ABSTRACT

Background
Suicide in older adults is a significant overlooked problem worldwide. This is especially true in Canada where a national suicide prevention strategy has not been established.

Methods
Using linked health-care administrative databases, this population-level study (2011 to 2015) described the incidence of older adult suicide (aged 65+), and identified clinical and socio-demographic factors associated with suicide deaths.

Results
The findings suggest that suicide remains a persistent cause of death in older adults, with an average annual suicide rate of about 100 per million people over the five-year study period. Factors positively associated with suicide vs. non-suicide death included being male, living in rural areas, having a mental illness, having a new dementia diagnosis, and having increased emergency department visits in the year prior to death; whereas, increased age, living in long-term care, having one or more chronic health condition, and increased interactions with primary health care were negatively associated with a suicide death.

Conclusion
Factors associated with suicide death among older adults highlighted in this study may provide better insights for the development and/or improvement of suicide prevention programs and policies.

Key words: older adult suicide, senior suicide, suicide, factors of suicide, mental health, population health

INTRODUCTION

Suicide is a global phenomenon that afflicts all age groups. Currently, it is the 15th leading cause of death globally resulting in it being labelled as a major public health issue worldwide. (1) In Canada, suicide is the 9th leading cause of death among all age groups which has remained largely unchanged over the last 15 years. (2–5) Despite older adults having the second highest rates of suicide in Canada, resulting in the 12th leading cause of death in this age group, (1–4,6–8) suicide prevention has been overlooked in this cross-section of the population.

To date, the epidemiology of older adult suicide in the Canadian context is lacking. Despite some available information, there remains conflicting understanding of the factors associated with suicide in older adults. For instance, while some reports indicate that diagnosis of dementia, depression, and cancer are associated with older adult suicide, (9–15) others contradict these associations. (16–20) It has been theorized that older adult suicidality sometimes goes unnoticed clinically, as health-care professionals possess a tendency only to categorize an individual as suicidal when they are diagnosed with depression or other mental health issues. (21) This preposition towards privileging depression and other diagnosed mental health issues as a singular causal mechanism to suicidal ideation may result in health-care professionals missing other individual and contextual factors predictive of suicide. In addition, the stigma towards suicide continues to persist, (22) which could also limit the capacity of further evaluating the complex factors of suicide.

With the current limited knowledge regarding older adult suicide in Canada, this study aimed to better understand the prevalence and predictors of suicide in older adults in Ontario, Canada. The objectives of this study were to 1) describe the five-year trend of suicide deaths among older adults in Ontario, Canada (2011 to 2015); 2) develop profiles of older adult suicide versus non-suicide deaths; and 3) identify factors associated with suicide deaths in older adults.

METHODS

Study Design and Setting
A population-level, retrospective study was conducted using linked administrative health-care databases available at ICES.
Study Population
The study population was comprised of older adults (aged 65+), who died between 1 January 2011 and 31 December 2015 in the province of Ontario, Canada. All older adults, aged 65 years and over, were included at the start of the analysis phase to establish the rate and trend of mortality at the population level. Older adults who had a missing or invalid OHIP number (thereby not eligible for health services in Ontario), with invalid demographic information such as age and sex (data cleaning), and not residing in Ontario were excluded from the study.

In Ontario, older adults are eligible for government-funded medication use when they turn 65, through the Ontario Drug Benefit program. To enable a two-year look-back period to establish health status for the second phase of the analysis (identifying factors or predictors associated with older adult suicide deaths), individuals less than 67 years old were further excluded, hereon referred to as the analysis cohort.

Data Sources
The following health-care administrative databases held at ICES were used to gather cohort data characteristics: Registered Persons Database, Office of the Registrar General-Deaths (ORGD) Vital Statistics Database, Ontario Population Estimates and Projections (POP) (Ontario Ministry of Health and Long-Term Care: IntelliHEALTH ONTARIO), Ontario Drug Benefit Claims (ODB), CIHI-Discharge Abstract Database (DAD), CIHI-National Ambulatory Care Reporting System (NACRS), Ontario Health Insurance Plan (OHIP), CIHI-Ontario Mental Health Reporting System (OMHRS), ICES Physician Database (IPDB), Cancer Care Ontario-Ontario Cancer Registry (OCR), and ICES-Derived Cohorts (ASTHMA, CHF, COPD, DEMENTIA, HIV, HYPER, OCCC, ODD, ORAD, OMID). Datasets were linked using unique encoded identifiers and analyzed at ICES. Variables were defined using the International Statistical Classification of Diseases Ninth and Tenth revision (ICD-9 and ICD-10) diagnostic codes, and OHIP fee/diagnostic. Definitions of all variables can be found in Appendices A and B.

Outcomes
The primary outcome of interest was a binary classification of death as “death by suicide vs. other suicide deaths”, identified on ORGD records as having a cause of death (COD) ICD-9 code between E980 and E987, or E989; or having an underlying COD ICD-10 code between Y10 and Y32, Y34, or Y87. Refer to Appendix B for detailed description of the codes and references used to generate the COD codes.

Predictive Factors
Several socio-demographic and health-related characteristics were collected to describe the analysis cohort and assess factors associated with suicide deaths. The generated profile included pre-existing chronic conditions; new health-care issues (e.g., a recent diagnosis of dementia or cancer); and health-care services utilization (e.g., hospital admissions, emergency room visits, and primary health-care visits). The following look-back periods were selected to capture health and socio-demographic characteristics of older adult deaths (aged 67+): (a) five years for most pre-existing chronic conditions; (b) two years for new diagnoses; and (c) one year for health-care utilization. The following variables were selected to further estimate their association with the ‘death by suicide’ outcome: age, sex, marital status, income, rurality, living in long-term care (LTC) facilities, comorbidities, new health-care issues, and health-care services utilization.

Statistical Analysis
A time trend analysis was utilized to examine changes in rates of older adult (aged 65+) mortality over a five-year time frame. Descriptive statistics were used to describe the characteristics of the analysis cohort. Frequencies and percentages were used to describe categorical characteristics, while means and standard deviations or medians and interquartile ranges (IQR) were used for continuous characteristics.

To compare characteristics across groups for both the primary and secondary outcomes, chi-square was used for categorical data and t-test was used for continuous data to obtain p values. For the primary outcome, a logistic regression, which predicts the odds of an event given an independent variable, was utilized to estimate the odds ratio ‘death by suicide’ given the selected covariates. Results are presented as adjusted odds ratios (AORs) with 95% confidence intervals (CI). Furthermore, a sensitivity analysis was conducted to assess the consistency of the odds ratio estimates after combining the ‘death by suicide’ and the ‘death by probable suicide’ groups and re-running the regression. The two regression results were then compared to observe any differences. All statistical analyses were performed using SAS Version 9.4 (SAS Institute), utilizing a threshold of alpha at 0.05 (α = 0.05).

Ethics Approval
ICES is an independent, non-profit research institute whose legal status under Ontario’s health information privacy law allows it to collect and analyze health-care and demographic data, without consent, for health system evaluation and improvement. The use of data in this project was authorized under section 45.
of Ontario’s Personal Health Information Protection Act, which
does not require review by a Research Ethics Board.

RESULTS

Over the five-year study time frame (2011–2015), 368,458
older adult deaths were recorded in the province of Ontario,
of which 998 (0.27% of all older adult deaths) were coded
as a death by suicide. The population rate of suicide deaths
was stable over the years, with a slight upward trend ranging
from 91 to 100 per million older adult population (Table 1).

After excluding older adults < 67 years of age, the cohort
used for further analysis included 354,967 older adult (aged
67+) mortalities (with 869 suicide deaths) in Ontario, Can-
ada (Figure 1; Table 2) over the five-year study time frame
(2011–2015).

Demographic Characteristics

Detailed characteristics comparing older adults who died by
suicide and other non-suicide causes are outlined in Table

| Year | Death by Suicide | Death by Non-Suicide Causes |
|------|------------------|-----------------------------|
| 2011 | 183 (97)         | 70,185 (37,192)             |
| 2012 | 179 (91)         | 70,803 (35,866)             |
| 2013 | 207 (100)        | 73,612 (35,716)             |
| 2014 | 211 (99)         | 75,814 (35,433)             |
| 2015 | 218 (98)         | 77,046 (34,798)             |

Source of population denominators: Ontario Ministry of Health and Long-Term Care: IntelliHEALTH ONTARIO, Data Last
Refreshed [July/2020].

FIGURE 1. Flow chart of cohort selection after meeting the inclusion and exclusion criteria
### Table 2.
Characteristics of older adult who died by suicide and other non-suicide causes

| Characteristic                      | Death by Suicide | Death by any Other Non-Suicide Causes | p value |
|-------------------------------------|------------------|--------------------------------------|---------|
| **Demographics**                    |                  |                                      |         |
| Age at Index Date                   |                  |                                      |         |
| Mean (SD)                           | 76.56 ± 7.11     | 83.25 ± 8.22                         | <.001   |
| Median (IQR)                        | 76 (70-82)       | 84 (77-89)                           |         |
| 67-74                               | 390 (44.9%)      | 62,826 (17.7%)                       | <.001   |
| 75-84                               | 341 (39.2%)      | 124,212 (35.1%)                      |         |
| 85+                                 | 138 (15.9%)      | 167,060 (47.2%)                      |         |
| Female, N(%)                        | 215 (24.7%)      | 187,603 (53.0%)                      | <.001   |
| Marital Status, N(%)                |                  |                                      |         |
| Common-law                          | 26 (3.0%)        | 5,423 (1.5%)                         | <.001   |
| Divorced                            | 97 (11.2%)       | 21,892 (6.2%)                        |         |
| Married                             | 440 (50.6%)      | 141,476 (40.0%)                      |         |
| Single                              | 73 (8.4%)        | 19,280 (5.4%)                        |         |
| Unknown                             | 0 (0.0%)         | 21 (0.0%)                            |         |
| Widowed                             | 229 (26.4%)      | 165,449 (46.7%)                      |         |
| Income Quintile, N(%)               |                  |                                      |         |
| Quintile 1                          | 217 (25.0%)      | 83,195 (23.5%)                       | .587    |
| Quintile 2                          | 172 (19.8%)      | 75,055 (21.2%)                       |         |
| Quintile 3                          | 164 (18.9%)      | 68,653 (19.4%)                       |         |
| Quintile 4                          | 151 (17.4%)      | 64,293 (18.2%)                       |         |
| Quintile 5                          | 163 (18.8%)      | 61,426 (17.3%)                       |         |
| Rural, Yes, N(%)                    | 160 (18.4%)      | 49,998 (14.1%)                       | .001    |
| Year of cohort entry, N(%)          |                  |                                      |         |
| 2011                                | 160 (18.4%)      | 67,759 (19.1%)                       | .696    |
| 2012                                | 155 (17.8%)      | 68,246 (19.3%)                       |         |
| 2013                                | 185 (21.3%)      | 70,751 (20.0%)                       |         |
| 2014                                | 179 (20.6%)      | 72,985 (20.6%)                       |         |
| 2015                                | 190 (21.9%)      | 74,357 (21.0%)                       |         |
| Living in long-term Care (LTC)      | 12 (1.4%)        | 108,649 (30.7%)                      | <.001   |
| Comorbidities in the Previous Two Years, N(%) |                  |                                      |         |
| Charlson Comorbidity Index          |                  |                                      |         |
| 0                                   | 317 (36.5%)      | 35,310 (10.0%)                       | <.001   |
| 1                                   | 114 (13.1%)      | 51,966 (14.7%)                       |         |
| 2+                                  | 229 (26.4%)      | 237,021 (66.9%)                      |         |
| No Hospitalizations                 | 209 (24.1%)      | 29,801 (8.4%)                        | <.001   |
| Congestive heart failure (CHF)      | 113 (13.0%)      | 139,830 (39.5%)                      | <.001   |
| Myocardial Infarction (MI)          | 58 (6.7%)        | 47,692 (13.5%)                       | <.001   |
| Asthma                              | 114 (13.1%)      | 55,648 (15.7%)                       | .036    |
| Chronic Obstructive Pulmonary Disease (COPD) | 292 (33.6%)  | 148,447 (41.9%)                      | <.001   |
| Diabetes                            | 241 (27.7%)      | 134,309 (37.9%)                      | <.001   |
| Hypertension                        | 624 (71.8%)      | 297,566 (84.0%)                      | <.001   |
| Chronic Liver Disease (CLD)         | 7 (0.8%)         | 19,352 (5.5%)                        | <.001   |
| Chronic Kidney Disease (CKD)        | 122 (14.0%)      | 114,614 (32.4%)                      | <.001   |
| Chronic Dialysis User               | 1-5              | 5,601-5,605                          | NR      |
2. In univariate analyses, older adults who died by suicide tended to be relatively younger (67–74 vs. 85+) (n = 390, 44.9% vs. n = 138, 15.9%); less likely female (n = 215, 24.7%); less likely to live in LTCs (n = 12, 1.4%); and less likely to live in rural areas (n = 160, 18.4%). In the adjusted analyses (Table 3), increasing age (aOR 0.94, 95% CI: 0.93-0.95) and living in LTC (aOR 0.07, 95% CI: 0.04-0.13) were associated with lower odds of suicide. Male (vs. female) sex (aOR 2.91, 95% CI: 2.47-3.44) and residing in a rural region (aOR 1.32, 95% CI: 1.11-1.58) were associated with higher odds of suicide deaths.

Mental Illness
From the list of medical illnesses (Table 2), the majority of the older adults who died by suicide had a mental health diagnosis, particularly non-psychotic disorders (n = 498, 57.3%), which was higher compared to the older adults in the non-suicide group (57.3% vs. 32.6%, p < .001). In the adjusted analysis, mental illness diagnosis showed significantly higher odds of older adult suicide (Table 3). The odds of suicide were 2.75 times higher for psychotic disorder diagnosis (aOR 2.75, 95% CI: 2.08-3.62), and 3.34 times higher for non-psychotic disorder diagnosis (aOR 3.34, 95% CI: 2.91-3.87).

New Health-care Issues
In the adjusted analysis, a new diagnosis of dementia was associated with increased odds of suicide (aOR 1.72, 95% CI: 1.06-2.79), while a new diagnosis of cancer was associated with a substantially lower odds of suicide (aOR 0.32; 95% CI: 0.24-0.44) (Table 3).

Health-care Utilization
In the adjusted analysis, the odds of emergency department use in the year prior to death was associated with moderate increase in the odds of suicide deaths (aOR 1.05, 95% CI 1.02-1.08), whereas visits to a primary care practitioner were associated with a lower odds (aOR 0.98, 95% CI: 0.97-0.99) (Table 3).

Death by Suicide Vs. Death by Probable Suicide
A small number of older adults were recorded as dying by probable suicide means (N = 29) (Table 4). In comparison to older adults who died by suicide causes, those who died by probable suicide causes were younger (median 72, vs. 76, p < .001); more often male 37.9% vs. 24.7%, p < .001; more likely to have visited a primary health-care practitioner in the previous year (median 9 vs. 8 visits, p < .001); and more
### TABLE 3.
Adjust odds ratios of characteristics associated with suicide deaths among older adults

| Characteristic                                                                 | OR    | 95% CI     | p value |
|--------------------------------------------------------------------------------|-------|------------|---------|
| **Demographics**                                                              |       |            |         |
| Age (continuous)                                                              | 0.94  | 0.93, 0.95 | <.0001  |
| Sex (reference=females)                                                       | 2.91  | 2.47, 3.44 | <.0001  |
| Marital Status (reference=married)                                           |       |            |         |
| Married (combined m=married & c=common-law)                                   | REF   |            |         |
| Widowed (w)                                                                   | 1.08  | 0.90, 1.29 | .4489   |
| Divorced (d)                                                                  | 1.10  | 0.87, 1.39 | .3905   |
| Single (s)                                                                    | 0.90  | 0.69, 1.16 | .5539   |
| Other (combined missing, o=other, u=unknown)                                  | 0.84  | 0.31, 2.33 | .719    |
| Income quintile (reference=quintile 5; recode missing to ‘3’)                 |       |            |         |
| Quintile 1                                                                     | 0.93  | 0.75, 1.15 | .7377   |
| Quintile 2                                                                     | 0.85  | 0.68, 1.06 | .3117   |
| Quintile 3                                                                     | 0.89  | 0.72, 1.11 | .769    |
| Quintile 4                                                                     | 0.89  | 0.71, 1.11 | .7249   |
| Quintile 5                                                                     | REF   |            |         |
| Rural (reference=urban; recode missing to urban)                              | 1.32  | 1.11, 1.58 | .0021   |
| LTC (reference=no)                                                            | 0.07  | 0.04, 0.13 | <.0001  |
| **Comorbidities (reference=no)**                                              |       |            |         |
| Charlson score                                                                |       |            |         |
| 0 (combined 0 and ‘no hospitalizations’)                                      | REF   |            |         |
| 1                                                                             | 0.36  | 0.29, 0.44 | .0178   |
| 2+                                                                            | 0.21  | 0.17, 0.26 | <.0001  |
| Congestive Heart Failure (CHF)                                                | 0.46  | 0.37, 0.58 | <.0001  |
| Myocardial Infarction (MI)                                                    | 0.73  | 0.55, 0.96 | .0241   |
| Asthma                                                                        | 1.05  | 0.85, 1.30 | .6554   |
| Chronic Obstructive Pulmonary Disease (COPD)                                  | 0.84  | 0.72, 0.98 | .0227   |
| Diabetes                                                                      | 1.01  | 0.86, 1.18 | .9464   |
| Hypertension                                                                  | 0.98  | 0.84, 1.15 | .8165   |
| Chronic Kidney Disease (CKD)                                                  | 0.74  | 0.60, 0.91 | .0041   |
| Chronic Dialysis User                                                         | 0.45  | 0.14, 1.43 | .1777   |
| Rheumatoid Arthritis                                                          | 0.79  | 0.50, 1.27 | .3374   |
| Crohn’s/Ulcerative Colitis (UC)                                               | 0.83  | 0.37, 1.88 | .6608   |
| Cancer                                                                        | 0.73  | 0.61, 0.89 | .0018   |
| Dementia                                                                       | 0.31  | 0.22, 0.45 | <.0001  |
| Mental Illness                                                                |       |            |         |
| Psychotic disorders (PSY)                                                     | 2.75  | 2.08, 3.62 | <.0001  |
| Non-psychotic disorders (nPSY)                                                | 3.36  | 2.91, 3.87 | <.0001  |
| Substance abuse disorders (SUB)                                               | 1.20  | 0.91, 1.59 | .2033   |
| Others (OTH- Social problems and others; not inc. dementia)                   | 0.97  | 0.64, 1.47 | .8801   |
| **New Health-care Issues**                                                    |       |            |         |
| New diagnosis of dementia (reference=no)                                      | 1.72  | 1.06, 2.79 | .0277   |
| New diagnosis of cancer (reference=no)                                        | 0.32  | 0.24, 0.44 | <.0001  |
| **Health-care System Utilization and Access (continuous)**                    |       |            |         |
| Number of hospitalizations                                                     | 0.95  | 0.87, 1.04 | .2829   |
| Number of ER visits                                                           | 1.05  | 1.02, 1.08 | .0015   |
| Number of PHC visits                                                          | 0.98  | 0.97, 0.99 | <.0001  |

*aSome variables were omitted due to non-reportable values.
N = 354,967 (869 deaths by suicide); OR = odd ratio; CI = confidence interval, 95%.
TABLE 4.
Characteristics of older adults who died by suicide and probable suicide causes

| Characteristic                      | Death by Suicide | Death by Probable Suicide | p value |
|------------------------------------|------------------|---------------------------|---------|
| **Demographics**                   | **N=869**        | **N=29**                  |         |
| Age at Index Date                  |                  |                           |         |
| Mean (SD)                          | 76.56 ± 7.11     | 75.24 ± 7.42              | <.001   |
| Median (IQR)                       | 76 (70-82)       | 72 (70-80)                |         |
| Female, N(%)                       |                  |                           |         |
|                                    | 215 (24.7%)      | 11 (37.9%)                | <.001   |
| Marital Status, N(%)               |                  |                           |         |
| Married                            | 440 (50.6%)      | 9 (31.0%)                 |         |
| Widowed                            | 229 (26.4%)      | 13 (44.8%)                |         |
| **Health-care System Utilization and Access in the Previous Two Years** |                  |                           |         |
| Number of hospitalizations         |                  |                           |         |
| Median (IQR)                       | 0 (0-1)          | 0 (0-1)                   | <.001   |
| Number of ER visits                |                  |                           |         |
| Median (IQR)                       | 1 (0-2)          | 1 (0-3)                   | <.001   |
| Number of visits to PHC            |                  |                           |         |
| Median (IQR)                       | 8 (4-14)         | 9 (6-15)                  | <.001   |

*Other variables were omitted due to missing/non-reportable values.

Probable suicide: with the small number of this cohort, other variables cannot be further reported.

IQR = interquartile range; SD = standard deviation.

likely widowed (44.8% vs. 26.4%; p < .001). In sensitivity analysis, wherein the outcome included death by suicide or death by probable suicide, results of the primary adjusted analyses remained unchanged (Appendix C).

**DISCUSSION**

This study demonstrates that suicide remains to be a persistent cause of death among older adults (aged 65+) in Ontario, averaging roughly 200 suicide deaths per year from 2011 to 2015. Among all older adult deaths recorded over the five-year study period, 0.27% was resultant of suicide. Several factors were analyzed in this study to further understand the factors associated with suicide in older adults. Being male, living in rural areas, having a mental illness, a new dementia diagnosis, and having increased emergency department visits were positively associated with suicide deaths; whereas, increased age, living in long-term care, having chronic health conditions, and increased interactions with primary health care were negatively associated with suicide deaths.

Although suicide is prevalent in older adults, the findings reported in this work are likely an underestimate, due to a range of misclassification and systemic biases related to the reporting of suicide. The lack of transparency in reporting older adult suicides may perhaps be due to the lingering stigma and culture surrounding suicide, or the medical/legal complexity of registering suicide cases in general. Older adults also tend to be excluded from contemporary suicide prevention programs and policy in Canada, as these programs tend to focus on youth and young adults.

Previous studies have reported the main characteristics of older adults who died by suicide as being younger (aged 65–74), male, and married, which were consistent with the findings in this study, with the exception of marital associations. Research studies from New Zealand, Denmark, and The United States of America have consistently shown more suicide deaths in older adults who were younger (less than 80 years old), while emphasizing that older adults (aged 80–85+) presented with more physical health issues than those under the age of 80 years. Furthermore, these older adults (aged 80+) visited their general practitioners more for physical issues rather than for mental health issues. The findings in this research study showed the cohort to be relatively younger, although age was not found to be predictive of suicide. A 2019 U.S. descriptive study of 16,924 older adults (aged 65+) reported higher odds of suicide risk for those who were older (aged 75–84; and 85+), which contrasted this research study’s finding in terms of age. This could perhaps be due to the systematic underreporting of suicide deaths in older adults, as mentioned previously, or lack of understanding regarding the underlying risk factors associated with suicide deaths during health-care visits. More research is needed to better ascertain the true impacts of various characteristics of older adults and the association with suicide death.

Male gender has also been commonly described in the literature as a predictor of older adult suicide. Although not specifically directed to older adult suicide, the influence of men’s health information-seeking behaviours and traditional or stereotypical views of masculinity may...
perhaps explain this association. While marital status did not produce a significant relationship in this study, other studies reported that various factors, such as gender or income, could influence the association of marital status with older adult suicide.\(^\text{(36,37)}\)

Several studies have also uncovered associations between various physical/mental health conditions with older adult suicide, particularly dementia, depression, and cancer.\(^\text{(9-18,20)}\) Findings from this research study further reinforced that a diagnosis of mental illness appears to be a health condition that is highly associated with older adult suicide. This expected finding suggests that mental illness is an immense factor in older adult suicide that must be effectively managed. Previous research has reported that a new diagnosis of dementia, between six months and three years after initial diagnosis, was associated with older adult suicide.\(^\text{(10,15)}\) In this study, a new diagnosis of dementia showed to be highly associated with older adult suicide. A possible explanation for the increased risk is that older adults who are newly diagnosed with dementia still have the cognitive ability to understand the hardships (i.e., functional/cognitive decline) ahead, and are able to initiate suicide death if they deem themselves potentially incapable in the future.\(^\text{(20,38)}\)

Past research exploring the association of living in a LTC facility and suicide in older adults remains inconclusive.\(^\text{(9,15,39)}\) Two recent 2019 research studies\(^\text{(9,39)}\) completed in the United States claimed that living within or transitioning to LTC facilities is a predictive factor of suicide. Interestingly, the findings of this population-level study demonstrated that admission to LTC showed a reduction in odds of suicide for older adults, which was congruous with the findings of another earlier American research study\(^\text{(15)}\) that reported a lowered suicide risk for nursing home admissions. While more specific research will be needed to clarify these findings, it has been suggested that the protective mechanism of LTC facilities on older adult suicide may be due to the “structured, supervised nature” of LTC facilities and the higher prevalence of patients with advanced cognitive/physical limitations.\(^\text{(15)}\)

Other research from the United States, Canada, and New Zealand observed that older adults who died by suicide commonly visited their family doctor within seven to 30 days before death.\(^\text{(12,14,17,30)}\) While this study examined healthcare visits within one year prior to suicide death, further work should be completed to examine if there are any other predictors of suicide related to the window of time between PHC visit and suicide death. Enhanced screening during patient-provider interactions to assess underlying risk factors of suicide, particularly in relation to mental illness and new diagnosis of dementia, should be considered in light of these findings.

Living in a rural environment was another significant factor determined in this study, such that it showed a positive association to suicide. It has been reported that older adults residing in rural and small population areas have the lowest access to health-care services.\(^\text{(40)}\) Moreover, rural residents commonly lack access to family physicians, nurse practitioners, specialty physicians, and other health-care services.\(^\text{(34,40)}\) The lack of access to health-care services in rural areas force rural residents to travel to urban areas to seek care, which may result in more emergency department usage.\(^\text{(33)}\) Future suicide prevention program and health policy for older adults should consider aspects related to health-care access equity.

### Implications and Future Directions

The findings of this study have implications and future directions for research and policy. For instance, future exploration regarding the factors surrounding living in LTC and aging-in-place should be conducted, particularly those living in rural or remote areas. Current and future digital health technology should also be examined in order to influence action and support for older adult suicide prevention programs/policies. It is evident that the increased adoption of digital health technologies (i.e., electronic health record, remote patient monitoring, telemedicine, etc.) across Canada has allowed health-care providers to efficiently access patient health information, which aids in the decision-making process and quality of care.\(^\text{(41-44)}\) With the continued usage and innovation of digital health technology to help span the care continuum, the assessment and evaluation of patient needs should be further integrated into healthy system planning.\(^\text{(45)}\)

Further, the legalization of medical assistance in dying (MAiD) in many jurisdictions, societal awareness of MAiD, and the impact of MAiD interventions upon older adult suicide should also all be considered in future work. From a policy perspective, ongoing training of health-care providers to improve suicide screening assessments on older adults must also be explored in further depth. Health-care providers can take a proactive role toward advocating for the needs of older adults, by developing care models and supportive mechanisms that can better identify at-risk individuals. Moreover, the needs of older adults who are systematically oppressed due to historical prejudice and discrimination, such as those who are homeless or part of the 2SLGBTQ+ community, should not be overlooked as well.\(^\text{(46-48)}\)

### Strengths and Limitations

The findings from this population-based research study provided insights related to the complexity of suicide in older adults in Ontario, Canada. The interlinked population-level data provided a comprehensive overview of the prevalence and the factors directly associated with older adult suicide, which can be used to inform decision-making processes surrounding suicide prevention programs and policies, both provincially and nationally.

While the study possessed strengths, there are several limitations that should be considered when interpreting the findings of this study. First, the accuracy of suicide deaths listed in this study may not fully express the true number of older adult suicides in Ontario, Canada. Even with defining suicide deaths in older adults using ORGD requirements, suicide deaths could still potentially have been misclassified or underreported.\(^\text{(1,8,21)}\) Further research to examine the issue
of misclassification or underreporting of suicide deaths and the specific characteristic profile of older adults who died by suicide or experienced suicide attempts should be sought. Second, as with studies utilizing secondary data, the variables selected for inclusion in the study were limited to those captured by health-care administrative data, and in some cases, were not as specific as would have been preferred. Although efforts to control for confounding were undertaken, due to the administrative nature of the source data, residual confounding is likely. For example, factors previously identified as being associated with suicide deaths (i.e., chronic pain, new diagnosis of specific mental illnesses, and other social determinants of health) could not be included because they were either unavailable or poorly defined in the administrative data sources. Third, the exclusion criteria of this study meant that the health inequities of other older adult subcohorts (i.e., newcomers, individuals experiencing homelessness, 2SLGBTQ+) could not be assessed in further depth. With the reported rise of emergency shelter usage among homeless older adults in Canada, economic barriers of newcomers accessing health-care services during a three-month wait period prior to provincial coverage, and lack of mental health services stemming from traumatic experiences faced by 2SLGBTQ+ Canadian older adults, it is essential that these factors—along with other unmet needs—be further explored in future research. Finally, while MAiD was legalized in Canada in 2016, this medical intervention was purposefully excluded in this study through the selection of the 2011–2015 period in an effort to reduce the potential of residual confounding. While excluding MAiD could be conceived as a study limitation, the results of this study could be used to inform future MAiD-specific research related to older adults in the province of Ontario.

CONCLUSION

With an average of 200 deaths of older adults (aged 65+) in Ontario per year for five years (2011–2015), it is important to be aware that suicide exists in the older adult population. Although not an exhaustive list, the factors highlighted in this population-based study provide a better understanding of the complexity of suicide in older adults, and can be used to provide insights for the improvement of programs and policies related to this demographic.

ACKNOWLEDGEMENTS

This study was supported by ICES, which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care. The study was completed at the ICES Western site, where core funding is provided by the Academic Medical Organization of Southwestern Ontario, the Schulich School of Medicine and Dentistry, Western University, and the Lawson Health Research Institute. Parts of this material are based on data and information compiled and provided by the Canadian Institute for Health Information, IntelliHEALTH Ontario, and Cancer Care Ontario. Parts of this report are based on Ontario Registrar General information on deaths, the original source of which is ServiceOntario (Ministry of Government Services). We thank IQVIA Solutions Canada Inc. for use of their Drug Information Database. The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of the funding or data sources; no endorsement is intended or should be inferred.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood the Canadian Geriatrics Journal’s policy on conflicts of interest disclosure and declare no conflicts of interest.

FUNDING

Elements of this study were supported through funding provided by the Lawson Health Research Institute Internal Research Fund (Booth); and through an Early Researcher Award (2017–2022) (Booth) from the Ontario Ministry of Research, Innovation and Science.

REFERENCES

1. World Health Organization. Preventing suicide: a global imperative [Internet]. 2014 [cited 2020 Dec 15]. Available from: http://apps.who.int/iris/bitstream/handle/10665/131056/9789241564779-eng.pdf?sequence=1
2. Navaneelan T. Suicide rates: an overview. Statistics Canada Health at a Glance. Catalogue No. 82-624-X. 2012 [cited 2020 Dec 15]. Available from: https://www150.statcan.gc.ca/n1/pub/82-624-x/2012001/article/11696-eng.htm
3. Public Health Agency of Canada. Working together to prevent suicide in Canada - the federal framework for suicide prevention. 2018 Progress report. 2019 [cited 2020 Dec 15]. Available from: https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/healthy-living/64-03-18-2232-Progress-Report-SuicidePrevention_EN-06-eng.pdf
4. Public Health Agency of Canada. Suicide in Canada: key statistics (infographics) [Internet]. 2016 [cited 2020 Dec 15]. Available from: https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/healthy-living/suicide-canada-key-statistics-infographic/pub-eng.pdf
5. Statistics Canada. Deaths and age-specific mortality rates, by selected grouped causes [Internet]. 2019 [cited 2020 Dec 15]. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039201
6. Butcher HK, Ingram TN. Evidence-based practice guideline: secondary prevention of late-life suicide. J Gerontol Nurs [Internet]. 2018 [cited 2020 Dec 15]; 44(11):20–32. Available from: https://doi.org/10.3928/00989134-20180907-01
7. Couillet A, Terra JL, Brochard N, Chauliac N. Barriers to the prevention of suicide in nursing homes: a qualitative study of the social representations of caregivers. Crisis. 2017;38(6):423–32.
8. World Health Organization. Suicide in the world: global health estimates [Internet]. 2019 [cited 2020 Dec 15]. Available from: https://www.who.int/publications/i/item/suicide-in-the-world
9. Choi NG, DiNitto DM, Marti CN, Conwell Y. Physical health problems as a late-life suicide precipitant: examination of coroner/medical examiner and law enforcement reports. *Gerontologist*. 2019;59(2):356–67.

10. Erlangsen A, Zarit SH, Conwell Y. Hospital-diagnosed dementia and suicide: a longitudinal study using prospective, nationwide register data. *Am J Geriatr Psychiatry*. 2008;16(3):220–28.

11. Erlangsen A, Stenager E, Conwell Y. Physical diseases as predictors of suicide in older adults: a nationwide, register-based cohort study. *Soc Psychiatry Psychiatr Epidemiol*. 2015;50(9):1427–39.

12. Juurink DN, Herrmann N, Szalai JP, Kopp A, Redelmeier DA. Medical illness and the risk of suicide in the elderly. *Arch Intern Med* [Internet]. 2004 [cited 2020 Dec 15];164(11):1179–84. Available from: https://doi.org/10.1001/archinte.164.11.1179

13. Klaassen Z, Wallis CJ, Chandrasekhar T, et al. Cancer diagnosis and risk of suicide after accounting for prediagnosis psychiatric care: a matched-cohort study of patients with incident solid-organ malignancies. *Cancer*. 2019;125(16):2886–95.

14. Miller M, Mogn H, Azrael D, Hempstead K, Solomon DH. Cancer and the risk of suicide in older Americans. *J Clin Oncol*. 2008;26(29):4720–24.

15. Seyfried LS, Kales HC, Ignacio RV, Conwell Y. Predictors of suicide in patients with dementia. *Alzheimers Dement*. 2011;7(6):567–73.

16. Hossain HU, Afrab A, Soron TR, Alam MT, Chowdhury WA, Uddin A. Suicide and depression in the World Health Organization South-East Asia region: a systematic review. *WHO South-East Asia J Pub Health* [Internet]. 2017 [cited 2020 Dec 15];6(1):60–66. Available from: https://apps.who.int/iris/handle/10665/329603

17. Conejero I, Olle E, Courret P, Calati R. Suicide in older adults: current perspectives. *Clin Interv Aging*. 2018;13:691.

18. Diehl-Schmid J, Jox R, Gauthier S, et al. Suicide and assisted dying in dementia: What we know and what we need to know. A narrative literature review. *Int Psychogeriatr*. 2017;29(8):1247–59.

19. Kjoseth I, Ekeberg O, Steihaug S. Why suicide? Elderly people who committed suicide and their experience of life in the period before their death. *Int Psychogeriatr*. 2010;22(2):209–18.

20. Kossos DN, Szanto K, Alexopoulos GS. Suicide in older adults: the role of emotions and cognition topical collection. *Curr Psychiatry Rep*. 2014;16(11).

21. Deuter K, Procter N, Evans D, Jaworski K. Suicide in older people: revisioning new approaches. *Int J Ment Health Nurs*. 2016;25(2):144–50.

22. Spiwak R, Elias B, Bolton J, Martens P, Sareen J. Suicide policy in Canada: lessons from history. *Can J Pub Health*, [Internet]. 2012 [cited 2020 Dec 15];103(5):338–41. Available from: https://www.researchgate.net/publication/236337171_Suicide_Policy_in_Canada_Lessons_From_History

23. Government of Ontario. Health care in Ontario [Internet]. 2020 [cited 2020 Dec 15]. Available from: https://www.ontario.ca/page/health-care-ontario

24. Statistics Canada. Population estimates on July 1st, by age and sex [Internet]. 2020 [cited 2020 Dec 15]. Available from: https://www150.statcan.gc.ca/t1/ibfl1/en/tv.action?pid=1710000501&pickMembers%5B0%5D=1.7&pickMembers%5B1%5D=2.1&cubeTimeFrame.startYear=2016&cubeTimeFrame.endYear=2020&referencePeriods=20160101%2C20200101

25. Strand S, Cadwallader S. Module 4: Binary logistic regression. In: *Using Statistical Regression Methods in Education Research* [Internet]. Southampton, UK: University of Southampton, National Centre for Research Methods; 2011 [cited 2020 Dec 15]. Available from: https://www.restore.ac.uk/srne/www/fac/soc/wie/research-new/srne/modules/mod4/index.html

26. Bakst SS, Braun T, Zucker I, Amitai Z, Shohat T. The accuracy of suicide statistics: are true suicide deaths misclassified? *Soc Psychiatry Psychiatr Epidemiol*. 2016;51(1):115–23.

27. Cox KL, Nock MK, Biggs QM, et al. An Examination of Potential Misclassification of Army Suicides: Results from the Army Study to Assess Risk and Resilience in Servicemembers. *Suicide Life-Threaten Behav*. 2017;47(3):257–65.

28. Niederkrotenthaler T, Braun M, Pirks J, et al. Association between suicide reporting in the media and suicide: systematic review and meta-analysis. *BMJ*. 2020;368.

29. Vogel L. Canada suicide prevention efforts lagging, experts say. *CMAJ*. 2011;183(1):E27–E28.

30. Cheung G, Merry S, Sundram F. Do suicide characteristics differ by age in older people? *Int Psychogeriatr*. 2018;30(3):323–30.

31. Dombrovski AY, Aslinger E, Wright AGC, Szanto K. Losing the battle: perceived status loss and contemplated or attempted suicide in older adults. *Int J Geriatr Psychiatry*. 2018;33(7):907–14.

32. Ju YJ, Park EC, Han KT, et al. Low socioeconomic status and suicidal ideation among elderly individuals. *Int Psychogeriatr*. 2016;28(12):2055–66.

33. McConnell D, Hahn L, Savage A, Dubé C, Park E. Suicidal ideation among adults with disability in Western Canada: a brief report. *Community Ment Health J*. 2016;52(5):519–26.

34. Hiebert B, Leipzig R, Regan S, Burkell J. Rural men’s health, health information seeking, and gender identities: a conceptual theoretical review of the literature. *Am J Men’s Health*. 2018;12(4):863–76.

35. Thompson EH, Langendoerfer KB. Older men’s blueprint for “Being a Man.” *Men Masculinities*. 2016;19(2):119–47.

36. Masocco M, Pompili M, Vanacore N, et al. Completed suicide and marital status according to the Italian region of Origin. *Psychiatr Q*. 2010;81(1):57–71.

37. McLaren S, Gomez R, Gill P, Chesler J. Marital status and suicidal ideation among Australian older adults: the mediating role of sense of belonging. *Int Psychogeriatr*. [Internet]. 2015 [cited 2020 Dec 15];27(1):145–154. Available from: https://doi.org/10.1017/S1041161014001501

38. Cipriani G, Vedovello M, Lucetti C, di Fiorino A, Nuti A. Dementia and suicidal behavior. *Agress Violent Behav*. 2013;18(6):656–59.

39. Mezuk B, Ko TM, Kalesnikava VA, Jungens D. Suicide among older adults living in or transitioning to residential long-term care, 2003 to 2015. *JAMA Network Open*. 2019;2(6):e195627.

40. Shah TI, Clark AF, Seabrook JA, Sibbald S, Gilliland JA. Geographic accessibility to primary care providers: comparing rural and urban areas in Southwestern Ontario. *The Can Geographer*. 2020;64(1):65–78.

41. Canada Health Infoway. Connected health information in Canada: a benefits evaluation study [Internet]. 2018 [cited 2020 Dec 15]. Available from: https://www.infoway-inforoute.ca/en/component/edocman/3510-connected-health-information-in-canada-a-benefits-evaluation-study-document/view-document?itemId=0

42. Dobrow MJ, Byttautas JP, Tharmalingam S, Hagens S. Interoperable electronic health records and health information exchanges: systematic review. *JMR Med Inform*. 2019;7(2):e12607.
43. Serrano A, Garcia-Guzman J, Xydopoulos G, Tarhini A. Analysis of barriers to the deployment of health information systems: a stakeholder perspective. *Inform Syst Front*. 2020;22(2):455–74.

44. Tharmalingam S, Hagens S, Zelmer J. The value of connected health information: perceptions of electronic health record users in Canada. *BMC Med Inform Decision Making*. 2016;16(1):1–9.

45. Leung K, Lu-McLean D, Kuziemsky C, *et al*. Using patient and family engagement strategies to improve outcomes of health information technology initiatives: scoping review. *J Med Internet Res*. 2019;21(10):e14683.

46. Buccieri K, Oudshoorn A, Frederick T, *et al*. Hospital discharge planning for Canadians experiencing homelessness. *Housing Care Support*. 2018;22(1).

47. Gaetz S, Dej E, Richter T, Redman M. The state of homelessness in Canada [Internet]. Toronto; Canadian Observatory on Homelessness Press; 2016 [cited 2020 Dec 15]. Available from: https://homelesshub.ca/sites/default/files/SOHC16_final_20Oct2016.pdf

48. Ross LE, Gibson MF, Daley A, Steele LS, Williams CC. In spite of the system: a qualitatively-driven mixed methods analysis of the mental health services experiences of LGBTQ people living in poverty in Ontario, Canada. *PLOS ONE*. 2018;13(8):e0201437.

49. Connelly R, Playford CJ, Gayle V, Dibben C. The role of administrative data in the big data revolution in social science research. *Soc Sci Res*. 2016;59:1–2.

50. Smith AK, Ayanian JZ, Covinsky KE, *et al*. conducting high-value secondary dataset analysis: an introductory guide and resources. *J Gen Intern Med*. 2011;26(8):920–29.

51. Thygesen LC, Ersholl AK. When the entire population is the sample: strengths and limitations in register-based epidemiology. *Eur J Epidemiol*. 2014;29(8):551–58.

52. Sanchez J, Cheff R, Hassen N, Katakia D. Part One: Examining the health status & health care experiences of new permanent residents in the three-month OHIP wait: a scoping review of the peer-reviewed literature [Internet]. Toronto; Wellesley Institute; 2016 [cited 2020 Dec 15]. Available from: https://www.wellesleyinstitute.com/wp-content/uploads/2016/07/Examining-Health-in-the-Three-Month-Wait-Part-One.pdf

Correspondence to: Eada M.P. Novilla-Surette, FIMS & Nursing Building, Room 2333, 1151 Richmond Street, Western University, London, ON N6A 3K7

E-mail: enovilla@uwo.ca
## APPENDIX A. Databases and Definitions Used

**TABLE A1: ICES databases used in the study and their descriptions**

| Database                                      | Description                                                                                                                                                                                                 |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Registered Persons Database (RPDB)            | Contains basic demographic information (age and sex), income (categorized into quintiles), location or residence (rurality and urban, and geographical location i.e., LHIN-Local Health Integration Network) |
| Office of the Registrar General – Deaths (ORGD) Vital Statistics Database | Contains data on Ontario individuals’ mortality (i.e. causes and other demographic information)                                                                                                           |
| Ontario Population Estimates and Projections (POP) | Contains data on populations estimates and projections in Ontario                                                                                                                                          |
| Ontario Drug Benefit Claims (ODB)             | Contains claims for prescription drugs received under the ODB program (most are for those ≥65 years of age)                                                                                            |
| CIHI-Discharge Abstract Database (DAD)        | Contains patient-level data for acute, rehab, chronic and day surgery institutions in Ontario                                                                                                                  |
| CIHI-National Ambulatory Care Reporting System (NACRS) | Contains patient visits to hospital- and community-based ambulatory care centres (i.e. emergency departments, day surgery units, hemodialysis units, and cancer care clinics)                                  |
| Ontario Health Insurance Plan (OHIP)          | Contains claims data on inpatient and outpatient services paid for by the Ontario Health Insurance Plan for most healthcare professionals in the province |
| CIHI-Ontario Mental Health Reporting System (OMHRS) | Contains administrative, clinical (diagnoses and procedures), demographic, and administrative information for all admissions to adult designated inpatient mental health beds |
| ICES Physician Database (IPDB)                | Contains data about all physicians who have practiced in Ontario and other data included in the OHIP Claims History Database, the OHIP Corporate Provider Database (CPDB), and the Ontario Physician Human Resource Data Centre Database (OPHRDC) |
| Cancer Care Ontario-Ontario Cancer Registry (OCR) | Contains data on all Ontario residents who have been newly diagnosed with or died of cancer (except non-melanoma skin cancers)                                                                     |
| Ontario Asthma Database (ASTHMA)              | An ICES-derived cohort that contains all Ontario individuals identified as having Asthma                                                                                                                     |
| Ontario Congestive Heart Failure Database (CHF) | An ICES-derived cohort that contains all Ontario individuals identified as having CHF                                                                                                                      |
| Ontario Chronic Obstructive Pulmonary Disease (COPD) | An ICES-derived cohort that contains all Ontario patients with COPD                                                                                                                                 |
| Ontario Dementia Database (DEMENTIA)          | An ICES-derived cohort that contains all Ontario individuals with Dementia                                                                                                                                  |
| Ontario Human Immunodeficiency Database (HIV)  | An ICES-derived cohort that contains all Ontario HIV positive patients                                                                                                                                     |
| Ontario Hypertension Database (HYPER)         | An ICES-derived cohort that contains all Ontario individuals identified as having hypertension                                                                                                               |
| Ontario Crohn’s and Colitis dataset (OCCC)    | An ICES-derived cohort that contains all Ontario individuals identified as having Crohn’s or Colitis                                                                                                       |
| Ontario Diabetes Database (ODD)               | An ICES-derived cohort that contains all incident cases of diabetes in Ontario                                                                                                                              |
| Ontario Rheumatoid Arthritis Database (ORAD)   | An ICES-derived cohort that contains all Ontario individuals identified as having Rheumatoid Arthritis                                                                                                         |
| Ontario Myocardial Infarction Database (OMID)  | An ICES-derived cohort that contains hospitalized patients with first acute myocardial infarction                                                                                                          |
| Medical Conditions                        | Definition                                                                                                                                 |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Congestive Heart Failure (CHF<sup>(1)</sup>) | The CHF Database was used to identify patients with CHF, based on 1 Hospitalization record (CIHI-DAD, CIHI-SDS, OMHRS, OHIP billing for Q050), or 1 OHIP/ED (ambulatory record) followed by a second record from either source (Hosp/ED/OHIP) within 1 year.  
  **OHIP**  
  OHIP diagnostic code: 428  
  CIHI-DAD, CIHI-SDS  
  ICD-9 diagnostic code: 428  
  ICD-10 diagnostic code: I500, I501, I509  
  **OHIP diagnostic code: 428**  
  **CIHI-DAD, CIHI-SDS**  
  **ICD-9 diagnostic code: 428**  
  **ICD-10 diagnostic code: I500, I501, I509** |
| Acute Myocardial Infarction (MI)<sup>(2)</sup> | The OMID Database was used to identify patients with a history of acute MI using OHIP, CIHI-DAD, and CIHI-SDS.  
  **OHIP**  
  OHIP service codes: C132, C133, C134, C135, C136, C137, C139, C435, C602, C603, C604, C605, C606, C607, C609, C675, C002, C003, C004, C005, C006, C007, C009, C905, G297, G557, G558, G559, G400, G401, G402, G405, G406, G407, R742, R743, Z434, Z442.  
  **CIHI-DAD, CIHI-SDS**  
  CCI procedure codes: 31S10, 31P10, 2HZ28, 1J150, 1J157, or 1J176  
  CCP procedure codes: 4802, 4803, 4809, 4892, 4893, 4894, 4895, 4896, 4897, 4898, 4996, or 4997  
  ICD-9 diagnostic codes: 410, 411, 413, or 428  
  ICD-10 diagnostic codes: I21, I50, or I20 |
| Asthma<sup>(3)</sup> | The ASTHMA database was used to identify patients with asthma, based on ≥1 Hospitalization or ≥2 OHIP (ambulatory claims) in a two-year period.  
  **OHIP**  
  OHIP diagnostic code: 493  
  **CIHI-DAD**  
  ICD-9 diagnostic code: 493  
  ICD-10 diagnostic codes: J45, J46 |
| Chronic Obstructive Pulmonary Disease (COPD)<sup>(4)</sup> | The COPD database was used to identify patients with COPD, based on ≥1 Hospitalization (DAD/SDS) or ≥3 OHIP (ambulatory care) in a two-year period.  
  **OHIP**  
  OHIP diagnostic codes: 491, 492, 496  
  **CIHI-DAD**  
  ICD-9 diagnostic codes: 491, 492, 496  
  ICD-10 diagnostic codes: J41, J42, J43, J44 |
| Diabetes<sup>(5,6)</sup> | The ODD database was used to identify patients with diabetes, based on ≥2 OHIP diagnosis code OR ≥1 Hospitalization OR ≥1 physician claim with a diabetes-specific fee code within 2 years.  
  **OHIP**  
  OHIP diagnostic code: 250  
  OHIP service codes: Q040, K029, K030, K045, K046  
  **CIHI-DAD, CIHI-SDS**  
  ICD-9 diagnostic code: 250  
  ICD-10 diagnostic codes: E10, E11, E13, E14 |
| Hypertension (HTN)<sup>(7,8)</sup> | The HYPER Database was used to identify patients with diabetes, based on ≥1 Hospitalization (admission and discharge with a diagnosis of hypertension) OR ≥2 OHIP claim (physician billing claims) in a 2-year period; OR 1 OHIP followed by OHIP/Hospitalization within two years.  
  **OHIP**  
  OHIP diagnostic codes: 401, 402, 403, 404, or 405  
  **CIHI-DAD, CIHI-SDS**  
  ICD-9 diagnostic codes: 401, 402, 403, 404, 405  
  ICD-10 diagnostic codes: 110, 111, 112, 113, 115 |
| Medical Conditions                          | Definition                                                                                                                                                                                                                                                                 |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chronic Liver Disease (CLD)<sup>9</sup>    | The DAD, NACRS and OHIP databases were used to identify patients with CLD, using the following definitions: <br>Any hospitalization or ED visit with a diagnosis code, OR <br>Any OHIP claim with both a fee code and diagnosis code OHIP <br>OHIP diagnostic codes: 070, 571, 573 <br>OHIP fee codes: Z551 and Z554 <br>DAD <br>ICD-10 diagnostic codes: B16, B17, B18, B19, B942, E830, E831, I85, K70, K713, K714, K715, K717, K721, K729, K73, K74, K753, K754, K758, K759, K76, K77, R160, R162, R17, R18, Z225. <br>Refer to Appendix B, Table B1 (BC_CLD) for detailed description of the listed codes. |
| Chronic Kidney Disease (CKD)<sup>9-13</sup> | The DAD, NACRS and OHIP databases were used to identify patients with CLD. <br>OHIP <br>OHIP diagnostic codes: 403, 580, 581, 585. <br>DAD <br>ICD-10 diagnostic codes: E102, E112, E132, E142, I12, I13, N00, N01, N02, N03, N04, N05, N06, N07, N08, N10, N11, N12, N13, N14, N16, N17, N18, N19, N20, N21, N22, N23, N25. <br>Refer to Appendix B, Table B2 (BC_CKD) for detailed description of the listed codes. |
| Chronic Dialysis User<sup>13,14</sup>      | The DAD and OHIP databases were used to identify patients who were chronic dialysis users, based on any 2 codes separated by at least 90 days, but less than 150 days. <br>OHIP <br>OHIP fee codes: R849, G323, G325, G326, G860, G862, G863, G865, G866, G082, G083, G085, G090, G091, G092, G093, G094, G095. <br>DAD <br>CCI procedure codes: 1PZ21HQBS, 1PZ2HQBR, 1PZ21HPD4 <br>Refer to Appendix B, Table B3 (BC_CDU) for detailed description of the listed codes. |
| Rheumatoid Arthritis<sup>15</sup>         | The ORAD database was used to identify patients with Rheumatoid Arthritis, based on ≥1 Hospitalization with any type of RA diagnosis code OR ≥3 OHIP claim in a two-year period (with ≥1 of the claims made by a musculoskeletal specialist). <br>OHIP <br>OHIP diagnostic codes: 714 <br>DAD <br>ICD-10 diagnostic codes: M05, M06. |
| Crohn’s/Ulcerative Colitis<sup>16</sup>    | The OCCC database was used to identify patients with Crohn’s/Ulcerative Colitis, using the following definition for older adults (65+): <br>Two years of OHIP eligibility and ≥5 Hospitalization/ED/OHIP in a four-year period and ≥1 ODB claim for IBD medication <br>OHIP <br>OHIP diagnostic codes: 555, 556. <br>DAD <br>ICD-10 diagnostic codes: K50, K51. |
| Human Immunodeficiency Virus (HIV)<sup>17</sup> | The HIV database was used to identify patients with HIV, based on ≥3 OHIP claims in a three-year period. <br>OHIP <br>OHIP diagnostic codes: 042, 043, 044. <br>DAD <br>ICD-10 diagnostic codes: B20, B21, B22, B23, B24. |
| Cancer<sup>18</sup>                       | The OCR database was used to identify patients with a history of cancer in Ontario, except for non-melanoma skin cancer. <br>For recent diagnosis of cancer, this definition was used: “New” Dx of cancer are those beginning within 2-year prior to index date |
**TABLE A2: (Continued)**

| Medical Conditions                      | Definition                                                                                                                                 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| **Dementia**<sup>(19)</sup>             | The DEMENTIA database was used to identify patients with dementia, based on ≥1 Hospitalization (DAD/SDS) for dementia; OR ≥1 ODB claim for cholinesterase inhibitors; OR ≥3 OHIP claim at least 30 days apart in a two-year period. For new diagnosis of dementia, this definition was used: “New” Dx of dementia are those beginning within 2-year prior to index date. |
| **OHIP**                                | OHIP diagnostic codes: 290, 331                                                                                                               |
| **CIHI-DAD, CIHI-SDS**                   | ICD-9 diagnostic codes: 0461, 290, 294, 331.0, 331.1, 331.5                                                                             |
| **ICD-10 diagnostic codes:**            | F00, F01, F02, F03, G30                                                                                                                     |
| **ODB**                                 | 1 prescription for a cholinesterase inhibitor                                                                                              |
| **Mental Illness-Psychotic Disorders**<sup>(20,21)</sup> | The DAD, OMHRS, and OHIP databases were used to identify patients with psychotic disorders, based on hospitalization with a diagnosis code OR ≥2 claims in 2 years or less with both a fee code and diagnosis code from the following code list: |
| **OHIP**                                | OHIP diagnosis codes: 295, 296, 297, 298.                                                                                                  |
| **OHIP fee codes:**                     | K005, K007, K623, A001, A003, A004, A005, A006, A007, A008, A888, A901, A905.                                                            |
| **DAD**                                 | ICD-10 diagnosis codes: F20, F22, F23, F24, F25, F28, F29, F323, F333.                                                                     |
| **DSM-IV**                              | 295, 297, 298, 312.                                                                                                                        |
| **Refer to Appendix B, Table B4 (BC_PSY)** | For detailed description of the listed codes.                                                                                             |
| **Mental Illness-Non-Psychotic Disorders**<sup>(20,21)</sup> | The DAD, OMHRS, and OHIP databases were used to identify patients with non-psychotic disorders, based on 1 hospitalization with a diagnosis code OR ≥2 claims in 2 years or less with both a fee code and diagnosis code from the following code list: |
| **OHIP**                                | OHIP diagnostic codes: 300, 301, 302, 306, 309, 311                                                                                      |
| **OHIP fee codes:**                     | K005, K007, K623, A001, A003, A004, A005, A006, A007, A008, A888, A901, A905.                                                            |
| **DAD**                                 | ICD-10 diagnosis codes: F21, F30, F31, F321, F322, F328, F330, F331, F332, F334, F338, F339, F348, F349, F380, F381, F388, F39, F40, F41, F42, F43, F48, F60, F93. |
| **DSM-IV**                              | 296, 300, 30000, 3002, 3003, 3004, 30113, 3083, 3090, 30924, 30928, 3093, 3094, 3098, 3099.                                             |
| **Refer to Appendix B, Table B5 (BC_nPSY)** | For detailed description of the listed codes.                                                                                              |
| **Mental Illness-Substance Use Disorders**<sup>(20,21)</sup> | The DAD, OMHRS, and OHIP databases were used to identify patients with substance abuse disorders, based on 1 hospitalization with a diagnosis code OR ≥2 claims in 2 years or less with both a fee code and diagnosis code from the following code list: |
| **OHIP**                                | OHIP fee codes: K005, K007, K623, A001, A003, A004, A005, A006, A007, A008, A888, A901, A905.                                           |
| **OHIP diagnosis codes:**               | 303, 304.                                                                                                                               |
| **DAD**                                 | ICD-10 diagnosis codes: F10, F11, F12, F13, F14, F15, F16, F17, F18, F19, F55                                                        |
| **DSM-IV**                              | 291 (all 291 codes, excluding 291.82), 292 (all 292 codes, excluding 292.85), 303, 304, 305                                             |
| **Refer to Appendix B, Table B6 (BC.SUB)** | For detailed description of the listed codes.                                                                                              |
| **Mental Illness- Others (Social Problems and Others; not including dementia)**<sup>(20,21)</sup> | The DAD, OMHRS, and OHIP databases were used to identify patients with other mental illness and social problems (excluding dementia), based 2 claims in 2 years or less with both a fee code and diagnosis code from the following code list: |
| **OHIP**                                | OHIP fee codes: K005, K007, K623, A001, A003, A004, A005, A006, A007, A008, A888, A901, A905.                                           |
| **OHIP diagnostic codes:**              | 897, 898, 899, 900, 901, 902, 904, 905, 906, 909.                                                                                       |
| **DAD**                                 | ICD-10 diagnostic codes: F44, F45, F50, F51, F52, F53, F45, F55, F59, F61, F62, F63, F64, F65, F66, F68, F69, F70, F71, F72, F73, F78, F79, F80, F81, F82, F83, F84, F88, F89, F90, F91, F92, F94, F95, F98, F99. |
| **Refer to Appendix B, Table B7 (BC.OTH)** | For detailed description of the listed codes.                                                                                              |
| Mortality                  | Definition                                                                 |
|---------------------------|---------------------------------------------------------------------------|
| Suicide\(^{22-26}\)       | The ORGD database was used to gather data on suicide deaths in older adults, based on the following: COD in: E950-E959, OR COD\(_{UNDERLYING\_ICD10}\) in: X60-X84, OR MANNER\(_{OF\_DEATH}\) = “4” ICD-9 E950, E951, E952, E953, E954, E955, E956, E957, E958, E959 ICD-10 Poisoning: X60, X61, X62, X63, X64, X65, X66, X67, X68, X69 Asphyxiation: X70, X71 Violence (firearms, explosives, crashes and stabblings): X72, X73, X74, X75, X76, X77, X78, X79, X80, X81, X82 Other: X83, X84 Refer to Appendix B, Table B8 (OUT\(_{SUIC}\)) for detailed description of the listed codes. |
| Non-Suicide               | The ORGD database was used to gather data on non-suicide deaths in older adults, based on: For primary exposure: COD or COD\(_{UNDERLYING\_ICD10}\) codes not in Appendix B, Table B8 (OUT\(_{SUIC}\)). For secondary exposure: COD or COD\(_{UNDERLYING\_ICD10}\) codes not in Appendix B, Table B8 (OUT\(_{SUIC}\)) or Appendix B, Table B9 (OUT\(_{NONSUIC\_PROB}\)). |
| Probable Suicide\(^{22,23,27-29}\) | The ORGD database was used to gather data on probable suicide deaths in older adults, based on the following: COD in: E980-E987, E989 COD\(_{UNDERLYING\_ICD10}\) in: Y10-Y32, Y34, Y87 ICD-9 Undetermined Poisoning: E980, E981, E982 Undetermined Asphyxiation: E983, E984 Undetermined injury from Violence (firearms, explosions, stabbing): E985, E986 Undetermined Injury from Fall: E987 E989 ICD-10 Poisoning or Undetermined Poisoning: Y10, Y11, Y12, Y13, Y14, Y15, Y16, Y17, Y18, Y19 Hanging, Strangulation and Suffocation, Drowning: Y20, Y21 Violence (firearms, explosives, crashes and stabblings): Y22, Y23, Y24, Y25, Y26, Y27, Y28, Y29, Y30, Y31, Y32, Y34 Y87 Refer to Appendix B, Table B9 (OUT\(_{NONSUIC\_PROB}\)) for detailed description of the listed codes. |
APPENDIX B: Definitions of Codes for Other Non-ICES-derived Variables

| Code Type          | Codes | Description                                               |
|--------------------|-------|-----------------------------------------------------------|
| DAD DXCODE ICD 10  | B16   | Acute hepatitis B                                         |
|                    | B17   | Other acute viral hepatitis                               |
|                    | B18   | Chronic viral hepatitis                                   |
|                    | B19   | Unspecified viral hepatitis                               |
|                    | B942  | Sequelae of viral hepatitis                               |
|                    | E830  | Disorder of copper metabolism                             |
|                    | E831  | Disorder of iron metabolism                               |
|                    | I85   | Esophageal varices                                         |
|                    | K70   | Alcoholic liver disease                                   |
|                    | K713  | Toxic liver disease with chronic persistent hepatitis      |
|                    | K714  | Toxic liver disease with chronic lobular hepatitis         |
|                    | K715  | Toxic liver disease with chronic active hepatitis          |
|                    | K717  | Toxic liver disease with fibrosis and cirrhosis of liver   |
|                    | K721  | Chronic hepatic failure                                   |
|                    | K729  | Hepatic failure, unspecified                               |
|                    | K73   | Chronic hepatitis, not elsewhere classified                |
|                    | K74   | Fibrosis and cirrhosis of liver                            |
|                    | K753  | Granulomatous hepatitis, not elsewhere classified          |
|                    | K754  | Autoimmune hepatitis                                       |
|                    | K758  | Other specified inflammatory liver diseases               |
|                    | K759  | Inflammatory liver disease, unspecified                   |
|                    | K76   | Other diseases of the liver                                |
|                    | K77   | Liver disorders in diseases classified elsewhere           |
|                    | R160  | Hepatomegaly, not elsewhere classified                     |
|                    | R162  | Hepatomegaly with splenomegaly, not elsewhere classified   |
|                    | R17   | Unspecified jaundice                                       |
|                    | R18   | Ascites                                                    |
|                    | Z225  | Carrier of viral hepatitis B                               |
| OHIP DXCODE        | 070   | Viral hepatitis                                            |
|                    | 571   | Cirrhosis of the liver (e.g. alcoholic cirrhosis, biliary cirrhosis) |
|                    | 573   | Other diseases of the liver                                |
| OHIP fee           | Z551  | Liver-incision-biopsy, needle                              |
|                    | Z554  | Liver-incision-biopsy                                     |
### TABLE B2: Chronic kidney disease (BC_CKD) variable—definitions of codes used¹⁰⁻¹³

| Code Type                  | Codes | Description                                                                 |
|----------------------------|-------|----------------------------------------------------------------------------|
| DAD DX10CODE - ICD 10      | E102  | Type 1 diabetes mellitus with incipient diabetic nephropathy               |
|                            | E112  | Type 2 diabetes mellitus with end-stage renal disease [ESRD]               |
|                            | E132  | Other specified diabetes mellitus with incipient diabetic nephropathy      |
|                            | E142  | Unspecified diabetes mellitus with incipient diabetic nephropathy          |
|                            | I12   | Hypertensive Renal Disease                                                 |
|                            | I13   | Hypertensive heart and renal disease                                       |
|                            | N00   | Acute nephritic syndrome                                                   |
|                            | N01   | Rapidly progressive nephritic syndrome                                     |
|                            | N02   | Recurrent and persistent hematuria                                         |
|                            | N03   | Chronic nephritic syndrome                                                 |
|                            | N04   | Nephrotic syndrome                                                         |
|                            | N05   | Unspecified nephritic syndrome                                             |
|                            | N06   | Isolated proteinuria with specified morphological lesion                   |
|                            | N07   | Hereditary nephropathy, not elsewhere classified                           |
|                            | N08   | Glomerular disorders in diseases classified elsewhere                       |
|                            | N10   | Acute tubulo-interstitial nephritis                                        |
|                            | N11   | Chronic tubulo-interstitial nephritis                                      |
|                            | N12   | Tubulo-interstitial nephritis, not specified as acute or chronic           |
|                            | N13   | Obstructive and reflux uropathy                                            |
|                            | N14   | Drug- and heavy-metal-induced tubulo-interstitial and tubular conditions   |
|                            | N16   | Renal tubulo-interstitial disorders in disease classified elsewhere        |
|                            | N17   | Acute renal failure                                                        |
|                            | N18   | Chronic renal failure                                                      |
|                            | N19   | Unspecified kidney failure                                                 |
|                            | N20   | Calculus of kidney and ureter                                              |
|                            | N21   | Calculus of lower urinary tract                                            |
|                            | N22   | Calculus of urinary tract in diseases classified elsewhere                 |
|                            | N23   | Unspecified renal colic                                                    |
|                            | N25   | Disorders resulting from impaired renal tubular function                   |
| OHIP DXCODE                | 403   | Hypertensive Renal Disease                                                 |
|                            | 580   | Acute glomerulonephritis                                                   |
|                            | 581   | Nephrotic syndrome                                                         |
|                            | 585   | Chronic renal failure, uremia                                              |
### Table B3: Chronic dialysis user (BC_CDU) variable—definitions of codes used[^13,14]

| Source        | Code          | Description                                                                 |
|---------------|---------------|----------------------------------------------------------------------------|
| CCI           | 1PZ21HQBS     | Dialysis, urinary system NEC continuous venovenous hemodialysis             |
|               | 1PZ21HQBR     | Dialysis, urinary system NEC hemodialysis                                   |
|               | 1PZ21HPD4     | Dialysis, urinary system NEC peritoneal dialysis using dialysate            |
| OHIP feecode  | R849          | Dialysis – Haemodialysis - Initial & acute                                 |
|               | G323          | Dialysis – Haemodialysis - Acute, repeat (max 3)                           |
|               | G325          | Dialysis – Haemodialysis - Medical component (incl. in unit fee)           |
|               | G326          | Dialysis - Chronic, contin. haemodialysis or haemofiltration each          |
|               | G860          | Chronic hemodialysis hospital location                                     |
|               | G862          | Hospital self-care chronic hemodialysis                                     |
|               | G863          | Chronic hemodialysis IHF location                                          |
|               | G865          | Chronic Home hemodialysis                                                  |
|               | G866          | Intermittent hemodialysis treatment centre                                 |
|               | G082          | Continuous venovenous haemodialfiltration                                  |
|               | G083          | Continuous venovenous haemodialysis                                        |
|               | G085          | Continuous venovenous haemofiltration                                      |
|               | G090          | Veneovenous slow continuous ultrafiltration                                |
|               | G091          | Continuous arteriovenous haemodialysis                                     |
|               | G092          | Continuous arteriovenous haemodiafiltration                                |
|               | G093          | Haemodiafiltration - Contin. Init & Acute (repeatx3)                       |
|               | G094          | Haemodiafiltration - Contin. Chronic                                       |
|               | G095          | Slow Continuous Ultra Filtration - Initial & Acute (repeat)                |

### TABLE B4: Mental illness–psychotic disorders (BC_PSY) variable—definitions of codes used[^20,21]

| Code Type            | Codes | Description                                                                 |
|----------------------|-------|-----------------------------------------------------------------------------|
| ICD-10               | F20   | Schizophrenia                                                               |
|                      | F22   | Persistent delusional disorders                                             |
|                      | F23   | Acute and transient psychotic disorders                                     |
|                      | F24   | Induced delusional disorder                                                 |
|                      | F25   | Schizoaffective disorders                                                   |
|                      | F28   | Other nonorganic psychotic disorders                                        |
|                      | F29   | Unspecified nonorganic psychosis                                            |
|                      | F323  | Severe depressive episode with psychotic symptoms                           |
|                      | F333  | Recurrent depressive disorder, current episode severe with psychotic symptoms|
| OHIP DXCODE          | 295   | Schizophrenia                                                               |
|                      | 296   | Manic depressive psychosis, involutional melancholia                         |
|                      | 297   | Paranoid states                                                             |
|                      | 298   | Other psychoses                                                             |
| OHIP FEE CODE        | K005  | Primary mental healthcare - Individual care (30 mins)                       |
|                      | K007  | Psychotherapy                                                               |
|                      | K623  | Form 1 (APA)                                                                |
|                      | A001  | Minor assessment                                                            |
|                      | A003  | General assessment                                                          |
|                      | A004  | General re-assessment                                                       |
|                      | A005  | Consultation                                                                |
|                      | A006  | Repeat consultation                                                         |
|                      | A007  | Intermediate assessment                                                     |
|                      | A008  | Mini assessment                                                             |
|                      | A888  | Partial assessment                                                          |
|                      | A901  | House call assessment                                                       |
|                      | A905  | Limited consultation                                                        |
| DSM-4                | 295   | Schizophrenia                                                               |
|                      | 297   | Delusional Disorders                                                       |
|                      | 298   | Psychotic Disorders                                                        |
|                      | 312   | Impulse Control Disorders (-omanias)                                        |
TABLE B5: Mental illness–non-psychotic disorders (BC_nPSY) variable—definitions of codes used\(^\text{20,21}\)

| Code Type | Codes | Description |
|-----------|-------|-------------|
| ICD-10    | F21   | Schizotypal disorder |
|           | F30   | Manic episode       |
|           | F31   | Bipolar affective disorder |
|           | F321  | Moderate depressive episode |
|           | F322  | Severe depressive episode without psychotic symptoms |
|           | F328  | Other depressive episodes |
|           | F330  | Recurrent depressive disorder, current episode mild |
|           | F331  | Recurrent depressive disorder, current episode moderate |
|           | F332  | Recurrent depressive disorder, current episode severe without psychotic symptoms |
|           | F334  | Recurrent depressive disorder, currently in remission |
|           | F338  | Other recurrent depressive disorders |
|           | F339  | Recurrent depressive disorder, unspecified |
|           | F348  | Other persistent mood [affective] disorders |
|           | F349  | Persistent mood [affective] disorder, unspecified |
|           | F380  | Other single mood [affective] disorders |
|           | F381  | Other recurrent mood [affective] disorders |
|           | F388  | Other specified mood [affective] disorders |
|           | F39   | Unspecified mood [affective] disorder |
|           | F40   | Phobic anxiety disorders |
|           | F41   | Other anxiety disorders |
|           | F42   | Obsessive-compulsive disorder |
|           | F43   | Reaction to severe stress, and adjustment disorders |
|           | F48   | Other neurotic disorders |
|           | F60   | Specific personality disorders |
|           | F93   | Emotional disorders with onset specific to childhood |
| OHIP DXCODE | 300  | Anxiety neurosis, hysteria, neurasthenia, obsessive compulsive neurosis, reactive depression |
|            | 301  | Personality disorders (e.g., paranoid personality, schizoid personality, obsessive compulsive personality) |
|            | 302  | Sexual deviations |
|            | 306  | Psychosomatic disturbances |
|            | 309  | Adjustment reaction |
|            | 311  | Depressive or other non-psychotic disorders, not elsewhere classified |
| OHIP FEE CODE | K005 | Primary mental healthcare - Individual care (30 mins) |
|             | K007 | Psychotherapy |
|             | K623 | Form 1 (APA) |
|             | A001 | Minor assessment |
|             | A003 | General assessment |
|             | A004 | General re-assessment |
|             | A005 | Consultation |
|             | A006 | Repeat consultation |
|             | A007 | Intermediate assessment |
|             | A008 | Mini assessment |
|             | A888 | Partial assessment |
|             | A901 | Housecall assessment |
|             | A905 | Limited consultation |
| DSM-4      | 296  | Major Depressive and Bipolar Disorders |
|           | 300  | Anxiety Disorder NOS |
|           | 3000 | Panic and Anxiety Disorders |
|           | 3002 | Phobias |
|           | 3003 | Obsessive-compulsive disorder |
|           | 3004 | Dysthymic Disorder |
|           | 30113| Cyclothymic Disorder |
|           | 3083 | Acute Stress Disorder |
|           | 3090 | Adjustment Disorder with Depression |
|           | 30924| Adjustment Disorder with Anxiety |
|           | 30928| Adjustment Disorder with Mixed Anxiety and Depressed Mood |
|           | 3093 | Adjustment Disorder with Disturbance of Conduct |
|           | 3094 | Adjustment Disorder with Mixed Disturbances of Emotions and Conduct |
|           | 3098 | Post-traumatic Stress Disorders |
|           | 3099 | Adjustment Disorder, Unspecified |
| Code Type            | Codes | Description                                                                 |
|----------------------|-------|-----------------------------------------------------------------------------|
| OHIP DXCODE          | 303   | Alcohol intoxication                                                        |
|                      | 304   | Substance dependence                                                       |
| ICD-10               | F10   | Mental and behavioural disorders due to use of alcohol                      |
|                      | F11   | Mental and behavioural disorders due to use of opioids                      |
|                      | F12   | Mental and behavioural disorders due to use of cannabinoids                 |
|                      | F13   | Mental and behavioural disorders due to use of sedatives or hypnotics       |
|                      | F14   | Mental and behavioural disorders due to use of cocaine                      |
|                      | F15   | Mental and behavioural disorders due to use of other stimulants, including caffeine |
|                      | F16   | Mental and behavioural disorders due to use of hallucinogens                |
|                      | F17   | Mental and behavioural disorders due to use of tobacco                      |
|                      | F18   | Mental and behavioural disorders due to use of volatile solvents            |
|                      | F19   | Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances |
|                      | F55   | Abuse of non-dependence-producing substances                                |
| OHIP FEE CODE        | K005  | Primary mental healthcare - Individual care (30 mins)                       |
|                      | K007  | Psychotherapy                                                               |
|                      | K623  | Form 1 (APA)                                                                |
|                      | A001  | Minor assessment                                                            |
|                      | A003  | General assessment                                                          |
|                      | A004  | General re-assessment                                                       |
|                      | A005  | Consultation                                                                |
|                      | A006  | Repeat consultation                                                          |
|                      | A007  | Intermediate assessment                                                     |
|                      | A008  | Mini assessment                                                             |
|                      | A888  | Partial assessment                                                          |
|                      | A901  | Housecall assessment                                                        |
|                      | A905  | Limited consultation                                                        |
|                      | 303   | Alcohol intoxication                                                        |
|                      | 304   | Substance dependence                                                       |
|                      | 305   | Substance Abuse                                                             |
| Code Type | Codes | Description |
|-----------|-------|-------------|
| OHIP DXCODE | 897 | Economic problems |
|           | 898 | Marital issues |
|           | 899 | Parent-child issues |
|           | 900 | Problems with aged parents or in-laws |
|           | 901 | Family disruption/divorce |
|           | 902 | Education problems |
|           | 904 | Social maladjustment |
|           | 905 | Occupational problems |
|           | 906 | Legal problems |
|           | 909 | Other problems of social adjustment |
| ICD 10   | F44 | Dissociative [conversion] disorders |
|          | F45 | Somatoform disorders |
|          | F50 | Eating disorders |
|          | F51 | Nonorganic sleep disorders |
|          | F52 | Sexual dysfunction, not caused by organic disorder or disease |
|          | F53 | Mental and behavioural disorders associated with the puerperium, not elsewhere classified |
|          | F54 | Psychological and behavioural factors associated with disorders or diseases classified elsewhere |
|          | F55 | Abuse of non-dependence-producing substances |
|          | F59 | Unspecified behavioural syndromes associated with physiological disturbances and physical factors |
|          | F61 | Mixed and other personality disorders |
|          | F62 | Enduring personality changes, not attributable to brain damage and disease |
|          | F63 | Habit and impulse disorders |
|          | F64 | Gender identity disorders |
|          | F65 | Disorders of sexual preference |
|          | F66 | Psychological and behavioural disorders associated with sexual development and orientation |
|          | F68 | Other disorders of adult personality and behaviour |
|          | F69 | Unspecified disorder of adult personality and behaviour |
|          | F70 | Mild mental retardation |
|          | F71 | Moderate mental retardation |
|          | F72 | Severe mental retardation |
|          | F73 | Profound mental retardation |
|          | F78 | Other mental retardation |
|          | F79 | Unspecified mental retardation |
|          | F80 | Specific developmental disorders of speech and language |
|          | F81 | Specific developmental disorders of scholastic skills |
|          | F82 | Specific developmental disorder of motor function |
|          | F83 | Mixed specific developmental disorders |
|          | F84 | Pervasive developmental disorders |
|          | F88 | Other disorders of psychological development |
|          | F89 | Unspecified disorder of psychological development |
|          | F90 | Hyperkinetic disorders |
|          | F91 | Conduct disorders |
|          | F92 | Mixed disorders of conduct and emotions |
|          | F94 | Disorders of social functioning with onset specific to childhood and adolescence |
|          | F95 | Tic disorders |
|          | F98 | Other behavioural and emotional disorders with onset usually occurring in childhood and adolescence |
|          | F99 | Mental disorder, not otherwise specified |
| Code Type          | Codes | Description                                                                 |
|-------------------|-------|-----------------------------------------------------------------------------|
| OHIP FEE CODE      | K005  | Primary mental healthcare - Individual care (30 min)                        |
|                   | K007  | Psychotherapy                                                               |
|                   | K623  | Form 1 (APA)                                                                |
|                   | A001  | Minor assessment                                                            |
|                   | A003  | General assessment                                                          |
|                   | A004  | General re-assessment                                                       |
|                   | A005  | Consultation                                                                |
|                   | A006  | Repeat consultation                                                         |
|                   | A007  | Intermediate assessment                                                     |
|                   | A008  | Mini assessment                                                             |
|                   | A888  | Partial assessment                                                          |
|                   | A901  | House call assessment                                                       |
|                   | A905  | Limited consultation                                                        |
| DSM-4             | 299   | Autism-Spectrum Disorders                                                   |
|                   | 30016 | Factitious Disorder With Predominantly Psychological Signs and Symptoms     |
|                   | 30019 | Factitious Disorder, NOS                                                    |
|                   | 3026  | Gender Identity Disorder                                                   |
|                   | 3071  | Anorexia Nervosa                                                            |
|                   | 3072  | Tic Disorders                                                               |
|                   | 3073  | Stereotypic Movement Disorders                                              |
|                   | 3075  | Eating Disorders                                                            |
|                   | 30751 | Bulimia Nervosa                                                             |
|                   | 3076  | Enuresis (Involuntary Urination), Not Due to a Medical Condition            |
|                   | 3077  | Encopresis (Involuntary Defecation), Without Constipation and Overflow Incontinence |
|                   | 314   | Attention-Deficit/Hyperactivity Disorder                                     |
|                   | 315   | Learning Disorders                                                          |
|                   | 7876  | Encopresis (Involuntary Defecation), With Constipation and Overflow Incontinence |
TABLE B8: ‘Death by suicide’ (OUT_SUIC) outcome—definitions of codes used(22-26)

| Code Type | Codes | Description |
|-----------|-------|-------------|
| ICD10     | Poisoning | Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics |
|           |       | X60         |
|           | Poisoning | Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified |
|           |       | X61         |
|           | Poisoning | Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified |
|           |       | X62         |
|           | Poisoning | Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system |
|           |       | X63         |
|           | Poisoning | Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances |
|           |       | X64         |
|           | Poisoning | Intentional self-poisoning by and exposure to alcohol |
|           |       | X65         |
|           | Poisoning | Intentional self-poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours |
|           |       | X66         |
|           | Poisoning | Intentional self-poisoning by and exposure to other gases and vapours |
|           |       | X67         |
|           | Poisoning | Intentional self-poisoning by and exposure to pesticides |
|           |       | X68         |
|           | Poisoning | Intentional self-poisoning by and exposure to other and unspecified chemicals and noxious substances |
|           |       | X69         |
|           | Asphyxiation | Intentional self-harm by hanging, strangulation and suffocation |
|           |       | X70         |
|           | Asphyxiation | Intentional self-harm by drowning and submersion |
|           |       | X71         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by handgun discharge |
|           |       | X72         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by rifle, shotgun and larger firearm discharge |
|           |       | X73         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by other and unspecified firearm discharge |
|           |       | X74         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by explosive material |
|           |       | X75         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by smoke, fire and flames |
|           |       | X76         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by steam, hot vapours and hot objects |
|           |       | X77         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by sharp object |
|           |       | X78         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by blunt object |
|           |       | X79         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by jumping from a high place |
|           |       | X80         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by jumping or lying before moving object |
|           |       | X81         |
|           | Violence (firearms, explosives, crashes and stabbings) | Intentional self-harm by crashing of motor vehicle |
|           |       | X82         |
|           | Other  | Intentional self-harm by other specified means |
|           |       | X83         |
|           | Other  | Intentional self-harm by unspecified means |
|           |       | X84         |
|           | ICD9   | Suicide and self-inflicted poisoning by solid or liquid substances |
|           |       | E950        |
|           | ICD9   | Suicide and self-inflicted poisoning by gases in domestic use |
|           |       | E951        |
|           | ICD9   | Suicide and self-inflicted poisoning by other gases and vapors |
|           |       | E952        |
|           | ICD9   | Suicide and self-inflicted injury by hanging strangulation and suffocation |
|           |       | E953        |
|           | ICD9   | Suicide and self-inflicted injury by submersion (drowning) |
|           |       | E954        |
|           | ICD9   | Suicide and self-inflicted injury by firearms air guns and explosives |
|           |       | E955        |
|           | ICD9   | Suicide and self-inflicted injury by cutting and piercing instrument |
|           |       | E956        |
|           | ICD9   | Suicide and self-inflicted injury by jumping from high place |
|           |       | E957        |
|           | ICD9   | Suicide and self-inflicted injury by other and unspecified means |
|           |       | E958        |
|           | ICD9   | Late effects of self-inflicted injury |
|           |       | E959        |
### TABLE B9: ‘Death by probable suicide’ (OUT_NONSUIC_PROB) outcome—definitions of codes used\(^{(22-26)}\)

| Code Type | Codes | Description |
|-----------|-------|-------------|
| ICD9      | Undetermined Poisoning | |
|           | E980  | Poisoning by solid or liquid substances undetermined whether accidentally or purposely inflicted |
|           | E981  | Poisoning by gases in domestic use undetermined whether accidentally or purposely inflicted |
|           | E982  | Poisoning by other gases undetermined whether accidentally or purposely inflicted |
|           | E983  | Hanging strangulation or suffocation undetermined whether accidentally or purposely inflicted |
|           | E984  | Submersion (drowning), undetermined whether accidentally or purposely inflicted |
|           | E985  | Injury by firearms, air guns and explosives undetermined whether accidentally or purposely inflicted |
|           | E986  | Injury by cutting and piercing instruments, undetermined whether accidentally or purposely inflicted |
|           | E987  | Falling from high place undetermined whether accidentally or purposely inflicted |
|           | E989  | Late effects of injury, undetermined whether accidentally or purposely inflicted |
| ICD10     | Poisoning or Undetermined Poisoning | |
|           | Y10   | Poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics, undetermined intent |
|           | Y11   | Poisoning by and exposure to antiepileptic, desative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified, undetermined intent |
|           | Y12   | Poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified, undetermined intent |
|           | Y13   | Poisoning by and exposure to other drugs acting on the autonomic nervous system, undetermined intent |
|           | Y14   | Poisoning by and exposure to other and unspecified drugs, medicaments and biological substances, undetermined intent |
|           | Y15   | Poisoning by and exposure to alcohol, undetermined intent |
|           | Y16   | Poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours, undetermined intent |
|           | Y17   | Poisoning by and exposure to other gases and vapours, undetermined intent |
|           | Y18   | Poisoning by and exposure to pesticides, undetermined intent |
|           | Y19   | Poisoning by and exposure to other and unspecified chemicals and noxious substances, undetermined intent |
|           | Y20   | Hanging, strangulation and suffocation, undetermined intent |
|           | Y21   | Drowning and submersion, undetermined intent |
|           | Y22   | Handgun discharge, undetermined intent |
|           | Y23   | Rifle, shotgun and larger firearm discharge, undetermined intent |
|           | Y24   | Other and unspecified firearm discharge, undetermined intent |
|           | Y25   | Contact with explosive material, undetermined intent |
|           | Y26   | Exposure to smoke, fire and flames, undetermined intent |
|           | Y27   | Contact with steam, hot vapours and hot objects, undetermined intent |
|           | Y28   | Contact with sharp object, undetermined intent |
|           | Y29   | Contact with blunt object, undetermined intent |
|           | Y30   | Falling, jumping or pushed from a high place, undetermined intent |
|           | Y31   | Falling, lying or running before or into moving object, undetermined intent |
|           | Y32   | Crashing of motor vehicle, undetermined intent |
|           | Y34   | Unspecified event, undetermined intent |
|           | Y87   | Sequelae of intentional self-harm, assault and events of undetermined intent |
### APPENDIX C: Sensitivity analysis—adjust odds ratios of characteristic associated with suicide or probable suicide deaths among older adults who died in Ontario between 2011 and 2015

| Characteristic                                    | OR   | 95% CI       | p value |
|---------------------------------------------------|------|--------------|---------|
| **Demographics**                                  |      |              |         |
| Age (continuous)                                  | 0.937| 0.928, 0.946 | <.0001  |
| Sex (reference=females)                           | 2.88 | 2.447, 3.39  | <.0001  |
| Marital Status (reference=married)                |      |              |         |
| Married (combined m=married & c=common-law)       | REF  |              |         |
| Widowed (w)                                       | 1.121| 0.942, 1.335 | .3064   |
| Divorced (d)                                      | 1.126| 0.899, 1.411 | .3247   |
| Single (s)                                        | 0.899| 0.696, 1.16  | .5142   |
| Other (combined missing, o=other, u=unknown)      | 0.823| 0.299, 2.268 | .661    |
| Income quintile (reference=quintile 5; recode missing to ‘3’) |      |              |         |
| Quintile 1                                        | 0.935| 0.761, 1.15  | .5965   |
| Quintile 2                                        | 0.845| 0.682, 1.047 | .3201   |
| Quintile 3                                        | 0.874| 0.703, 1.085 | .6168   |
| Quintile 4                                        | 0.876| 0.702, 1.094 | .6614   |
| Quintile 5                                        | REF  |              |         |
| Rural (reference=urban; recode missing to urban)  | 1.308| 1.098, 1.558 | .0026   |
| LTC (reference=no)                                | 0.096| 0.057, 0.162 | <.0001  |
| **Comorbidities (reference=no)**                  |      |              |         |
| Charlson score                                    |      |              |         |
| 0 (combined 0 and ‘no hospitalizations’)          | REF  |              |         |
| 1                                                 | 0.362| 0.295, 0.446 | .0234   |
| 2+                                                | 0.21 | 0.172, 0.257 | <.0001  |
| Congestive Heart Failure (CHF)                    | 0.456| 0.368, 0.565 | <.0001  |
| Myocardial Infarction (MI)                        | 0.748| 0.571, 0.98  | .0353   |
| Asthma                                            | 1.019| 0.826, 1.257 | .8599   |
| Chronic Obstructive Pulmonary Disease (COPD)      | 0.829| 0.712, 0.965 | .0156   |
| Diabetes                                          | 0.985| 0.841, 1.155 | .8566   |
| Hypertension                                      | 1    | 0.855, 1.169 | .9983   |
| Chronic Liver Disease (CLD)                       | 0.184| 0.087, 0.391 | <.0001  |
| Chronic Kidney Disease (CKD)                      | 0.745| 0.607, 0.915 | .0049   |
| Chronic Dialysis User (please remove if unstable estimates) | 0.438| 0.139, 1.386 | .1601   |
| Rheumatoid Arthritis                              | 0.856| 0.546, 1.342 | .4983   |
| Crohn’s/Ulcerative Colitis (UC)                   | 0.803| 0.357, 1.808 | .5964   |
| Cancer                                            | 0.749| 0.619, 0.906 | .003    |
| Dementia                                          | 0.307| 0.217, 0.434 | <.0001  |
| Mental Illness                                    |      |              |         |
| Psychotic disorders (PSY)                         | 2.826| 2.161, 3.697 | <.0001  |
| Non-psychotic disorders (nPSY)                    | 3.34 | 2.902, 3.843 | <.0001  |
| Substance abuse disorders (SUB)                   | 1.241| 0.944, 1.631 | .1218   |
| Others (OTH- Social problems and others; not inc. dementia) | 1.012| 0.677, 1.512 | .9534   |
APPENDIX C: (Continued)

| Characteristic                  | OR    | 95% CI       | p value |
|---------------------------------|-------|--------------|---------|
| New diagnosis of dementia       | 1.727 | 1.075, 2.773 | .0238   |
| New diagnosis of cancer         | 0.332 | 0.244, 0.452 | <.0001  |
| Number of hospitalizations      | 0.96  | 0.879, 1.048 | .362    |
| Number of ER visits             | 1.044 | 1.015, 1.074 | .0028   |
| Number of PHC visits            | 0.98  | 0.975, 0.986 | <.0001  |

Some variables were omitted due to non-reportable values. N = 354,967 (898 deaths by suicide or probable suicide); OR = odds ratio; CI = confidence interval, 95%.

REFERENCES (for Appendices A & B)

1. Schultz S, Rothwell D, Chen Z. Identifying cases of congestive heart failure from administrative data: a validation study using primary care patient records. Chron Dis Injur Canada. 2013;33(3):160–66. http://search.proquest.com/docview/1442472455/

2. Austin P, Daly P, Tu J. A multicenter study of the coding accuracy of hospital discharge administrative data for patients admitted to cardiac care units in Ontario. Am Heart J. 2002;144(2):290–96. https://doi.org/10.1067/mhj.2002.123839

3. Gershon A, Wang C, Guan J, Vasilevska-Ristovska J, Cicutto L, To T. Identifying Patients with physician-diagnosed asthma in health administrative databases. Can Resp J. 2009;16(6):183–88. https://doi.org/10.1155/2009/963098

4. Gershon A, Wang C, Guan J, Vasilevska-Ristovska J, Cicutto L, To T. Identifying individuals with physician diagnosed COPD in health administrative databases. COPD. 2009;6(5):388–94. https://doi.org/10.1080/15412550903140865

5. Hux J, Ivis F, Flintoft V, Bica A. Diabetes in Ontario: determination of prevalence and incidence using a validated administrative data algorithm. Diabetes Care. 2002;25(3):512–16. https://doi.org/10.2337/diabetes.25.3.512

6. Lipscombe L, Hwee J, Shah L, Booth G, Tu K. Identifying diabetes cases from administrative data: a population-based validation study. BMC Health Serv Res. 2018;18(1):316. https://doi.org/10.1186/s12913-018-3148-0

7. Tu K, Campbell N, Chen Z, Cauch-Dudek K, McAlister F. Accuracy of administrative databases in identifying patients with hypertension. Open Med. 2007;1(1):e18–e26. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2801913/pdf/OpenMed-01-e18.pdf

8. Tu K, Chen Z, Lipscombe L. Prevalence and incidence of hypertension from 1995 to 2005: a population-based study. CMAJ. 2008;178(11):1429–35. https://doi.org/10.1503/cmaj.071283

9. Weisman A, Tomlinson GA, Lipscombe LL, Perkins BA, Hawker GA. Association between allopurinol and cardiovascular outcomes and all-cause mortality in diabetes: A retrospective, population-based cohort study. Diabetes Obesity Metabol. 2019;21(6):1322–29. https://doi.org/10.1111/dom.13656

10. Fleet JL, Dixon SN, Shariff SZ, et al. Detecting chronic kidney disease in population-based administrative databases using an algorithm of hospital encounter and physician claim codes. BMC Nephrol. 2013;14(1).

11. Haroon NN, Austin PC, Shah BR, Wu J, Gill SS, Booth GL. Risk of dementia in seniors with newly diagnosed diabetes: a population-based study. Diabetes Care. 2015;38(10):1868–75. doi:10.2337/dc15-0491

12. Rosella L, Kornas K, Huang A, Bornbaum C, Henry D, Wodchis WP. Accumulation of chronic conditions at the time of death increased in Ontario from 1994 to 2013. Health Affairs. 2018;37(3):464–72. doi:10.1377/hlthaff.2017.1150

13. Wald R, Quinn RR, Adhikari NK, et al. Risk of chronic dis- alysis and death following acute kidney injury. Am J Med. 2012;125(6):585–93. doi:10.1016/j.amjmed.2012.01.016

14. Quinn R, Laupacis C, Austin E, et al. Using administrative data to study outcomes in dialysis patients: a validation study. Medical Care. 2010;48(8):745–50. https://doi.org/10.1097/MLR.0b013e3181e419fd

15. Widdifield J, Bombardier C, Bernatsky S, et al. An administrative data validation study of the accuracy of algorithms for identifying rheumatoid arthritis: the influence of the reference standard on algorithm performance. BMC Musculoskel Disord. 2014;15(1):216. https://doi.org/10.1186/1477-2525-15-216

16. Benchimol E, Guttmann A, Mack D, et al. Validation of international algorithms to identify adults with inflammatory bowel disease in health administrative data from Ontario, Canada. J Clin Epidemiol. 2014;67(8):887–96. https://doi.org/10.1016/j.jclinepi.2014.02.019

17. Antoniou T, Zagorski B, Loutfy M, Strike C, Glazier R. Validation of case-finding algorithms derived from administrative data for identifying adults living with human immunodeficiency virus infection. PLoS ONE. 2011;6(6):e21748. https://doi.org/10.1371/journal.pone.0021748

18. Hall S, Schulze K, Groome P, Mackillop W, Holowaty E. Using cancer registry data for survival studies: the example of the Ontario Cancer Registry. J Clin Epidemiol. 2006;59(1):67–76. https://doi.org/10.1016/j.jclinepi.2005.05.001

19. Jaakimainen RL, Bronskill SE, Tierney M, et al. Identification of physician-diagnosed Alzheimer’s disease and related dementias in population-based administrative data: a validation study using family physicians’ electronic medical records. J Alzheimer Dis. 2016;54(1):337–49. https://pubmed.ncbi.nlm.nih.gov/27567819/ Accessed 24 May 2020.

20. Steele LS, Glazier RH, Lin E, Evans M. Using administrative data to measure ambulatory mental health service provision in primary care. Medical Care. 2004;42(10):960–965. https://doi.org/10.1097/00005650-200410000-00004
21. Simcoe Muskoka District Health Unit. Simcoe Muskoka Health Stats (n.d.). OMHRS (Ontario Mental Health Reporting System). http://www.simcoemuskokahealthstats.org/resources/data-sources/omhrs
22. Statistics Canada. Leading causes of death, total population, by age group. Table 13-10-0394-01. Ottawa: Statistics Canada; 2020. https://doi.org/10.25318/1310039401-eng
23. Saunders NR, Lebenbaum M, Stukel TA, et al. Suicide and self-harm trends in recent immigrant youth in Ontario, 1996-2012: a population-based longitudinal cohort study. BMJ Open. 2017;7(9):e014863. https://doi.org/10.1136/bmjopen-2016-014863
24. World Health Organization. ICD-10 version:2019. Chapter 20—External Causes of Morbidity & Mortality: Internal self-harm (X60–X84). Geneva: WHO; 2020. https://icd.who.int/browse10/2019/en#/X60-X84
25. Canadian Institute for Health Information [CIHI]. Canadian coding standards for version 2018 ICD-10-CA and CCI. Ottawa: CIHI; 2018. https://secure.cihi.ca/free_products/Coding-Standards_v2018_EN.pdf
26. ICD9Data.com. Supplementary Classification of External Causes of Injury and Poisoning E000-E999. ICD: 2013. Retrieved from http://www.icd9data.com/2013/Volume1/E000-E999/E950-E959/default.htm
27. Fralick M, Thiruchelvam D, Tien HC, Redelmeier DA. Risk of suicide after a concussion. CMAJ. 2016;188(7):497–504. https://doi.org/10.1503/Cmaj.150790
28. Zaheer J, Jacob B, de Oliveira C, Rudoler D, Juda A, Kurdyak P. Service utilization and suicide among people with schizophrenia spectrum disorders. Schizophrenia Res. 2018;202:347–53. doi:10.1016/j.schres.2018.06.025
29. Grigoriadis S, Wilton AS, Kurdyak PA, et al. Perinatal suicide in Ontario, Canada: a 15-year population-based study. CMAJ. 2017;189(34):E1085–E1092. doi:10.1503/cmaj.170088 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5573543/?tool=pmcreport=abstract