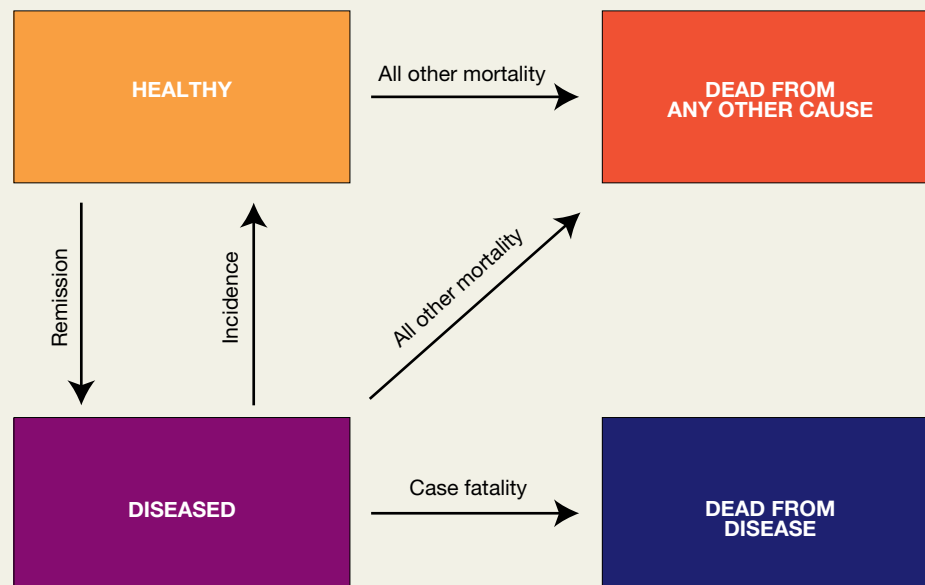
Case fatality

DEAD FROM
DISEASE

## Exhibit C.2

**Epidemiological data sources for the mental illnesses and addictions examined in this study**

| MENTAL ILLNESS | HEALTH CARE UTILIZATION (prevalence/incidence) | CCHS CYCLE 1.2 (prevalence) | CAMH MONITOR (prevalence) | NSDUH (prevalence) | NESARC (duration and incidence) |
|---|---|---|---|---|---|
| Agoraphobia | | X | | | X |
| Bipolar disorder | X | | | | X |
| Major depression | | X | | | X |
| Panic disorder | | X | | | X |
| Schizophrenia | X | | | | |
| Social phobia | | X | | | X |
| **ADDICTION** | | | | | |
| Alcohol use disorders | | X | | | X |
| Cocaine use disorders | | X | | X | X |
| Prescription opioid misuse | | | X | X | |

CCHS: Canadian Community Health Survey
CAMH: Centre for Addiction and Mental Health
NSDUH: National Survey on Drug Use and Health

NESARC: National Epidemiologic Survey on Alcohol
and Related Conditions

# Appendix D

## Comparison of HALY and DALY Methodologies

The results in the main analysis of this report are based on methods used in previous Canadian burden of disease reports.[10,11,61] However, most burden of disease studies done outside of Canada have used the World Health Organization's Global Burden of Disease (GBD) methodology, which is based on the calculation of disability-adjusted life years (DALYs). DALYs are conceptually similar to health-adjusted life years (HALYs) but are informed by different social value choices, including measure of life expectancy, use of age weighting and discounting, and source of health state valuations.

In the main analysis of this study, HALYs were calculated to: (1) allow comparison with other conditions in Canadian studies; (2) use health state valuations that were derived in Canada to reflect preferences and impact of various conditions in Canada; and (3) provide the flexibility to examine conditions and health states that were not examined in previous studies.

Exhibit D.1 outlines the differences between the HALY (this report) and DALY (GBD) methodologies.

In order to compare our results with those of the GBD study, a sensitivity analysis was conducted to calculate the burden of our mental health conditions and addictions using GBD methods. Thus, we used the standard DALY methodology (using the GBD life expectancy for the YLL calculation, applying age weights, using a discounting tariff of 3% and using GBD disability weights).

DALY template worksheets taken from the WHO website[81] were used to calculate DALYs using Ontario incidence numbers and durations while utilizing the social value choices listed in Exhibit D.1.

The results of the analysis are found in Exhibit D.2. The majority of the rankings remained the same in the two methods. Further, the overall burden was similar using the two methods (approximately 604,000 using HALYs and 606,000 using DALYs). However, the contribution of YLL using the HALY method was double the contribution using the DALY method. This is most likely due to discounting future years in the DALY method. Exhibit D.3 shows the contribution of YLL (mortality) and YLD (morbidity) to overall burden using the GBD method. The distribution is similar to that found using HALYs (see Exhibit 3.1).

**Exhibit D.1**

**Differences between health-adjusted life years (HALYs) and disability-adjusted life years (DALYs) in Ontario**

|  | HALYs | DALYs |
|---|---|---|
| **Life expectancy** | Ontario, 2001 Life expectancy at birth: 82.0 years for females, 77.4 years for males | GBD standard Life expectancy at birth: 82.5 years for females, 80.0 years for males |
| **Age weighting** | Uniform age weights (i.e., no age weighting) | Non-uniform age weights: higher weights given to those in the most economically productive time of their life (i.e., young adulthood) |
| **Discounting** | No discounting | Discount tariff of 3% |
| **Health state valuation** | Severity weights (using CLAMES instrument – see Appendix A) | Disability weights (from GBD study) |

## Exhibit D.2

Comparative ranking of selected mental illnesses and addictions in Ontario, by HALY and DALY methodologies

| | HALY METHODOLOGY | | | | | DALY METHODOLOGY | | | |
|---|---|---|---|---|---|---|---|---|---|
| HALY RANK | MENTAL ILLNESS/ADDICTION | YLL | YERF | HALYs | DALY RANK | MENTAL ILLNESS/ADDICTION | YLL | YLD | DALYs |
| 1 | **Major depression** | 493 | 203,970 | 204,463 | 1 | **Major depression** | 193 | 239,947 | 240,140 |
| 2 | **Bipolar disorder** | 107 | 116,814 | 116,921 | 2 | **Bipolar disorder** | 47 | 95,014 | 95,061 |
| 3 | **Alcohol use disorders** | 18,465 | 65,734 | 84,199 | 4 | **Schizophrenia** | 365 | 72,499 | 72,864 |
| 4 | **Social phobia** | 0 | 75,368 | 75,368 | 5 | **Alcohol use disorders** | 9,068 | 60,634 | 69,702 |
| 5 | **Schizophrenia** | 787 | 54,409 | 55,196 | 3 | **Social phobia** | 0 | 65,201 | 65,201 |
| 6 | **Panic disorder** | 0 | 25,351 | 25,351 | 6 | **Panic disorder** | 0 | 26,787 | 26,787 |
| 7 | **Agoraphobia** | 0 | 19,235 | 19,235 | 9 | **Prescription opioid misuse** | 42 | 15,518 | 15,560 |
| 8 | **Cocaine use disorders** | 354 | 11,923 | 12,277 | 8 | **Cocaine use disorders** | 191 | 12,084 | 12,275 |
| 9 | **Prescription opioid misuse** | 77 | 10,684 | 10,761 | 7 | **Agoraphobia** | 0 | 8,032 | 8,032 |
| | **Total** | **20,283** | **583,488** | **603,771** | | **Total** | **9,906** | **595,716** | **605,622** |

HALYs: Health-adjusted life years
DALYs: Disability-adjusted life years

YLL: Years of life lost due to premature mortality
YERF: Year-equivalents of reduced functioning from living with the disease

YLD: Years of life lost due to disease or disability

**Exhibit D.3**

Disability-adjusted life years (DALYs) for selected mental illnesses and addictions in Ontario, by years of life lost due to premature mortality (YLL) and years of life lost due to disease or disability (YLD)
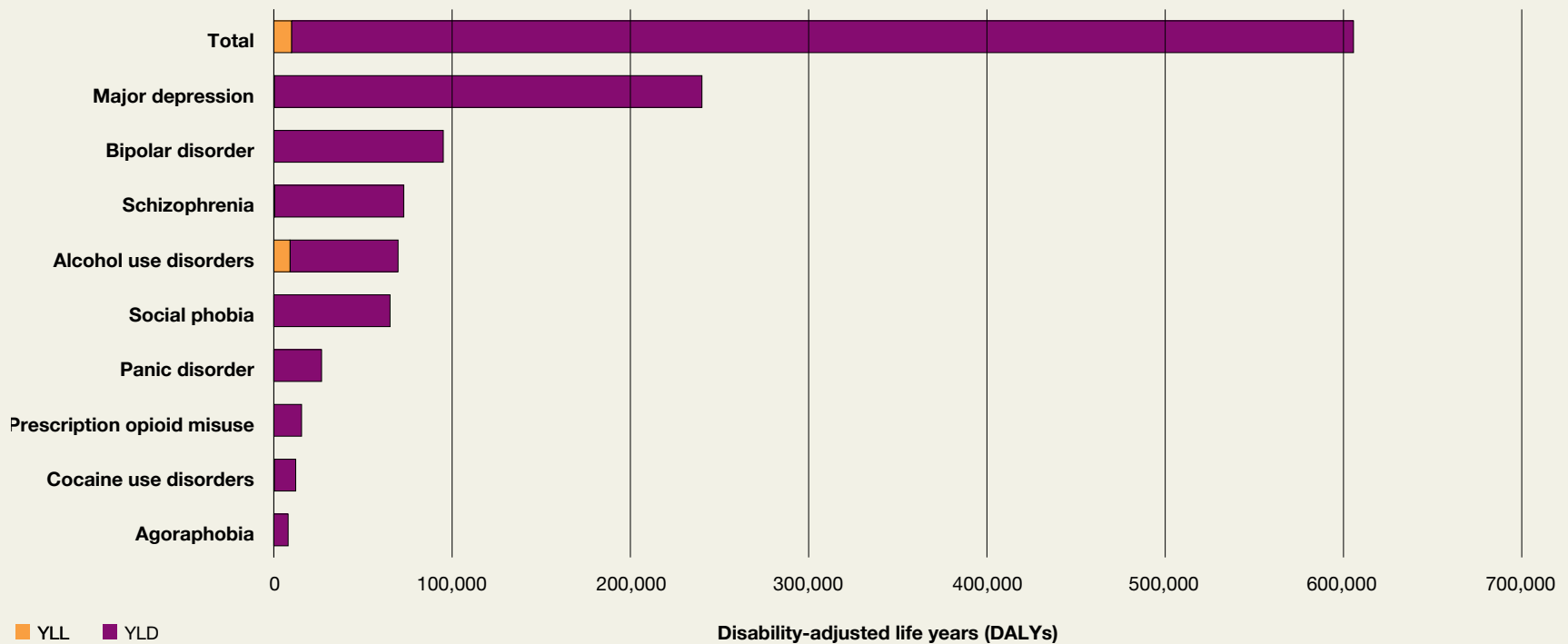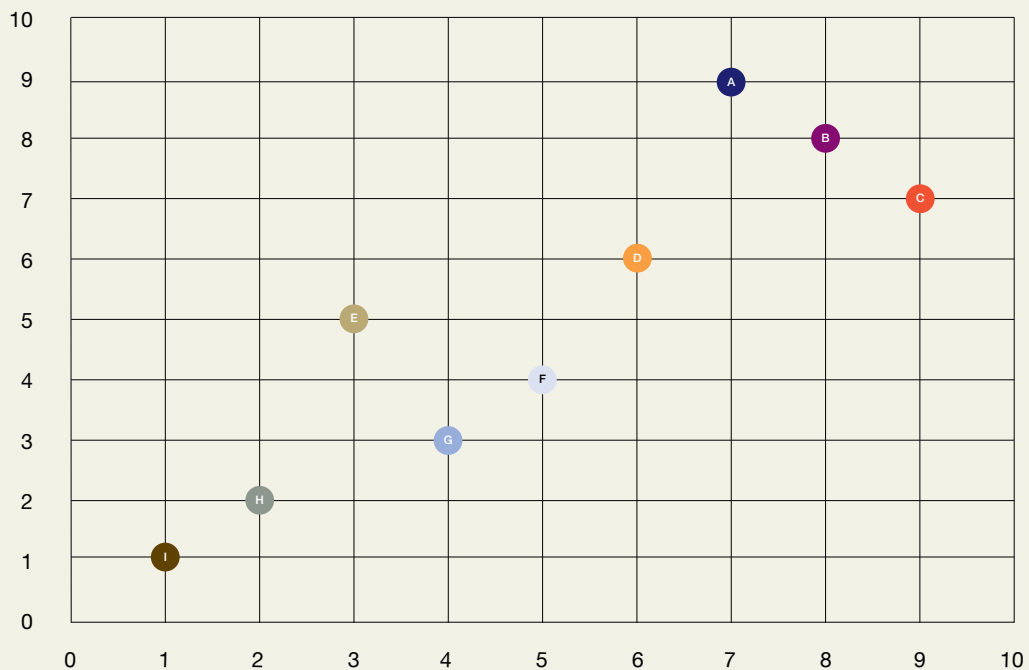


Disability-adjusted life years (DALYs)

■ YLL  ■ YLD

## Exhibit D.4

**Comparison of health-adjusted life year (HALY) and disability-adjusted life year (DALY) rankings for selected mental illnesses and addictions in Ontario**

**HALY Ranking**



**DALY Ranking**

- ● A Prescription opioid misuse
- ● B Cocaine use disorders
- ● C Agoraphobia
- ● D Panic disorder
- ● E Schizophrenia
- ● F Social phobia
- ● G Alcohol use disorders
- ● H Bipolar disorder
- ● I Major depression

Exhibit D.4 shows the correlation between the rankings using the two methods ($r^2 = 0.78$, based on Spearman's rank correlation coefficient). This correlation was statistically significant (p-value < 0.01). A few conditions did change rankings. Schizophrenia moved from fifth to third position, and agoraphobia dropped below the two addictions in the DALY method. Both of these changes were primarily due to age weighting. When years lost in young adulthood are weighted higher than later years, schizophrenia and drug addictions are likely to achieve a higher ranking due to their higher prevalence in young adulthood.

In summary, although the social value choices that inform the DALY and HALY methods are different, the overall rankings are similar.

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