12-2-2020 1:00 PM

Trends and Factors Associated with Suicide Deaths in Older Adults

Eada Novilla-Surette, *The University of Western Ontario*

Supervisor: Booth, Richard, *The University of Western Ontario*
: Shariff, Salimah, *ICES Western*
A thesis submitted in partial fulfillment of the requirements for the Master of Health Information Science degree in Health Information Science

Abstract

Suicide in older adults is a significant overlooked problem worldwide; particularly in Canada where a national suicide prevention strategy has not yet been established. This population-level study utilized and analyzed linked administrative health care databases (from 2011-2015) that were available at ICES (provincial health care administrative data steward), to build a better understanding of suicide (rate; trends; risks/preventive factors) in older adults living in Ontario, Canada. The findings suggest that suicide remains a persistent cause of death in older adults (with an average annual suicide rate of 0.1 per 1000 people over 5 years; the risks include being male, living in rural areas, having a mental illness, a new dementia diagnosis, and increased emergency department visits; while the preventive factors include increased age, living in LTC, having chronic health conditions, and increased interactions with primary health care. The insights from this study could potentially generate evidence-informed suicide prevention programs/policies for older adults in Canada.

Keywords

Older Adult Suicide; Senior Suicide; Elderly Suicide, Factors of Suicide; Suicide; Mental Health; Population Health

Summary for Lay Audience

Suicide in older adults is an important public health problem worldwide. In Canada, there is no national suicide prevention strategy that has been created. To this date, there is research that has explored suicide within older adult populations, but some of the information do not agree with what others have found. This makes it hard to tell what predicts suicide in older adults.

This study's main goal was to better understand the common factors related to suicide in older adults living in Ontario, Canada. It used data from ICES (an independent, non-profit research institute, which houses health and health-related administrative data of Ontarians) in order to identify older adults who died by either suicide or other non-suicide between January 2011 to December 2015.

This study found that the older adults who died by suicide were younger men who were married, diagnosed with a physical health condition, have received a mental health diagnosis, were less connected to the health care system, and were not living in a long-term care (LTC) facility. Also, the chances are that an older adult who died by suicide will most likely be a male, living in rural areas, having a diagnosis of mental illness, having a new diagnosis of dementia, and increased visits to emergency rooms; and least likely to be older in age, living in a LTC facility, have a chronic health condition, and have visited their family doctor more.

This study focused on factors related to older adult suicide, which helps to understand suicide in older adults living in Ontario. The hope of this study is to one day be able to put an end to older adult suicide.

Co-Authorship Statement

Eada Novilla-Surette completed the following work under the supervision of Dr. Richard Booth, and the advisement of Dr. Salimah Shariff and Britney Le, who will be co-authors on future publications produced from this thesis.

Dedication

To *Raina*, *Jesse* and *Roberta,* for always reminding me to *turn on the light*

To *Mama* and *Papa*, for bestowing upon us *the delight of poetic adventures*

Acknowledgments

Deepest thanks to my supervisor, *Dr. Richard Booth*, for always enlightening me with your thought-provoking insights, for your patience in guiding me in the right direction, and for your motivational words that kept me going this past two years. You have truly inspired me in this journey! To *Dr. Salimah Shariff*, thank you very much for your expertise with all-things-ICES, for sharing your knowledge throughout the research process, for your patience in providing constructive feedbacks, and for your overall remarkable intelligence and full support. Richard and Salimah, both of you have played an instrumental role in the completion of this thesis project. I have truly learned a lot from you both, and will carry your teachings along with me throughout my career/life. With this, I am truly grateful. A special thanks to *Britney Le* as well, for the advice and support during data generation and statistical analysis. Thanks, Britney!

To *Dr. Jennifer Lapum*, for reminding me to be curious and reflective in the most artistic way possible. To *Wendy Garcia*, for always giving me sound advice and rooting for me. To *Dr. Lori Schindel Martin*, for inspiring me care for the older adult population.

To my *L.B.*, for handling my septapolar personalities, for nourishing me during late night hours, and for always supporting me during my #EdzBrainBreak sessions. *M.K.S.S.*

To *Papa Tony*, for all the inspiring conversations we've had (and continue to have) and for consistently reminding me to maintain balance in life. To *Mama Josie*, for supporting me no matter what I do and providing me with delicious food. To *Raina Momo*, for being my daily dose of silliness and happiness ---- you three are my constant inspiration in life! *Salamat!*

To *Auntie Vida*, for your ceaseless love and support. To *Doña Lola Cordia*, for teaching me to work harder and never give up. To *Uncle Fu*, for inspiring me to be a researcher and a photographer ever since I was ten. To *Auntie Fely*, for making my childhood whole. To *Cuz Jess*, for being my cheerleader from afar. To the rest of the *Prado and Novilla* family, *Maraming Salamat po*!!

To *Mom Shelley*, *Dad Gerry*, *Jenna*, and *Jace*, for keeping me sane via house visits, family dinners, game nights, and sunset strolls. *Merci!*

To my friends (BFF Dessa, Setareh, Brent, Bim-Bim, Angelyniee, Arvin, Elisa, Neda, Cindy, Bea, Janina, Julia, Stephanie S., RU Nursing friends, RSHS G2, for the love and encouragement. *My constants!*

To *Ryan Chan*, for giving me confidence and for being an overall great (foodie) friend!

To my MHIS 2020 cohort and UWO peers (Ambassador Vy, Ebenezer, Jess, Tiff, Lucas, Talia, Alex, Sandy, and Sam), for the laughs and motivations when days went tougher than expected.

Lastly, a special shout-out to *Kimchi House*, for feeding my soul during stressful times.

Dataset Acknowledgments

Parts of this material are based on data and/or information compiled and provided by Canadian Institute for Health Information (CIHI). However, the analyses, conclusions, opinions and statements expressed in the material are those of the authors, and not necessarily those of CIHI.

Thank you to IMS Brogan Inc. for use of their Drug Information Database.

Thank you to Ontario Ministry of Health and Long-Term Care: IntelliHEALTH ONTARIO for use of their data to gather information on older adult population mortality rate.

Parts of this material are based on data and information provided by Cancer Care Ontario (CCO). The options, results, view, and conclusions reported in this paper are those of the authors and do not necessarily reflect those of CCO. No endorsement by CCO is intended of should be inferred.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1

1 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 problem in every country and every community worldwide" (WHO, 2014, p. 31), and results in approximately 800,000 deaths each year (WHO, 2018). In Canada, suicide is the 9th leading cause of death among all age groups and there are about 4,000 reported cases of suicide cause of death annually (Navaneelan, 2017; PHAC, 2019; PHAC, 2020; Statistics Canada, 2019).

As of 2017, WHO (2018) reported that there are about 40 developed and developing countries that have established a national suicide prevention strategy, including the United States of America (U.S.A.), Switzerland, and Australia. To date, Canada does not possess a ratified national strategy related to suicide prevention (CASP, 2009; Spiwak et al., 2012; Vogel, 2011; WHO, 2018), which has resulted in provincial and territorial health system policy gaps (Spiwak et al., 2012; Vogel, 2011). With suicide as the 2nd leading cause of death in Canadians under 30 years, most of the existing suicide prevention programs in Canada target youth and young adults (Navaneelan, 2017; PHAC, 2019; Spiwak et al., 2012; Vogel, 2011). One age cohort that has been largely left out of contemporary suicide prevention programs and policy in Canada are older adults. Currently, individuals who are aged 65 years and older comprise roughly 13% of the Canadian population (CMA, 2016; Statistics Canada, 2017). It is projected that the population of older adults living in Canada will continue to increase in the coming decades, with estimates suggesting older adults will make up 22-25% of the Canadian population by year 2056 (Decady & Greenberg, 2014; PHAC, 2014; Statistics Canada, Demography Division, 2016). Due to the various acute and chronic health issues that are becoming more prominent in older adults, suicide appears to be an overlooked issue amongst this cross-section of the population, despite the fact that older adults have the second highest rates of suicide in Canada (after adults ages 40-59), resulting in the 12th

leading cause of death in this age group (Butcher & Ingram, 2018; Couillet et al., 2017; Navaneelan, 2017; PHAC, 2019; PHAC, 2020; WHO, 2014; WHO, 2019).

To date, there has been some research generated in exploring the burden of suicide within older adult populations as well as the factors that influence suicide. Despite this available information, there are still conflicting information regarding precursors and predictors of suicide in older adults that need to be further explored, especially in the Canadian context. For instance, while some reports indicate that diagnosis of dementia, depression, and cancer are associated with older adult suicide (Choi et al., 2019; Erlangsen et al., 2008; Erlangsen et al., 2015; Juurlink et al., 2004; Klaassen et al., 2019; Miller et al., 2008; Seyfried et al. 2011); other research contradict these associations (Ahmed et al., 2017; Conejero et al., 2018; Diehl-Schmid et al., 2017; Kjoseth et al., 2010; Kiosses et al., 2014). Interestingly, several studies have identified that older adults who died by suicide commonly visited their physicians within a month before death (Cheung et al., 2018; Conejero et al., 2018; Juurlink et al., 2004; Miller et al., 2008). Furthermore, Miller et al. (2008) reported that 25% of older adults in their case-control study of 1408 patients (128 cases and 1280 control) were seen by a physician within only one week prior to suicide. It has been theorized that older adult suicidality sometimes goes unnoticed clinically, as health care professionals possess a tendency to only categorize an individual as *suicidal* when they are diagnosed with depression or other mental health issues (Deuter et al., 2016). This preposition towards privileging depression and other diagnosed mental health issues as a singular causal mechanism to suicidal ideation can result in health care professionals missing other individual and contextual factors predictive of suicide. In addition to this mentality, the added "stigmatization of suicide" towards all age groups continues to persist (Spiwak et al., 2012, p. 339). Subsequently, suicide in older adults appears to be an overlooked public health concern, especially in Canada where a national suicide prevention strategy has not yet been established. Due to this practice and policy gap, factors related to older adult suicide require further evaluation and research examination.

1.1 Purpose and Objectives of the Research Study

The purpose of this research study was to better understand the prevalence and predictors of suicide in older adults living in Ontario, Canada. In order to accomplish this goal, a population-level analysis was completed to:

a) Describe the 5-year trend of suicide deaths among older adults in Ontario, Canada (2011 to 2015);
b) Develop profiles of older adult suicide and non-suicide deaths; and,
c) Identify factors associated with suicide deaths in older adults.

1.2 Significance to Health Information Science

One of the key tenets of the Health Information Science graduate program at Western University is the essential role that interdisciplinary collaboration plays in the discussion and examination of health-related issues. Data, especially health data, is the root source of evidence that drives decision-making processes to have informed implementation and improvement of approaches. CIHI (2013) describes that health data enables one to better understand the context of illness in relation to the patients' needs and the population as a whole. This study highlights the value of data in an attempt to better understand the burden of suicide in older adults. As such, it is driven by the analysis of provincial-level data over multiple years to explore significant trends and factors surrounding older adult suicide, with the hope of informing policy and patient care.

Chapter 2

2 Literature Review

A literature review was conducted using the following databases: CINAHL, PubMed and Scopus. The keyword search terms used to help execute this literature review included, "*older adult suicide*", "*elderly suicide*", "*senior AND suicide*", "*Suicid* AND older* OR elderly*", and "*self-harm AND older* OR elderly*". Supplementary resources (e.g., websites; scholarly books) were also consulted to aid in defining suicide and identifying its prevalence and burden. The main websites used in this literature review were obtained from World Health Organization (WHO), Centre for Addiction and Mental Health (CAMH), Canadian Mental Health Association (CMHA), Centre for Suicide Prevention (a branch of the CMHA, in Alberta), and Public Health Agency of Canada (PHAC). De Leo's (2001) scholarly book, titled *Suicide and Euthanasia in Older Adults: A Transcultural Journey*, was chosen as one of the supplementary resources because it contained a comprehensive review of older adult suicide in various cultures worldwide.

The literature review is divided into four sections: (a) general definition, prevalence, and impact of suicide; (b) predictors of suicide; (c) preventors of suicide; and, (d) health care visits and suicide deaths. These sections were established based on the insights derived from the literature, which are explained through a narrative approach. Gaps in the literature are also highlighted.

2.1 Suicide: Definition, Prevalence and Impact

2.1.1 *Definition of Terms*

The term *suicide* possessed variation in description and definition across the consulted resources. WHO (2020) directly defines suicide as "the act of deliberately killing oneself" (para. 1). CAMH (2020) describes suicide as "the act of intentionally causing one's own death" (para. 1), while CMHA (2016) defined the term as the "means that someone ends their life on purpose" (para. 2).

According to the U.S. Center for Disease Control and Prevention, *suicide* (and related terms, *suicide attempt* and *suicidal ideation*) fall under the *Self-directed Violence* category, which encompasses "behaviors that are self-directed and deliberately results in injury or the potential for injury to oneself" (Crosby et al., 2011, p. 11; Klonsky et al., 2016, p. 309). In this work, *suicide* is defined as "death caused by self-directed injurious behavior with an intent to die as a result of the behavior"; *suicide attempt* is defined as "a nonfatal, self-directed, potentially injurious behavior with an intent to die as a result of the behavior even if the behavior does not result in injury"; *suicidal ideation* is defined as "thinking about, considering, or planning suicide" (Crosby et al., 2011, p. 21; Klonsky et al., 2016, p. 309).

Suicide is also commonly described as a behaviour driven by life stressors (Crocker et al., 2006 as cited in Kjolseth et al., 2010; Deuter et al., 2016). For instance, "suicide is [described as] intrapsychic", meaning that the person is unable to cope with the events or pain of current situations in life (Leenars, 2001, p. 162). This type of description tends to place blame on the individual, deeming the person as incapable in dealing with the difficulties in life. Kjolseth et al. (2010) conducted a psychology autopsy study with 63 people whose older adult family member or friend died by suicide means. From their interviews with the participants, Kjolseth et al. (2010) collectively characterized suicide as an "existential choice" (p. 210) based on the recurring theme of suicide being a choice of dying rather than experiencing the burdens in the last dependent days of life. Furthermore, Kjolseth et al. (2010) described that older adults examined in their study were "sad but not depressed" (p. 215) while they were still alive, meaning that they had the desire to live longer but were "physically aware" (p. 212) of the "unbearable" (p. 213) fact that their functional decline may affect the quality of their lives as they prolonged living. Like Leenars (2001), Kjolseth's (2010) study also emphasized suicide as being a choice driven by the individual, who are conceptualized to be at some level of fault. This suggests that older adults have different triggers from younger age groups. For instance, youths (ages 25 years and younger) tend to be mainly triggered by academic stress, bullying, family violence, death of a loved one or a celebrity, and discrimination against personal identity to name a few (Bilsen, 2018; Grimmond et al., 2019).

With these definitions of *suicide*, it is important to also understand its distinction from Medical Assistance in Dying (MAiD). The term *Medical Assistance in Dying* is described as:

> "a. the administration of a substance by a medical practitioner or nurse practitioner at the request of a person that causes that person's death (also known as voluntary euthanasia); or
>
> b. a medical practitioner or nurse practitioner prescribing or providing a substance to a person, at that person's request, that can be self-administered and that will cause the person's own death (also known as medically- or physician-assisted suicide." (Department of Justice, 2016, p. 7; Nicol & Tiedemann, 2018, p. 9)

The Centre for Suicide Prevention (2018) in Canada further described *suicide* as an intent to get rid of "the pain of living", being "carried out alone and in secrecy" and often involved violent methods (p. 1). Wiebe et al. (2020) in their secondary analysis of patients who had been found ineligible for MAiD and health providers of MAiD, all participants concluded "that suicide was uncertain and difficult, that it was usually done alone and without support, while MAiD was certain, painless and was done in a context of acceptance" (p. 806). These common distinctions and definitions signify the complexity and controversial perspectives surrounding *suicide* and *MAiD*, which need to be further explored.

The often-normalized common terms of suicide, such as *committed suicide, completed suicide, failed attempt, nonfatal suicide, successful suicide, suicidal gesture,* and *suicide threat*, stem from a lineage of past judgemental and stigmatized views against individuals with suicidal ideation or who seek help (Crosby et al., 2011; Klonsky et al., 2016; Olson, 2011; Sommer-Rotenberg, 1998). For example, suicide has been previously viewed as an illegal action, a "contamination" in the family that needs to be avoided, and a "demonic" selfish act (Sommer-Rotenberg, 1998, p. 239). Klonsky et al. (2016) cautioned readers to be vigilant of these unacceptable terms as they may be "pejorative or misleading" (p. 309). Two authors further suggested the adoption of a more "culturally-sensitive" (Olson,

2011, p. 3), “neutral and compassionate language” (Sommer-Rotenberg, 1998, p. 240) to describe suicide deaths and attempts.

2.1.2 *Prevalence of Suicide*

Suicide is a global phenomenon that affects all people across ages, gender, ethnicity, and social-economic status (CAMH, 2020; CMHA, 2016; PHAC, 2019; WHO, 2014; WHO, 2019). It is the 15th leading cause of death worldwide, and has been found to occur at higher rates in low- and middle-income countries, vulnerable groups, youth, older adults, and particularly among men (WHO, 2014; WHO, 2019). According to the World Health Organization (WHO, 2014; WHO, 2019), approximately 800,000 people die annually due to suicide. In Canada, there are about 4000 people who die by suicide every year, approximately 11 people each day (CMHA, 2016; PHAC, 2020). This average has remain largely unchanged over the last 15 years in Canada, from 2001 to 2016 (PHAC, 2019).

Globally, *suicide attempts* most commonly occur in youths under 15 years old and *suicide deaths* are most prominent among older adults compared to the other age groups for both men and women (Butcher & Ingram, 2018; Couillet et al., 2017; Ferguson et al., 2018; Navaneelan, 2017; PHAC, 2019; WHO, 2014). In Canada, about one-third of suicide deaths are among people who are 45-59 years old, but are closely followed in numbers by those aged 60-69 and 85+ (PHAC, 2020). Additionally, the risk of suicide is over six times greater for men aged 80+ years than similarly aged women (PHAC, 2019). With these concerning numbers, it is also imperative to consider the issues of underreporting and misclassification of suicide deaths which in turn may affect the quality of statistics presented (Deuter et al., 2016; WHO, 2014; WHO, 2019). Older adult suicides are mostly reported as “accidents or deaths from natural causes,” and are more likely classified as *suicide death* when overt methods (e.g. firearms) were used (Deuter et al., 2016, p. 145). 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 (Deuter et al., 2016; WHO, 2019).

2.1.3 *Burden of Suicide*

Suicide is a complex issue that possesses broad impacts on individuals, families, and at the societal level (CAMH, 2011; Deuter et al., 2016; Link et al., 2020; Pitman et al., 2014; Sommer-Rotenberg, 1998; WHO, 2014). It can create significant short- and long-term psychological effects for others within the social network of the deceased person (CAMH, 2011; Link et al., 2020; Pitman et al., 2014). For example, the family members or friends of the individual who died by suicide experience immediate (or lingering) feelings of shame, blame, and anger; moreover, the risk of suicide, admission to psychiatric care, and depression are heightened (CAMH, 2011; Link et al., 2020; Pitman et al., 2014). These feelings of anger and blame are emotions commonly reported by bereaved-by-suicide family members and other individuals in the social network, as they struggle to process the sudden death of loved ones (Link et al., 2020; Pitman et al., 2014).

2.2 Predictors of Older Adult Suicide

2.2.1 *Age, Gender, and Marital Status*

As previously mentioned, WHO (2014) and PHAC (2019) established that older adult men are generally at a higher risk of suicide over women. In their 2018 progress report, PHAC (2019) further claimed that older adult men (80 years and older) had six times higher risk of suicide than older adult women (80 years and older). The higher risk of suicide in older adult men is consistent with the findings in three descriptive studies found in the literature (Cheung et al., 2018; Choi et al., 2019; Erlangsen et al., 2015).

Cheung et al. (2018), in their descriptive study of 225 older adults (aged 65+) in New Zealand, reported that more men died by suicide than women. The older adult men in their study performed violent methods of suicide, including the use of firearms; older adult women generally utilized non-violent methods of suicide, including drug overdose (Cheung et al., 2018). In another descriptive study examining 4792 older adults (aged 65+) who died by suicide from 1990 to 2009 in Denmark, Erlangsen et al. (2015) reported a higher proportion of 65+ years older adult men (*n*=3021, 63%) who died by

suicide than women (*n*=3021, 37%). They also reported that older adult men and women who were married or in active relationships had a lower suicide rate (Erlangsen et al., 2015).

Another descriptive study of 16,924 older adults (aged 65+) with physical health problems in the U.S.A. described higher odds of suicide risk for older adult males compared to older adult females (AOR=1.17, 95% CI 1.06-1.30, $p<.01$); higher odds of suicide risk with 75-84 age (AOR=1.57, 95% CI 1.46-1.69, $p<.001$) and 85+ years (AOR=1.80, 95% CI 1.62-2.00, $p<.001$); and, lower odds of suicide risk when widowed (AOR=0.80, 95% CI 0.73-0.888, $p<.001$), divorced (AOR=0.91, 95% CI 0.73-0.88, $p<.01$), or single (AOR=0.82, 95% CI 0.71-0.95, $p<.01$) (Choi et al., 2019).

2.2.2 *Medical Illnesses*

Dementia, depression, and cancer were the predominant medical illnesses found to be highly associated with older adult suicide. Other reported physical and mental illnesses associated with increased risk of suicide include seizure, concussion, congestive heart failure, chronic obstructive pulmonary disease (COPD), liver diseases, psychotic disorder, anxiety disorders particularly post-traumatic stress disorder, bipolar disorder, hypertension, unspecified gastrointestinal symptoms, cerebrovascular disease, and unspecified cardiac symptoms and other heart diseases (Choi et al., 2019; Conejero et al., 2018; Erlangsen et al., 2015; Juurlink et al., 2004; Kiosses et al., 2014; Klaassen et al., 2019; Nakanishi & Endo, 2017; Park et al., 2014; Seyfried et al., 2011; Voaklander et al., 2008). Multiple illnesses or comorbidities have also been reported as posing a much higher risk of suicide deaths in older adults (Cabello et al., 2019; Erlangsen et al., 2015; Juurlink et al., 2004; Miller et al., 2008).

2.2.2.a. Dementia. In a 5-year U.S. cohort study comprising of 294,952 older adult veteran patients (241 patients died by suicide) aged 60+ years old, Seyfried et al. (2011) reported that 75% of the older adults who died by suicide had a new diagnosis of dementia. They categorized new diagnosis in their study as patients who were not diagnosed with dementia for three years or more (Seyfried et al., 2011). The association

between new diagnosis of dementia is further supported by an 11-year study conducted by Erlangsen et al. (2008) in Denmark. They observed 2,467,539 older adults aged 50+ years old, in which 5,699 died by suicide (Erlangsen et al., 2008). They determined that death by suicide was more common during the first six months after the initial diagnosis of dementia, with the highest suicide rates in the 50-69 age group (Erlangsen et al., 2008). In addition to this, the 50-69 age group had an 8 to 10 times higher risk of suicide compared to those who were not diagnosed of dementia. Those aged 70+ years old possessed a three times higher risk even though they made up the largest proportion of being diagnosed with dementia (Erlangsen et al., 2008).

Aside from the diagnosis timeline of dementia, Seyfried et al. (2011) emphasized that the type or stage of dementia diagnosis did not affect the risk for suicide. However, another U.S. study claimed that semantic dementia, a rare neurodegenerative disorder that causes loss of meaning in knowledge and concepts, was associated with suicide in older adults based on the 25 patient cases they analyzed (Sabodash et al., 2013). Though an important finding, the authors suggest caution in the interpretation of the results due to the limited small sample size of the study.

In a systematic review of published articles, Diehl-Schmid et al. (2017) summarized that there were contradicting results regarding the association between dementia and suicide in older adults and could not conclusively determine whether dementia was an associated factor. However, they were able to pinpoint that older adults who were in the early stages of dementia were generally at a higher risk for suicide compared to those who were in the advanced stages (Diehl-Schmid et al., 2017). In another review, Cipriani et al. (2013) summarized that a possible reason for this risk was due to the intact or less impaired awareness of one's personal dignity in the early stages of dementia, enabling them to deliberate plan and act. This reasoning was further supported by another narrative review which outlined that an increased cognitive decline or advanced dementia decreased suicide risk (Kiosses et al., 2014).

2.2.2.b. Depression. In a population-based case-control study in Ontario, Canada of 1329 suicide cases in older adults (aged 66+) from 1992 to 2000, Juurlink et al. (2004)

listed depression as one of the top diagnoses associated with older adult suicide. The diagnosis of dementia and the combined effect of dementia and depression were not included in this study, but the emphasis of a diagnosis of depression entails awareness of its risk. Depression can also manifest in other physical and psychological conditions besides dementia, particularly when these conditions become chronic as in cancer, arthritis, musculoskeletal conditions and other diseases (Ahmed et al., 2017; Choi et al., 2019; Juurlink et al., 2004).

Seyfried et al. (2011) reported that among the 241 older adults (aged 65+) who died by suicide, almost 25% had a diagnosis of depression. They further emphasized that among the other psychiatric diagnoses, a history of depression significantly poses a higher risk of dying by suicide (OR=2.04, 95% CI 1.45-2.85, $p<.0001$) (Seyfried et al., 2011). Additionally, anti-anxiety (OR=1.98, 95% CI 1.48-2.65, $p<.0001$) and antidepressant (OR=2.11, 95% CI 1.57-2.84, $p<.0001$) medications had a significant association to suicide death in older adults as well. In a case-control study conducted in the U.S.A of 128 suicide deaths from 1994 to 2002, Miller et al. (2008) reported that having a diagnosis of mental illness was a contributing factor to suicide, particularly affective disorders (OR=2.3, 95% CI 1.3-4.2, $p<.001$), and anxiety/personality disorder (OR=2.2, 95% CI 1.3-3.6, $p<.001$). Furthermore, antidepressants (OR=2.0, 95% CI 1.2-3.2, $p<.001$) and opioid analgesics (OR=1.6, 95% CI 1.0-2.5, $p<.001$) were significantly associated with suicide (Miller et al., 2008).

Other studies have reported mixed findings related to the association between depression and suicide ideation or death; however, systemic underreporting and lack of transparency in reporting older adult mortality may also contribute to this qualified relationship (Ahmed et al., 2017; Conejero et al., 2018; De Gioannis & De Leo, 2010 and Pridmore, 2011 as cited in Deuter et al., 2016; Juurlink et al., 2004; Kjoseth, Ekeberg & Steihaug, 2010; WHO, 2016).

2.2.2.c. Cancer. The presence of cancer in older adults has been reported by several studies as highly associated to suicidal death and ideation (Choi et al., 2019; Erlangsen et al., 2015; Klaassen et al., 2019; Miller et al., 2008; Voaklander et al., 2008).

The risk is even higher when cancer pain, metastasis, and progressed cancer stages are involved (Choi et al., 2019; Klaassen et al., 2019; Miller et al., 2008). Based from an analysis of older adults' suicide notes, Choi et al. (2019) mentioned that a prolonged pain from cancer was the most common reason for suicide in older adults. Contrastingly, Miller et al. (2008) noted that cancer still remained significantly associated with suicide deaths even when pain resulting from the active cancer was controlled (n=128, OR=2.3, 95% CI 1.1-4.8, p<.001).

Erlangsen et al. (2015) found that older adults (aged 65+) have a higher risk of suicide when they are diagnosed with the following types of cancer: lung, lymph node, gastrointestinal, breast, genital, and bladder. A diagnosis within three years of the previously stated cancer types, particularly gastrointestinal cancer and brain cancer, was linked to an increased risk of suicide deaths in diagnosed older adults compared to those who were not diagnosed (Erlangsen et al., 2015). Moreover, those who were diagnosed with brain cancer were reported to have a 3.5 times higher suicide ideation and deaths (Erlangsen et al., 2015). In an Ontario (Canada) population-based matched control study, Klaassen et al. (2019) indicated the high association between various types of cancer (i.e., breast, colorectal, melanoma, lung, bladder, endometrial, thyroid, kidney and oral cancer) and suicide (Klaassen et al., 2019). Klaassen et al. (2019) emphasized the higher risk of suicide deaths "within the first 50 months, [or a little over 4 years], after diagnosis [of cancer]" (p. 5).

2.2.3 *Socioeconomic Status and Disability*

Low socioeconomic status, specifically low household income and food insecurity, is considered one of the prominent factors associated to suicidal ideations and suicide attempts in older adults (Dombrovski et al., 2018; Ju et al., 2016; McConnell et al., 2016). Additionally, in a cross-sectional study of 58,590 older adults (aged 65+) conducted in South Korea, Ju et al. (2016) emphasized that a combination of food insecurity, living alone, and low income was more strongly associated to suicidal ideation more than either factor alone. In a retrospective case-control study of 162 older adults (55 to 85 years) in U.S.A., Dombrovski et al. (2018) reported that a perceived experience of

socioeconomic loss was associated with suicidal ideation and suicide attempt; moreover, the presence of depression in older adults tends to heighten the perception of socioeconomic loss, which then led to an increased risk of suicide ideations and attempts. The results remain the same when confounding variables, namely relationship status and evident hardships (i.e., "debts, financial difficulties, changes in income, or low income"), were factored into the model (Dombrovski et al., 2018, p. 912).

Findings from a study that analyzed participant data from two cross-national studies yielded important insights related to socioeconomic status (i.e., education, food deprivation, and income) and suicide. Cabello et al. (2019) gathered data from the following cross-national studies: (a) the World Health Organization (WHO) Study on Global AGEing and Adult Health (SAGE), which included data from low and middle income countries (LAMICs) such as China, Ghana, India, Mexico, Russia and South Africa arising between 2007-2010; and, (b) the Collaborative Research on Ageing in Europe (COURAGE), which included data from 3 high-income European countries namely Finland, Poland and Spain arising between 2011-2012. They included all adults ages 18 years and older, including a significant older adult (aged 50+; n=18,854) demographic in their sample (Cabello et al., 2019). For both LAMICs and high-income countries, Cabello et al. (2019) reported that having a higher household income was not associated with suicide attempts in any age group (young-and-middle age group, 18-64; older adult age group, 65+). Contrastingly, food deprivation was associated with higher odds and disability had slightly higher odds for suicidal ideations and suicide attempts in all age groups (in all income levels) (Cabello et al., 2019). The level of education did not have any significant influence on suicide (Cabello et al., 2019), which was similar to other findings (Choi et al., 2019; Corna et al., 2010).

In another study, a Canadian secondary data analysis of survey results from the Canadian Community Health Survey (CCHS), McConnell et al. (2016) reported that disability, accompanied by economic hardships such as food insecurity and low household income, was a significant factor associated with suicide in older adults. The influence of household income on suicide in McConnell et al.'s (2016) study contrasts that of Cabello et al.'s (2019) study discussed prior.

2.2.4 *Long-Term Care (LTC) Facilities*

Living within or transitioning to long-term care (LTC) facilities was also associated with higher rates of suicide (Choi et al., 2019; Mezuk et al., 2019). In a U.S. cross-sectional descriptive study of 47,759 older adult (aged 55+) deaths from 2003 to 2015, Mezuk et al. (2019) reported that there were 1037 deaths that occurred in LTC in some manner (980 suicide deaths and 57 other or undetermined deaths). Among this number (*n*=1037), 428 lived in a facility prior to death, 449 were transitioning into and out of LTC, and 160 were others; the largest group of suicide deaths linked to LTC come from the group who frequently transitioned into and out of LTC (Mezuk et al., 2019). The time duration of living in LTC and transitioning to LTC were not emphasized; no specific odds were mentioned as well.

As previously discussed in other sections, Choi et al. (2019) conducted a U.S. descriptive study analyzing quantitative data and coroner/medical examiner or law enforcement (CME/LE) summary reports (content analysis of suicide notes or reports from informal support systems as recorded by CME/LE) from the National Violent Death Reporting System (NVDRS) of older adults aged 65+ (*N*=16,924). In the content analysis of the reports (*n*=5077 CME/LE reports) relating to nursing home placements, 4.6% of the reports mentioned a fear or refusal to be placed in a nursing home while 4.4% of the reports mentioned the concern of becoming a burden (physically and financially) to loved ones as health declines (Choi et al., 2019). Some informal support systems reported that clients mentioned of their willingness to die rather than ending up in a nursing home, and as such took their own lives prior to nursing home admission (Choi et al., 2019, p. 363). The exact number of suicide deaths related to nursing home placement were not reported as this theme arose from their analysis of reports, however they emphasized that the theme included older adults who have a pending nursing home placement, have recently been placed in a nursing home, and have been previously placed in a nursing home (Choi et al. (2019)

Seyfried et al. (2011) found that a nursing home admission lowered the suicide risk among older adults (60+) (*n*=241, OR=0.33, 95% CI 0.14-0.75, *p*=0.0081); however, suicidal ideation was not fully examined in this study.

2.3 Preventors of Older Adult Suicide

In addition to the predictors of suicide in older adults, protective factors of older adult suicide were also reported in the literature. Some of the previously reported protective factors included the presence of social support networks; positive coping mechanisms; religious or spiritual beliefs; therapy groups; and a diagnosis of schizophrenia (Conejero et al., 2018; Kjolseth et al., 2010; Marty et al., 2010; McConnell et al., 2016; Navaneelan, 2017; Richman, 1995; Seyfried et al., 2011; Van Orden et al., 2010; WHO, 2014). While most of the protective factors reported in the literature were fairly unsurprising, a diagnosis of schizophrenia as a protective factor was interesting to note. Seyfried et al. (2011) reported that a diagnosis of schizophrenia, a mental illness affecting the executive and planning deficits of the brain, was associated with a significantly lower risk of suicide (OR=0.34, 95% CI 0.12-0.95, p=.0389). To date, no other published research has been found to substantiate Seyfried et al.'s (2011) finding of schizophrenia diagnosis acting as a protective mechanism against suicide in older adults.

Having a strong social support network appears to be a central protective factor against suicide in older adults reported in the literature. In a Canadian study utilizing data from Canadian Community Health Survey (CCHS), Corna et al. (2010) reported that social support was less likely to be associated with suicidal thoughts in older adults (aged 55+, *n*=36,984). Other studies also found that the presence of family, friends, and supportive communities helped alleviate feelings of distress, improved resiliency from life events, and created a sense of belongingness, which in turn had an impact on suicidal ideation and suicide attempts (Corna et al., 2010; Conejero et al., 2018; McConnell et al., 2016; Navaneelan, 2017; Park et al., 2013; Van Orden et al. 2010 as cited in Deuter et al., 2016). Park et al. (2013) added that the perceived social support, particularly from family members, that older adults (aged 55+) received had an influence in decreased suicidal

ideation. In addition to this, the acceptance and positive outlook of older adults towards their last stages of life influence emotion-focused coping strategies as they encounter new, stressful, and traumatizing life events, such as death of a spouse or loss of physical ability (Kjolseth et al., 2010; Marty et al., 2010).

2.4 Health Care Visits and Suicide Deaths

Several studies have reported that older adults commonly visit a physician or other health care provider within a month before death (Cheung et al., 2018; Conejero et al., 2018; Juurlink et al., 2004; Miller et al., 2008; Worche & Gearing, 2010). Cheung et al.'s (2018) descriptive study of 225 older adults who died by suicide in New Zealand reported that the older adults (aged 85+) who visited their general practitioners (GPs) within a month before suicide death had consulted their GPs regarding aspects of their physical health. Individuals who were below 85 years of age (especially those aged 65-74), visited their GPs for mental health reasons and were more in contact with psychiatric services (Cheung et al., 2018). As previously mentioned, Miller et al. (2008) reported that older adults visited physicians within a month before suicide death (128 suicide cases), and about 25% of the cases were seen by a physician within a week before suicide death. This is consistent with Juurlink et al.'s (2004) population-based case-control study, for which they reported that the suicide cases were almost twice as likely to have visited a physician in the week before death (n=1329 cases, 45% vs. 24%, p<.001).

2.5 Conclusion

There are multiple variables that are associated with suicidal ideation, attempts, and death in older adults presented by several studies in this literature review. However, the issue of older adult suicide and the uncertainty of factors that truly predict or protect against older adult, especially in the Canadian context, still remains to be further understood.

Chapter 3

3 Methodology

3.1 Conceptual Framework

Smith et al.'s (2011) framework for secondary analysis research provided the conceptual grounding for this study. A secondary analysis of large datasets is defined as a research methodology that uses existing high-quality secondary data collected previously for a different purpose to address a new research question, without causing any harm to the participants (Doolan & Froelicher, 2009; Smith et al., 2011). This type of analysis allows researchers to address significant or *high-impact* research questions with less time, costs, and resources compared to other primary research approaches (Doolan & Froelicher, 2009; Smith et al., 2011; Vartanian, 2011). Utilizing secondary data sets also allows for ample access to large sample sizes, which can assist in answering the *high-impact* question(s) generated by the researcher (Smith et al., 2011; Vartanian, 2011). While "exploratory analyses are acceptable if done in a thoughtful way that serves an a priori hypothesis" secondary analyses should not be research activities that "merely data dredg[e]… looking for associations" (p. 927). Therefore, conducting work using secondary data should utilize the same research principles as using primary data research, such as developing appropriate research questions, study samples, data collection measures, and data analyses (Smith et al., 2011).

To conduct a secondary data analysis, Smith et al. (2011) recommends four methodological steps to assist in analyzing large datasets: (1) definition of a research topic or question; (2) selection of an appropriate dataset(s); (3) getting to know the datasets; and, (4) structuring the analysis and presentation of findings in a way that is meaningful for practice and policy. Smith et al. (2011) also recommends that consultations with experts in data science be leveraged throughout the execution of secondary data analysis.

3.2 Study Design and Setting

A population-level, retrospective study was conducted using linked administrative health care databases available at ICES (provincial health care administrative data steward) in order to identify all older adults (aged 65+) who died by either suicide or other non-suicide means between January 2011 and December 2015, in the province of Ontario, Canada. Ontario is the most populous province in Canada, comprising of about 14.7 million people (making up approximately 40% of Canada), wherein most residents are covered by a single payer health care insurance system (OHIP – Ontario Health Insurance Plan) (Government of Ontario, 2020; MOHLTC, 2012; Statistics Canada, 2020).

ICES is an independent, non-profit research institute that holds a vast and secure array of Ontario's "individual-level, de-identified and linked health and health-related data" (Dolan et al., 2012, p. 19; ICES, 2020a; ICES, 2020b). As a prescribed entity under Ontario's privacy legislation, ICES is authorized to collect and use health care data for the purposes of health system analysis, policies, strategic plans, outcome evaluation, and other decision supports (ICES, 2020a). The private and confidential information stored in ICES are protected through a variety of physical and technological measures in addition to their own policies and procedures that are approved by the Information and Privacy Commissioner of Ontario, thus ensuring secure and controlled access (ICES, 2020a). With its rich collection of data from administrative health care databases in Ontario and its powerful impact to the health care system and research, ICES was chosen to fully support this study's research purpose and objectives.

Due to the legalization of Medical Assistance in Dying (MAiD) on 17 June 2016 in Canada (Nicol & Tiedemann, 2018), and subsequent uncertainties and discrepancies in suicide-related coding in the months following this legislation, an analytical decision to focus on deaths prior to the 2016 calendar year was made to ensure accuracy and reliability of suicide related data. Therefore, the date of death of a participant in this study fell between 1 January 2011 and 31 December 2015. With linked administrative health care data, health care and other characteristics are determined through interactions or records collected in health and health-related data. It is standard convention to anchor a study's cohort to a specific point in time (in this case, date of death) and *lookback* in their

linked data to quantify such characteristics. Using previously defined *lookback* periods, the following were selected: a) 5-year lookback window was used for most baseline individual characteristics and comorbidities; b) 2-year look window was used for medication use and new diagnosis of dementia and cancer; and c) 1-year look back window was used for healthcare utilization. A time trend analysis was utilized to examine changes in rates of older adult suicides and characteristics of individuals who died by suicide over a 5-year timeframe. This study followed a pre-defined analytic plan (i.e., Dataset Creation Plan) that was collectively created by the research team to better manage ICES dataset creation and analyses, and communication/documentation of decision points.

3.3 Study Population

The study population was comprised of older adults, 65 years old and older, who died between 1 January 2011 to 31 December 2015 in the province of Ontario, Canada. Older adults who were 65 years old and older were included at the start of the analysis phase, to determine the rate and trend of mortality. Furthermore, a sub-cohort of older adults who were less than 67 years old were then excluded to allow for a full two-year look back window in order to observe predictors of older adult suicide (i.e. medication prescription history, medical illnesses, etc.). Older adults who had missing or invalid Ontario Health Insurance Plan number (i.e. homeless individuals); had missing or invalid demographics such as age and sex (i.e. 2SLGBTQ+ individuals); and, not residing in Ontario (i.e. three-month waiting period prior to OHIP coverage for newcomers in Ontario and residents who were out-of-country for 5-6 months or longer) were excluded from the study.

The study population of older adults were divided into two primary outcome cohorts: (1) *death by suicide*; and (2) *death by any other non-suicide causes* to facilitate analysis and generate comparison. In order to further distinguish suicide deaths, *death by probable suicide* was added forming a secondary outcome group. All mortality data were gathered from the Office of the Registrar General – Deaths (ORGD) Vital Statistics Database.

The International Statistical Classification of Diseases and Related Health Problem (ICD), "developed by the World Health Organization and enhanced by CIHI to meet Canadian morbidity data needs", aids in the classification of diseases, injuries, causes of death, and other external factors contributing to health (CIHI, 2020, para. 2). In reference to the ICES *Data Repository* (consists of coded and linkable health data sets, including ICD codes) and to previous literature (those that listed mortality codes in their studies), codes were generated to define mortality/predictor outcomes of the study population. Older adults who died by *suicide* means were defined as having a cause of death (COD) code between E950-E959; or having an underlying COD (COD_UNDERLYING_ICD10) code between X60-X84; or having a manner of death (MANNER_OF_DEATH) code of "4". Older adults who died by *probable suicide* were defined as having a cause of death (COD) code between E980-E987, and E989; or having an underlying COD (COD_UNDERLYING_ICD10) code between Y10-Y32, Y34, and Y87. Older adults who died by *any other non-suicide* means were defined as other COD or COD_UNDERLYING_ICD10 codes that are not included under the definition of *suicide* and *probable suicide*. Refer to Appendix B, Table B8 (OUT_SUIC) and Appendix B, Table B9 (OUT_NONSUIC_PROB) for detailed description of the codes and references used to generate the COD codes.

3.4 Data Sources

The following healthcare administrative databases held at ICES were used to gather cohort data characteristics including demographics, comorbidity profiles, new medical diagnoses, health care utilization, medication use, and mortality. These datasets were linked using unique encoded identifiers and analyzed at ICES. All definitions of variables and administrative codes acquired from these data sources can be found in Appendices A and B.

Registered Persons Database (RPDB)

This database provides basic demographic information for those issued an Ontario health insurance number (ICES, 2017). It was used to gather information on the study population's age, sex, and income (categorized into quintiles); location or residence (rural vs. urban); and, geographical location (LHIN-Local Health Integration Network).

Office of the Registrar General – Deaths (ORGD) Vital Statistics Database

This database contains information on all deaths registered in Ontario starting on January 1, 1990; information on the causes of death recorded on the death certificate are captured (ICES, 2017). It was used to gather data on older adult deaths (i.e., suicide, probable suicide, and other non-suicide causes); and, marital status information registered in Ontario.

Ontario Population Estimates and Projections (POP)

This database contains data on population estimates and projections (intercensal and postcensal estimates) of the Ontario population by sex, age, and geographic areas (ICES, 2017). The data collected in this database comes from the Ontario Ministry of Health and Long-Term Care: IntelliHEALTH ONTARIO. It was used to gather information on the annual death rate of older adults.

Ontario Drug Benefit Claims (ODB)

This database contains claims for prescription medication claims for those covered under the provincial drug program: (a) those aged 65 years and older; (b) nursing home residents; (c) patients receiving services under the Ontario Home Care program; (d) those receiving social assistance; and, (e) residents eligible for specialized drug programs (ICES, 2017). It was used to gather data on medication use and which older adults resided in long-term care (LTC) facilities.

CIHI-Discharge Abstract Database (DAD).

This database, compiled by the Canadian Institute for Health Information (CIHI), contains patient-level data (i.e., administrative, clinical diagnoses, clinical procedures/interventions, demographic, and admissions) for acute, rehab, chronic, and day surgery institution in Ontario was used to gather patient-level data for acute, rehab, chronic, and day surgery institutions in Ontario (ICES, 2017). Medical illness data obtained from this database included Charlson comorbidity index, Chronic Liver disease, Chronic Kidney Disease, Chronic Dialysis, and Mental Illness. Health care utilization of older adults, specifically the number of hospitalizations, was also acquired from this database.

CIHI-National Ambulatory Care Reporting System (NACRS).

This database, compiled by CIHI, contains administrative, clinical diagnoses, clinical procedures, and demographic information for all patient visits made to hospital- and community-based ambulatory care centres (i.e., emergency departments, day surgery units, hemodialysis units, cancer care clinics) (ICES, 2017). Medical Illness data obtained from this database included Chronic Liver Disease and Chronic Kidney Disease. Health care utilization of older adults, specifically the number of emergency room (ER) visits, was also acquired from this database.

Ontario Health Insurance Plan (OHIP)

This database contains claims on inpatient and outpatient services paid for by the Ontario Health Insurance Plan for most healthcare professionals in the province (ICES, 2017). Medical illness data obtained from this database included Chronic Dialysis, and Mental Illness. Health care utilization of older adults, specifically the number of visits to Primary Health Care (PHC), was also acquired from this database.

CIHI-Ontario Mental Health Reporting System (OMHRS).

This database contains administrative, clinical (diagnoses and procedures), demographic, and administrative information for all admissions to adult designated

inpatient mental health beds (ICES, 2017). Mental Illness (i.e., psychotic disorders, non-psychotic disorders, substance use disorders, and other mental illness excluding dementia) data were obtained from this database.

ICES Physician Database (IPDB).

This database 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) (ICES, 2017). Health care utilization of older adults, specifically the number of visits to Primary Health Care (PHC), was acquired from this database.

Cancer Care Ontario-Ontario Cancer Registry (OCR).

This database contains data on all Ontario residents who have been newly diagnosed with or died of cancer (except non-melanoma skin cancers) (ICES, 2017). Data on past history and new diagnosis of cancer prior to death were obtained from this database.

ICES-Derived Cohorts

This sub-list is comprised of ICES-derived cohorts that were created in ICES by "utilizing validated case-finding algorithms to identify individuals with specific diseases" (ICES, 2017; ICES, 2019, p. 1; ICES, 2020)

ASTHMA. The Ontario Asthma Database is an ICES-derived cohort that was created using a definition of ≥1 Hospitalization or ≥2 OHIP (ambulatory claims) in a two-year period (Gershon, 2009a).

CHF. The Ontario Congestive Heart Failure Database is an ICES-derived cohort that was created using a definition of 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 (Schultz et al., 2013).

COPD. The Ontario COPD Database is an ICES-derived cohort that was created using a definition of ≥1 Hospitalization (DAD/SDS) or ≥3 OHIP (ambulatory care) in a two-year period (Gershon, 2009b).

DEMENTIA. The Ontario Dementia Database is an ICES-derived cohort that was created using a definition of ≥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 (Jaakkimainen et al., 2016).

HIV. The Ontario HIV Database is an ICES-derived cohort that was created using a definition of ≥3 OHIP claims in a three-year period (Antoniou et al., 2011).

HYPER. The Ontario Hypertension Database is an ICES-derived cohort that was created using a definition of ≥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 (Tu et al., 2007; Tu et al., 2008).

OCCC. The Ontario Crohn's and Colitis Cohort dataset is an ICES-derived cohort created using a definition of two years of OHIP eligibility and ≥5 in-patient hospitalizations/emergency visits/diagnosis in a four-year period and ≥1 ODB claim for IBD medication (Hall et al., 2006).

ODD. The Ontario Diabetes Database is an ICES-derived cohort and was created using the definition ≥2 OHIP diagnosis code or ≥1 Hospitalization OR ≥1 physician claim with a diabetes-specific fee code within two years (Hux et al., 2002; Lipscombe et al., 2018).

ORAD. The Ontario Rheumatoid Arthritis Database is an ICES-derived cohort and created using a definition of ≥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) (Widdifield et al., 2014).

OMID. The Ontario Myocardial Infarction Database is an ICES-derived cohort and contains records of all inpatient hospital admissions for acute myocardial infarctions in Ontario since 1991. These admissions are ascertained using the DAD and exclude in-hospital events and admissions where there had been a previous discharge for acute myocardial infarction in the previous year. This cohort of patients with acute myocardial infarctions hospital admissions is linked with hospitalization (DAD), same day surgery (SDS), and physician billing claims data (OHIP) to create indicators of hospital readmission after discharge and receipt of cardiac procedures during and after the initial hospital admission (Austin et al., 2002).

Additional Comorbidities and Definitions Used

The following list of illnesses variables were included in the study utilizing the DAD, NACRS, OHIP, and OMHRS datasets based on the respective definitions for each variable to define each group. The full list of codes and definitions of codes under each variable can also be found in Appendices A and B.

Chronic Liver Disease (CLD). The DAD, NACRS and OHIP databases were used to identify patients with CLD, using the following definitions: (1) Any hospitalization or ED visit with a diagnosis code; or (2) Any OHIP claim with both a fee code and diagnosis code (Weisman et al., 2019).

Chronic Kidney Disease (CKD). The DAD, NACRS, and OHIP databases were used to identify patients with CLD (Fleet et al., 2013; Haroon et al., 2015; Rosella et al., 2018; Weisman et al., 2019).

Chronic Dialysis User. 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 (Quinn et al., 2010; Wald et al., 2012).

Mental Illness – Psychotic Disorders. The DAD, OMHRS, and OHIP databases were used to identify patients with psychotic disorders, using the following definitions:

(1) 1 hospitalization with a diagnosis code; or (2) 2 claims in 2 years or less with both a fee code and diagnosis code (Steele et al., 2004).

Mental Illness – Non-Psychotic Disorders. The DAD, OMHRS, and OHIP databases were used to identify patients with non-psychotic disorders, using the following definitions: (1) 1 hospitalization with a diagnosis code; or (2) 2 claims in 2 years or less with both a fee code and diagnosis code (Steele et al., 2004).

Mental Illness – Substance Use Disorders. The DAD, OMHRS, and OHIP databases were used to identify patients with substance use disorders, using the following definitions: (1) 1 hospitalization with a diagnosis code; or (2) 2 claims in 2 years or less with both a fee code and diagnosis code (Steele et al., 2004).

Mental Illness – Others (Social Problems and Others; not including Dementia). The DAD, OMHRS, and OHIP databases were used to identify patients with other mental illness and social problems (excluding dementia), using the following definitions: (1) 1 hospitalization with a diagnosis code; or (2) 2 claims in 2 years or less with both a fee code and diagnosis code (Steele et al., 2004).

3.5 Outcome and Predictor Measures

The main outcome of interest in this study was *mortality (death)*, that included three groups: (1) *death by suicide*; (2) *death by probable suicide;* and, (3) *death by any other non-suicide*. Furthermore, the primary outcome group included the '*death by suicide' and 'death by any other non-suicide'* cohorts; while the secondary outcome group included the *'death by probable suicide'*, *'death by suicide'* and '*death by any other non-suicide'* cohorts.

Several health and health-related characteristics (occurring within 5 years for most baseline characteristics or using validated cohorts, and within 2 years for new diagnosis) were descriptively assessed to primarily understand the health profile characteristics of the three *mortality* groups. The generated profile included *comorbidities* (such as CHF,

MI, Asthma, COPD, Diabetes, HTN, CLD, CKD, CDU, Rheumatoid Arthritis, Crohn's/UC, HIV, Cancer, Dementia, Mental Illness – Psychotic/Non-Psychotic/Substance Use Disorders/Others), *new healthcare issues* (mainly a new diagnosis of dementia; and a new diagnosis of cancer), *health care services utilization* (specifically hospital admissions, emergency room visits, and primary health care practitioner visits), and *most common prescribed medications*.

The following variables were selected to further estimate their association (predictor vs. preventor variable) with the primary outcome group (*'death by suicide'* vs. *'death by non*-suicide'): age, sex, marital status, income, rurality, living in LTC, Charlson Comorbidity index, comorbidities, new health care issues, and health care services utilization.

3.6 Statistical Analysis

Descriptive statistics were used to describe the characteristics of the study 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. Furthermore, parametric and non-parametric tests were calculated to inspect statistical differences between the cohorts in the primary ('*death by suicide'* and '*death by any other non-suicide'*) and secondary ('*death by probable* suicide', '*death by suicide'*, and '*death by any other non-suicide'*) outcome groups.

In the primary outcome group, chi-square test was used for categorical data and t-test was used for continuous data to obtain *p* values. A Kruskal-Wallis test and a chi-square test were used to compare differences across all three groups in the secondary outcome group. The Kruskal-Wallis test is the non-parametric equivalent of a one-way ANOVA test, that determines any statistical difference between two or more independent group and does not have any assumptions on normality; thus, is better suited for the data in this study (Mackridge & Rowe, 2018; Van Hecke, 2012). Although the Kruskal-Wallis test does not specifically address which particular groups are statistically significant from each other, it

still holds more power in providing accurate significance compared to the ANOVA (Van Hecke, 2012).

Furthermore, comparisons between the cohorts in the primary and secondary outcome groups were evaluated using standardized differences. In the secondary outcome group, standardized difference was used to only analyze a meaningful difference between the '*death by probable* suicide' cohort and '*death by suicide'* cohort. Standardized differences are mostly used in comparing means of continuous variables, but can also be used in evaluating differences in dichotomous variables (Austin, 2009). Furthermore, Austin (2009) indicated that a meaningful difference is observed if the standardized difference is more than 10% ($d = 0.1$).

A logistic regression, which predicts the probability of an outcome or event to occur based on one or more independent variables (Strand et al., 2011), was utilized to determine the odds of the outcome ("*death by suicide*") from occurring given the chosen covariates: age, sex, marital status, income quintile, rurality, living in LTC, Charlson Comorbidity Index, comorbidities or chronic conditions, new health care issues, and health care utilization. Confounding variables may influence the relationship between the independent variables and the outcome (Holmes, 2014; Szymilas, 2010). To attend to this, adjusted odd ratios (AORs) with 95% confidence intervals (CI) were calculated in order to control for confounding variables, thus showing more accuracy of each variable predicting the outcome.

All statistical analyses were performed using SAS Version 9.4 (SAS Institute), utilizing a threshold of alpha at 0.05 ($a = 0.05$) for statistical significance and 10% ($d = 0.1$) for standardized difference.

3.7 Ethics Approval

ICES is a prescribed entity under section 45 of Ontario's Personal Health Information Act. Section 45 authorizes ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the

management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under section 45, by definition, do not require review by a Research Ethics Board. This project was conducted under section 45, and approved by ICES' Privacy and Legal Office.

Chapter 4

4 Results

After exclusions, the cohort included 354,967 older adult (aged 67+) mortalities (869 deaths by suicide; 29 deaths by probable suicide; and 354,069 deaths by any other non-suicide cause) in Ontario, Canada (Figure 1) over the five-year study time frame (2011 - 2015). The *death by suicide* mortality rate was stable over five years from 2011 to 2015, with a slight decrease in suicide deaths from 2011 to 2012 and slight increase each year thereafter (Table 1, Figure 2).

Figure 1: Flow Chart of Cohort Selection after meeting the inclusion and exclusion criteria

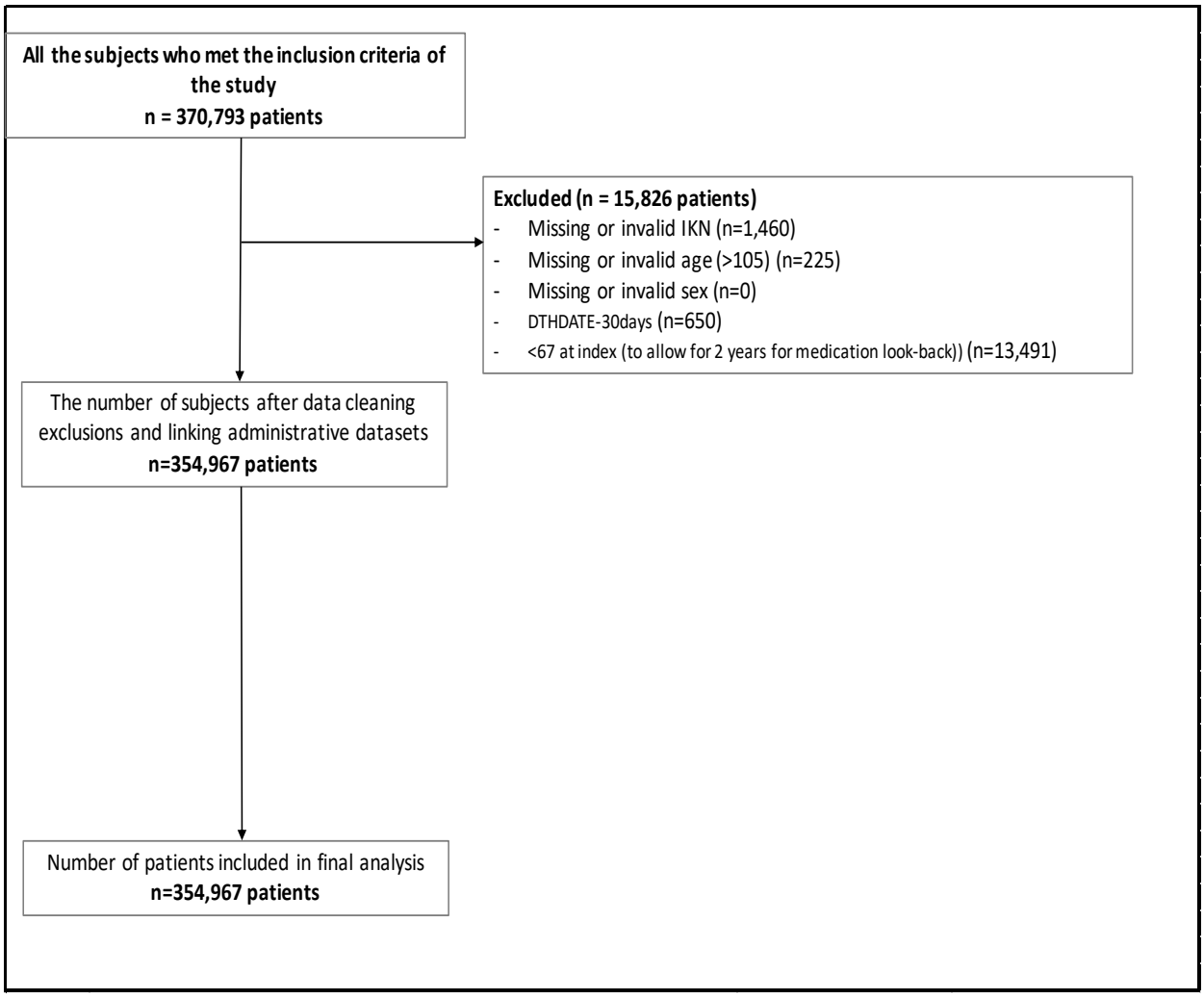
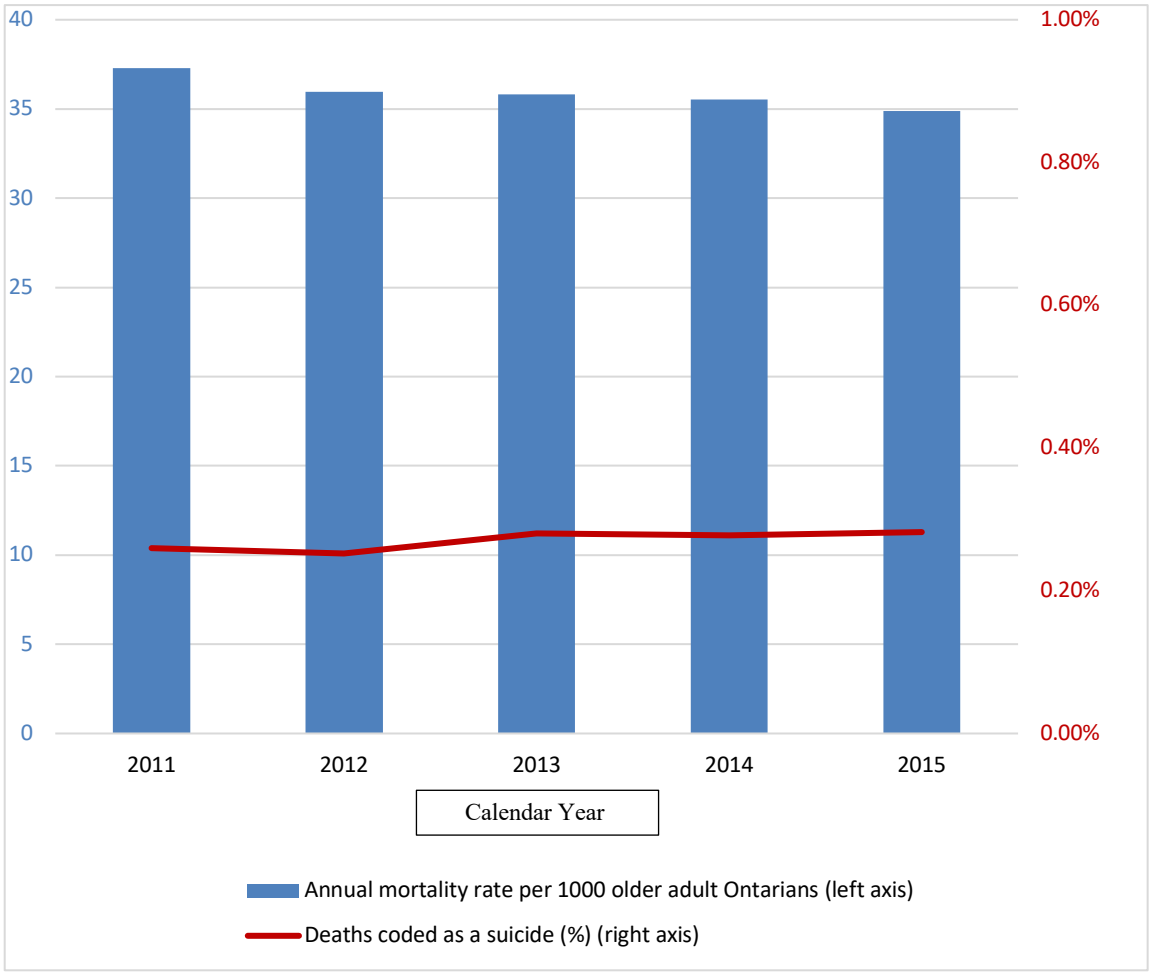


Table 1: Total Number of Deaths (including mortality rates per 1000 population) by Suicide versus Non-Suicide causes from 2011 to 2015

Year	Population Estimate (age 65+)	*Death by Suicide*	*Death by any other non-suicide causes*	*Overall mortality*
2011				
N	1887100	183	70185	70368
Rate per 1000 pop		0.097	37.192	37.289
2012				
N	1974100	179	70803	70982
Rate per 1000 pop		0.091	35.866	35.957
2013				
N	2061050	207	73612	73819
Rate per 1000 pop		0.100	35.716	35.816
2014				
N	2139672	211	75814	76025
Rate per 1000 pop		0.099	35.433	35.532
2015				
N	2214073	218	77046	77264
Rate per 1000 pop		0.098	34.798	34.896

Source: Ontario Ministry of Health and Long-Term Care: IntelliHEALTH ONTARIO

Figure 2: Trend of Suicide Deaths versus Overall Deaths from 2011 to 2015



Note: The yearly rates in the "Deaths coded as a suicide" (red line) was calculated as death by suicide rate divided by overall mortality rate, multiplied by 100%. All numbers used for the calculations stem from the values listed in Table 1.

4.1 Demographics

The two groups, *death by suicide* and *death by any other non-suicide* (including *death by probable suicide),* possessed distinct demographic, medical illnesses, and health care use profiles (Table 2; Table 4). Over the five-year duration of the study (2011-2015), older adults who died by suicide tended to be younger (67-74 vs. 85+) (*n* = 390, 44.9% vs. *n*=138, 15.9%); less likely females (*n*=215, 24.7%); more likely to be married (*n*=440, 50.6%); less likely to live in LTCs (*n* = 12, 1.4%); and less likely to live in rural areas (*n* = 160, 18.4%) (Table 2, unadjusted analysis). There were no significant differences observed between the suicide and non-suicide death groups in terms of geographical locations (LHIN) and income. LHIN 4 (Hamilton, Niagara, Haldimand, Brant) had the highest number of suicide deaths (*n* = 107, 12.3%), and LHIN 14 (North West) had the lowest number of suicide deaths (*n* = 17, 2.0%) (Table 2, unadjusted analysis). It is important to note that the percentages reported in this study do not reflect the population size of each LHIN.

In adjusted analyses, increasing age and living in LTC were associated with *lower* odds of suicide in the study population. There was a 6.1% *lower* odds of suicide death as age increased (AOR 0.939, 95% CI 0.929-0.948, *p*<.0001); and 92.6% *lower* odds of suicide death when living in LTC facilities (AOR 0.074, 95% CI 0.041-0.133, *p*<.0001). The odds of suicide for males compared to females was 191% higher for males (AOR 2.911, 95% CI 2.465-3.437, *p*<.0001); and, the odds of suicide for older adults living in rural areas was 32% higher compared to urban areas (AOR 1.321, 95% CI 1.106-1.577, *p* = 0.0021). Marital status and Income variables did not yield any significant association or odds to suicide death (Table 4).

Death by Suicide versus Death by Probable Suicide

There was a small cohort of older adults who *died by probable suicide means* (*N* = 29) (Table 3). In comparison to the *death by suicide* cohort, those who *died by probable suicide* appeared to be younger (mean 75.24 vs. 76.56; median 72, vs. 76; standardized difference = 18%); less females than males (*n* = 11, 37.9% vs. *n*=215, 24.7%, standardized difference = 29%); and more likely to visit primary health care (13241.38

vs. 11246.26 unique episodes per 1000 patients, standardized difference = 16%). In terms of marital status, those who *died by probable suicide* were more likely widowed compared to those who *died by suicide means* (*n* = 13, 44.8% vs. *n* = 229, 26.4%; standardized difference = 39%). With the small number of older adults reported in the *'death by probable suicide'* cohort, other variables cannot be further reported.

4.2 Medical Illness Portrait of the Cohort

Majority of the older adults in the suicide death groups had zero or one existing comorbidities (Table 2). The top five reported illnesses that the *death by suicide* group included (a) non-psychotic disorders (*n* = 498, 57.3%) and psychotic disorders (*n*=63, 7.2%); (b) HTN or hypertension (*n* = 624, 71.8%); (c) COPD or chronic obstructive pulmonary disease (*n* = 292, 33.6%); (d) diabetes (*n* = 241, 27.7%); and, (e) cancer (*n* = 198, 22.8%). The top five illnesses in the *death by non-suicide means* group included (a) HTN (*n* = 297,566; 84 %), (b) cancer (*n* = 149,590; 42.2%), (c) COPD (*n* = 148,447; 41.9%), (d) CHF or congestive heart failure (*n* = 139,830; 39.5%), and (e) diabetes (*n* = 134,309; 37.9%).

Majority of the older adults who *died by suicide* had a mental health diagnosis, particularly non-psychotic disorders (*n* = 498, 57.3%). This is higher compared to the older adults in the non-suicide group (57.3% v. 32.6%, standardized difference 51%). HTN was mainly present among older adults in both groups, with a slight difference in percentages (71.8% v. 84%, standardized difference 30%).

In the adjusted analysis, mental illness diagnosis (particularly psychotic and non-psychotic disorders) showed significantly *higher* odds of older adult suicide (Table 4). A diagnosis of psychotic disorder had 174.7% *higher* odds of suicide (AOR 2.747, 95% CI 2.084-3.62, *p*<.0001), while a non-psychotic disorder had 235.8% *higher* odds of suicide (AOR 3.358, 95% CI 2.912-3.874, *p*<.0001). CHF, MI, COPD, CLD, CKD, Cancer, and Dementia were associated with *lower* odds. Asthma, diabetes, hypertension, chronic dialysis user, rheumatoid arthritis, Crohn's/UC, substance abuse and others (social

problems and others; not including dementia) were not significant (Table 4). Furthermore, there was a 64.2% *lower* odds of suicide for those with a Charlson Comorbidity Index (CCI; to classify comorbid conditions) score of 1 (AOR 0.358, 95% CI 0.29-0.442, $p = 0.0178$), and a 78.9% *lower* odds for those with a CCI score of 2+ (AOR 0.211, 95% CI 0.172-0.259, $p<.0001$).

4.2.1. *New Healthcare Issues.*

In the adjusted analysis, a new diagnosis of dementia was associated with 72% *higher* odds of suicide (AOR 1.72, 95% CI 1.061-2.787, $p = 0.0277$); and a new diagnosis of cancer was associated with 67.7% *lower* odds of suicide (AOR 0.323; 95% CI 0.235-0.444, $p<.0001$) (Table 4).

4.2.2. *Medications.*

Table 2 includes a list of the most prescribed medications for each group. Benzodiazepines were the most prescribed class of medication in the *death by suicide* group ($n = 63$, 7.69%), while diuretics were the highest in the *death by non-suicide means* group ($n = 55{,}939$; 16.14%).

4.3 Health Care Utilization

In terms of healthcare utilization, both groups mostly accessed primary health care (PHC) compared to primary care (i.e., hospital/emergency department) (Table 2). In the adjusted analysis, there was 4.7% *higher* odds of suicide with every emergency department visit (AOR 1.047, 95% CI 1.018-1.077, $p=0.0015$), and a 2% *lower* odds of suicide with every PHC visit (AOR 0.98, 95% CI 0.974-0.986, $p<.0001$) (Table 4).

In summary of the variables discussed in this section, the *predictors* of older adult suicide (factors associated with *higher* odds of suicide) were male sex, living in a rural geographic region, having mental illness (particularly psychotic and non-psychotic disorders), having a new diagnosis of dementia, and increased use of the emergency department. Factors protective against older adult suicide included increasing age, living

in LTC, presence of existing chronic health conditions (including cancer and dementia), and increased interactions with primary health care (PHC).

Table 2: Baseline Characteristics of Older Adults Stratified by Suicide Deaths and Non-Suicide Deaths, Unadjusted Analysis

	Death by Suicide	**Death by any other non-suicide causes**	**Standardized Difference (Death by Suicide VS. Death by any other non-suicide causes)**	***p* value**
	N=869	**N=354,098**		
Demographics				
Age at Index Date				
Mean (SD)	76.56 ± 7.11	83.25 ± 8.22	87%	<.001
Median (IQR)	76 (70-82)	84 (77-89)		
67-74	390 (44.9%)	62,826 (17.7%)	61%	<.001
75-84	341 (39.2%)	124,212 (35.1%)	9%	
85+	138 (15.9%)	167,060 (47.2%)	72%	
Female, N(%)	215 (24.7%)	187,603 (53.0%)	61%	<.001
Marital Status, N(%)				
Common-law	26 (3.0%)	5,423 (1.5%)	10%	<.001
Divorced	97 (11.2%)	21,892 (6.2%)	18%	
Married	440 (50.6%)	141,476 (40.0%)	22%	
Other	NR	<=320 (0.09%)	NR	
Single	73 (8.4%)	19,280 (5.4%)	12%	
Unknown	0 (0.0%)	21 (0.0%)	1%	
Widowed	229 (26.4%)	165,449 (46.7%)	43%	

*Missing	NR	<=240 (<=0.07%)	NR	
Income quintile, N(%)				
Quintile 1	217 (25.0%)	83,195 (23.5%)	3%	0.587
Quintile 2	172 (19.8%)	75,053 (21.2%)	3%	
Quintile 3	164 (18.9%)	68,653 (19.4%)	1%	
Quintile 4	151 (17.4%)	64,293 (18.2%)	2%	
Quintile 5	163 (18.8%)	61,426 (17.3%)	4%	
*Missing	NR	1,478 (0.4%)	NR	
Rural, Yes, N(%)	160 (18.4%)	49,998 (14.1%)	12%	0.001
LHIN				
1	40 (4.6%)	20,861 (5.9%)	6%	0.017
2	72 (8.3%)	31,388 (8.9%)	2%	
3	49 (5.6%)	19,088 (5.4%)	1%	
4	107 (12.3%)	47,967 (13.5%)	4%	
5	35 (4.0%)	13,808 (3.9%)	1%	
6	56 (6.4%)	21,221 (6.0%)	2%	
7	89 (10.2%)	27,746 (7.8%)	8%	
8	93 (10.7%)	35,435 (10.0%)	2%	
9	87 (10.0%)	40,979 (11.6%)	5%	
10	40 (4.6%)	18,361 (5.2%)	3%	
11	68 (7.8%)	33,575 (9.5%)	6%	
12	43 (4.9%)	14,677 (4.1%)	4%	
13	73 (8.4%)	21,144 (6.0%)	9%	
14	17 (2.0%)	7,848 (2.2%)	2%	
Year of cohort entry, N(%)				
2011	160 (18.4%)	67,759 (19.1%)	2%	0.696

2012	155 (17.8%)	68,246 (19.3%)	4%	
2013	185 (21.3%)	70,751 (20.0%)	3%	
2014	179 (20.6%)	72,985 (20.6%)	0	
2015	190 (21.9%)	74,357 (21.0%)	2%	
LTC	12 (1.4%)	108,649 (30.7%)	87%	<.001
Comorbidities in the previous 2 years, N(%)				
Charlson Comorbidty Index				
0	317 (36.5%)	35,310 (10.0%)	66%	<.001
1	114 (13.1%)	51,966 (14.7%)	5%	
2+	229 (26.4%)	237,021 (66.9%)	89%	
No Hospitalizations	209 (24.1%)	29,801 (8.4%)	43%	
Congestive heart failure (CHF)	113 (13.0%)	139,830 (39.5%)	63%	<.001
Myocardial Infarction (MI)	58 (6.7%)	47,692 (13.5%)	23%	<.001
Asthma	114 (13.1%)	55,648 (15.7%)	7%	0.036
Chronic Obstructive Pulmonary Disease (COPD)	292 (33.6%)	148,447 (41.9%)	17%	<.001
Diabetes	241 (27.7%)	134,309 (37.9%)	22%	<.001
Hypertension	624 (71.8%)	297,566 (84.0%)	30%	<.001
Chronic Liver Disease (CLD)	NR	19,352 (5.5%)	NR	NR
Chronic Kidney Disease (CKD)	122 (14.0%)	114,614 (32.4%)	44%	<.001
Chronic Dialysis User	NR	<=5,605 (<=1.58%)	NR	NR
Rheumatoid Arthritis	18 (2.1%)	12,491 (3.5%)	9%	0.02
Crohn's/Ulcerative Colitis (UC)	NR	2,858 (0.8%)	NR	NR
HIV	NR	<=240 (<=0.07%)	NR	NR
Cancer	198 (22.8%)	149,590 (42.2%)	42%	<.001
Dementia	68 (7.8%)	131,166 (37.0%)	75%	<.001
Mental Illness				

Psychotic disorders (PSY)	63 (7.2%)	9,673 (2.7%)	21%	<.001
Non-psychotic disorders (nPSY)	498 (57.3%)	115,540 (32.6%)	51%	<.001
Substance abuse disorders (SUB)	58 (6.7%)	11,533 (3.3%)	16%	<.001
Others (Social problems and others; not inc. dementia)	24 (2.8%)	8,750 (2.5%)	2%	0.581
New healthcare issues, N(%)				
New diagnosis of dementia	32 (3.7%)	38,376 (10.8%)	28%	<.001
New diagnosis of cancer	56 (6.4%)	75,147 (21.2%)	44%	<.001
Healthcare system utilization and access in the previous 2 years				
Number of hospitalizations				
Mean ± SD	0.49 ± 0.98	1.04 ± 1.31	48%	<.001
Median (IQR)	0 (0-1)	1 (0-2)		<.001
# of unique episodes per 1000 patients	487.92	1038.76		
Number of ER visits				
Mean ± SD	1.77 ± 2.53	2.44 ± 2.57	27%	<.001
Median (IQR)	1 (0-2)	2 (1-3)		<.001
# of unique visits per 1000 patients	1765.25	2444.33		
Number of visits to PHC				
Mean ± SD	11.25 ± 11.86	22.65 ± 21.45	66%	<.001
Median (IQR)	8 (4-14)	16 (9-29)		<.001
# of unique visits per 1000 patients	11246.26	22645.14		
Medication Use, N(%)				
Medication Groupings (Top 10, 1=most prescribed)				
1	Benzodiazepine Derivatives 63 (7.69%)	Diuretics 55939 (16.14%)		

2	Diuretics 58 (7.08%)	Beta-Blockers 17186 (4.96%)		
3	ACE Inhibitors 36 (4.4%)	Cathartics and Laxatives 15539 (4.48%)		
4	Narcotics: Opiate Agonists 33 (4.03%)	Corticosteroids, Plain 15326 (4.42%)		
5	Corticosteroids, Plain 30 (3.66%)	Narcotics: Opiate Agonists 14722 (4.25%)		
6	Oral Anti-glycemics 30 (3.66%)	Benzodiazepine Derivatives 12009 (3.47%)		
7	Cathartics and Laxatives 29 (3.54%)	Hypothyroidism Therapy 10535 (3.04%)		
8	Beta-Blockers 27 (3.3%)	ACE Inhibitors 9847 (2.84%)		
9	Antilipemic: Statins 25 (3.05%)	Antilipemic: Statins 8245 (2.38%)		
10	Calcium Blockers 23 (2.81%)	Oral Anti-glycemics 7748 (2.24%)		

Note: Columns might not add-up due to *missing/non-reportable numbers
IQR – interquartile range
SD – standard deviation
NR – non-reportable

Table 3: Baseline Characteristics of Older Adults Stratified by Suicide Deaths and *Probable* Suicide Deaths, Unadjusted Analysis

	Death by suicide (same as previous)	**Death by probable suicide**	**Standardized Difference (Death by suicide VS. Death by Probable Suicide)**	***P* value**
	***N*=869**	***N*=29**		
Demographics				
Age at Index Date				
Mean (SD)	76.56 ± 7.11	75.24 ± 7.42	18%	<.001
Median (IQR)	76 (70-82)	72 (70-80)		
Female, N(%)	215 (24.7%)	11 (37.9%)	29%	<.001
Marital Status, N(%)				
Married	440 (50.6%)	9 (31.0%)	41%	
Widowed	229 (26.4%)	13 (44.8%)	39%	
Other	NR	NR	NR	
Income quintile, N(%)				
Quintile 1	217 (25.0%)	10 (34.5%)	21%	0.719
Quintile 2	172 (19.8%)	NR	NR	
Quintile 3	164 (18.9%)	NR	NR	
Quintile 4	151 (17.4%)	NR	NR	
Quintile 5	163 (18.8%)	NR	NR	
*Missing	NR	0 (0.0%)		
Rural, Yes, N(%)	160 (18.4%)	NR	NR	NR

LHIN				
1	40 (4.6%)	NR	NR	NR
2	72 (8.3%)	NR	NR	
3	49 (5.6%)	NR	NR	
4	107 (12.3%)	NR	NR	
5	35 (4.0%)	NR	NR	
6	56 (6.4%)	NR	NR	
7	89 (10.2%)	NR	NR	
8	93 (10.7%)	NR	NR	
9	87 (10.0%)	NR	NR	
10	40 (4.6%)	NR	NR	
11	68 (7.8%)	NR	NR	
12	43 (4.9%)	NR	NR	
13	73 (8.4%)	NR	NR	
14	17 (2.0%)	NR	NR	
Year of cohort entry, N(%)				
2011	160 (18.4%)	13 (44.8%)	59%	<.001
2012	155 (17.8%)	14 (48.3%)	68%	
2013	185 (21.3%)	NR	NR	
2014	179 (20.6%)	NR	NR	
2015	190 (21.9%)	NR	NR	
LTC	12 (1.4%)	NR	NR	NR
Comorbidities in the previous 2 years, N(%)				
Charlson Comorbidty Index				
0	317 (36.5%)	13 (44.8%)	17%	<.001
1	114 (13.1%)	NR	NR	
2+	229 (26.4%)	8 (27.6%)	3%	

No Hospitalizations	209 (24.1%)	NR	NR	
Congestive heart failure (CHF)	113 (13.0%)	NR	NR	NR
Myocardial Infarction (MI)	58 (6.7%)	NR	NR	NR
Asthma	114 (13.1%)	NR	NR	NR
Chronic Obstructive Pulmonary Disease (COPD)	292 (33.6%)	8 (27.6%)	13%	<.001
Diabetes	241 (27.7%)	NR	NR	NR
Hypertension	624 (71.8%)	23 (79.3%)	18%	<.001
Chronic Liver Disease (CLD)	7 (0.8%)	NR	NR	NR
Chronic Kidney Disease (CKD)	122 (14.0%)	NR	NR	NR
Chronic Dialysis User	NR	NR	NR	NR
Rheumatoid Arthritis	18 (2.1%)	NR	NR	NR
Crohn's/Ulcerative Colitis (UC)	NR	NR	NR	NR
HIV	NR	NR	NR	0.856
Cancer	198 (22.8%)	10 (34.5%)	26%	<.001
Dementia	68 (7.8%)	NR	NR	NR
Mental Illness				
Psychotic disorders (PSY)	63 (7.2%)	NR	NR	NR
Non-psychotic disorders (nPSY)	498 (57.3%)	17 (58.6%)	3%	<.001
Substance abuse disorders (SUB)	58 (6.7%)	NR	NR	NR
Others (Social problems and others; not inc. dementia)	24 (2.8%)	NR	NR	NR
New healthcare issues, N(%)				
New diagnosis of dementia	32 (3.7%)	NR	NR	NR
New diagnosis of cancer	56 (6.4%)	NR	NR	NR
Healthcare system utilization and access in the previous 2 years				
Number of hospitalizations				
Mean ± SD	0.49 ± 0.98	0.69 ± 0.97	21%	<.001
Median (IQR)	0 (0-1)	0 (0-1)		<.001

# of unique episodes per 1000 patients	487.92	689.66		
Number of ER visits				
Mean ± SD	1.77 ± 2.53	1.62 ± 1.47	7%	<.001
Median (IQR)	1 (0-2)	1 (0-3)		<.001
# of unique episodes per 1000 patients	1765.25	1620.69		
Number of visits to PHC				
Mean ± SD	11.25 ± 11.86	13.24 ± 13.03	16%	<.001
Median (IQR)	8 (4-14)	9 (6-15)		<.001
# of unique episodes per 1000 patients	11246.26	13241.38		

Note: Columns might not add-up due to *missing/non-reportable numbers
IQR – interquartile range
SD – standard deviation
NR – non-reportable

Table 4: Odds of Suicide Death, Adjusted Analysis (Logistic Regression)

COVARIATES	OR	Lower CI	Upper CI	*p*-value
Demographics				
Age (continuous)	0.939	0.929	0.948	<.0001
Sex (reference=*females*)	2.911	2.465	3.437	<.0001
Marital Status (reference=*married*)				
Married (combined m=married & c=common-law)	REF			
Widowed (w)	1.077	0.901	1.286	0.4489
Divorced (d)	1.1	0.874	1.385	0.3905
Single (s)	0.899	0.694	1.164	0.5539
Other (combined missing, o=other, u=unknown)	NR	NR	NR	NR
Income quintile (reference=*quintile 5*; recode missing to '3')				
Quintile 1	0.93	0.754	1.147	0.7377
Quintile 2	0.848	0.682	1.055	0.3117
Quintile 3	0.891	0.715	1.11	0.769
Quintile 4	0.887	0.708	1.11	0.7249
Quintile 5	REF			
Rural (reference=*urban; recode missing to urban*)	1.321	1.106	1.577	0.0021
LTC (reference=*no*)	0.074	0.041	0.133	<.0001
Comorbidities (reference=*no*)				
Charlson score				
0 (combined 0 and 'no hospitalizations')	REF			
1	0.358	0.29	0.442	0.0178
2+	0.211	0.172	0.259	<.0001
Congestive Heart Failure (CHF)	0.464	0.373	0.577	<.0001
Myocardial Infarction (MI)	0.727	0.551	0.959	0.0241

Asthma	1.049	0.85	1.296	0.6554
Chronic Obstructive Pulmonary Disease (COPD)	0.836	0.716	0.975	0.0227
Diabetes	1.006	0.856	1.181	0.9464
Hypertension	0.981	0.837	1.15	0.8165
Chronic Liver Disease (CLD)	NR	NR	NR	NR
Chronic Kidney Disease (CKD)	0.736	0.598	0.907	0.0041
Chronic Dialysis User	NR	NR	NR	NR
Rheumatoid Arthritis	0.794	0.495	1.273	0.3374
Crohn's/Ulcerative Colities (UC)	NR	NR	NR	NR
Cancer	0.734	0.605	0.892	0.0018
Dementia	0.313	0.22	0.445	<.0001
Mental Illness				
Psychotic disorders (PSY)	2.747	2.084	3.62	<.0001
Non-psychotic disorders (nPSY)	3.358	2.912	3.874	<.0001
Substance abuse disorders (SUB)	1.201	0.906	1.591	0.2033
Others (Social problems and others; not inc. dementia)	0.968	0.638	1.469	0.8801
New Health Care Issues				
New diagnosis of dementia (reference=*no*)	1.72	1.061	2.787	0.0277
New diagnosis of cancer (reference=*no*)	0.323	0.235	0.444	<.0001
Health care system utilization and access (continuous)				
Number of hospitalizations	0.952	0.87	1.042	0.2829
Number of ER visits	1.047	1.018	1.077	0.0015
Number of PHC visits	0.98	0.974	0.986	<.0001
OR – odd ratio *CI* – confidence interval, 95%				

Chapter 5

5 Discussion

The purpose of this population-based retrospective study was to better understand the prevalence and predictors of suicide in older adults living in Ontario, Canada.

Based on the findings in this population-based study, the number of suicide deaths among older adults in Ontario did not drastically change over time (from 2011 to 2015); however, it is evident that suicide in this particular age group remains a persistent cause of death in this population cohort (i.e., 0.27% of older adult deaths were suicide deaths over five years). 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 (Bakst et al., 2015; Cox et al., 2017; Niederkrotenthaler et al., 2020). Additionally, as mentioned previously, the older adults tend to be excluded from contemporary suicide prevention programs and policy in Canada, as these programs tend to focus on youth and young adults (Navaneelan, 2017; PHAC, 2019; Spiwak et al., 2012; Vogel, 2011). With the older adult population projected to represent 22-25% of the Canadian population by 2056 (Decady & Greenberg, 2014; PHAC, 2014; Statistics Canada, Demography Division, 2016), this study has demonstrated a need for better inclusion of older adults in suicide prevention program planning or policy creation in Canada.

In comparison to the older adults who *died by non-suicide means*, the characteristic profile of the cohort who *died by suicide means* appears to be older adults who are younger (67-74 years), male, married, diagnosed with a physical health condition, have received a mental health diagnosis, are less connected to the health care system, and not living in a long-term (LTC) facility. Furthermore, there were insignificant differences observed between the two groups in terms of geographical location and income level. In determining the odds of older adult suicide, the main predictors observed included being male, living in rural areas, having a diagnosis of mental illness, having a new diagnosis of dementia, and increased visits to emergency rooms. In addition, the main protective

factors observed were increased age, living in a LTC facility, presence of existing chronic health condition, and increased interactions with primary health care.

Previous studies have reported the main characteristics of older adults who died by suicide were younger (65-74), male, and married (Cheung et al., 2018; Choi et al., 2019; Erlangsen et al., 2015), which were consistent with the findings in this study, with the exception of marital status. The varying claims of the influence of marital status upon older adult suicide (Choi et al., 2019; Dombrovski et al., 2018; Erlangsen et al., 2015; Ju et al., 2016; McConnell et al., 2016) was not fully supported by the findings in this population-based study. Male gender has been commonly described in the literature as a predictor of older adult suicide (Cheung et al., 2018; Choi et al., 2019; Erlangsen et al., 2015; PHAC, 2019; WHO, 2014). Although not specifically directed to older adult suicide, the influence of men's health information-seeking behaviours (Hiebert et al., 2018) and traditional or stereotypical views of masculinity (Thompson & Langendoerfer, 2016) 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, religion, income or social isolation, could influence the association of marital status with older adult suicide (Masocco et al., 2010; McLaren et al., 2015). Nevertheless, more research needs to be done to further explain the role of gender and marital status in older adult suicide.

Several studies have also uncovered associations between various physical/mental health conditions with older adult suicide, particularly dementia, depression, and cancer (Ahmed et al., 2017; Choi et al., 2019; Conejero et al., 2018; Diehl-Schmid et al., 2017; Erlangsen et al., 2008; Erlangsen et al., 2015; Juurlink et al., 2004; Kiosses et al., 2014; Klaassen et al., 2019; Miller et al., 2008; Nakanishi & Endo, 2017; Park et al., 2014; Seyfried et al., 2011; Voaklander et al., 2008). 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. However, this does not mean that other illnesses should be disregarded; rather, more holistic assessments of older adults' mental and physical health and well-being should be sought.

Previous research has reported that a new diagnosis of dementia, between 6 months and 3 years after initial diagnosis, was associated with older adult suicide (Erlangsen et al., 2008; Seyfried et al., 2011). In this study, a new diagnosis of dementia showed higher odds of suicide in the older adult cohort. A possible explanation for the increased risk is that older adults who are newly diagnosed with dementia (in the early stages) 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 (Cipriani et al., 2013; Kiosses et al., 2014).

Currently, past research exploring the association of living in a LTC facility and suicide in older adults remains inconclusive (Choi et al., 2019; Mezuk et al., 2019; Seyfried et al., 2011). Both Choi et al. (2019) and Mezuk et al. (2019) studies claimed that living within or transitioning to LTC facilities is a predictive factor of suicide; however, the findings in this population-based study did not find a significant association. Interestingly, the findings of this study demonstrated a protective factor against suicide for older adults living in a LTC facility. While further, more specific research will be needed to clarify these findings with previously published literature, Seyfried et al. (2011) has suggested that 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 and physical limitations that could interfere with the executive functioning needed to plan and carry-out suicide (Seyfried et al., 2011, p. 572).

In this study, both cohorts (i.e., *death by suicide* and *death by non-suicide means*) had more visits with PHC providers than other health care services (i.e., hospital/emergency department), one year prior to suicide death. Similarly, prior research observed a common occurrence that older adults who died by suicide have visited their PHC providers within one week to one month before death (Cheung et al., 2018; Conejero et al., 2018; Juurlink et al., 2004; Miller et al., 2008; Worche & Gearing, 2010). Additionally, there was an increased likelihood of suicide with every emergency department visit and a decreased likelihood of suicide with every interaction with PHC, in this study. While this study examined health care visits within one year prior to suicide

death, further work should be completed to examine if there are any other overt 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. Although the unadjusted findings showed that the *death by suicide* cohort were less likely to live in rural areas, adjusted analysis showed that living in rural areas revealed *higher* odds of suicide. Shah et al. (2020) found that older adults (aged 65+), who reside in rural and small population centres, have the lowest access to health care services. Moreover, rural residents commonly lack access to family physicians, nurse practitioners, specialty physicians, and other health care services (Pitblado, 2012 as cited in Hiebert et al., 2018, p. 865; Sibley & Weiner, 2011 as cited in Shah et al., 2020). The lack of access to health care services, especially for older adults, in rural areas force rural residents to travel to urban areas to seek care, which may result in more emergency department usage (Pong et al., 2012, as cited in Hiebert et al., 2018, p. 865). 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 aid in the decision-making process and quality of care (Canada Health Infoway, 2018; Dobrow et al., 2019; Serrano et al., 2018; Tharmalingam et al., 2016). With the continued usage and innovation of digital health technology to help span the care continuum, the assessment and evaluation of client and patient needs (particularly older adults and family caregivers) should be further integrated into health system planning (Leung et al., 2019). Additionally, future suicide prevention program and health policy for older adults should consider aspects related to health care access equity and associations with suicide.

This population-based research study has demonstrated the power of linked datasets of health care administrative data. While this work was able to ascertain various mortality and morbidity rates of older adults, the time consuming and relatively slow nature of this type of traditional population-based database research (Connelly et al., 2016; Thygesen et

al., 2014) speaks to the need to better leverage real-time data sources and analysis processes to assist in suicide prediction and risk (Ma-Kellams et al., 2016; Torous et al., 2018; Walsh et al., 2017). To date, several studies have looked into the value of creating machine learning algorithms that assist in predicting patient length of stay (i.e., risk of readmission, extended hospital stays, accurate discharged date) (Cai et al., 2016); or, a range of health conditions, such as flu epidemics and suicide (Christakis et al., 2010; Ma-Kellams et al., 2016; Sanderson et al., 2020; Torous et al., 2018; Walsh et al., 2017). For instance, *Google* search data and other social media sites (i.e., Twitter) have been examined as potential sources of real-time data that can be used to assist in population health surveillance (Ma-Kellams et al., 2016; Schmidt, 2012). Additionally, real-time data, including data passively and actively derived from social media technology and smart devices, could also potentially supplement clinical examination to assess suicide risk, resulting in more timely interventions (Ma-Kellams et al., 2016; Torous et al., 2018; Walsh et al., 2017). With the rise and wide scale adoption of social media platforms, new and innovative ways to aggregate real-time data regarding people's lives, behaviours, and social connectedness has become a reality (Beam & Kohane, 2018; Schmidt, 2012). While real-time surveillance tools underpinned by socially generated data and advanced computing technology like machine learning are still primordial within health care activities, the increasing ubiquity of technology that use data arising from multiple sources to generate personalized recommendations and predictions (i.e., Amazon, Netflix, and Instagram recommendations) is an area that should be explored in the future by health care researchers (Beam & Kohane, 2018). Through these examples, the future of effectively utilizing health care data like that demonstrated in this project, along with other socially derived and/or real-time data, shows significant promise. Due to the significance of suicide in older adults, developing better health technology solutions that can leverage advanced prediction models incorporating health care administrative data and other data sources to better detect individuals at risk of suicide should be considered for future development to inform practice.

5.1 Implications

5.1.1 *Implications for Research*

The findings of this study have numerous implications for research. Foremost, with the recent legalization of Medical Assistance in Dying (MAiD), further research should be completed to explore the factors that influence MAiD and suicide (i.e. differences in characteristics, views of patients and families, knowledge and perspectives of health care professionals, types of support for patients, and consequences of being refused or denied MAiD after application), along with exploring other available end-of-life-care methods in older adult populations. Next, with admission to a LTC facility shown to be a predictive factor against suicide, future exploration regarding the factors surrounding living in/transitioning to LTC and aging-in-place should be conducted. There also needs to be more research and assessment of the health care needs of older adults living in rural or remote areas to determine appropriate support and delivery of health care services (i.e. accessibility to health care services, knowledge of using health care technology, individual or community health-seeking behaviours). Furthermore, research should be done surrounding the other variables that were not included in this study (i.e. chronic pain, disability, social support networks, other social determinants of health) to determine further influence of each variable or overlapping influence of variables to older adult suicide. Additionally, while this study was able to determine the odds of some variables predicting or preventing older adult suicide, it is important to understand that these factors do not signify any direct causation of older adult suicide. Finally, with technological advancements and the ability to develop predictive models from large amounts of health care and health-related data, future research should consider the potential of advanced predictive modeling techniques as a means from which to build better surveillance tools for suicide risk data in older adults. While this project clearly demonstrated the value of interlinked health care administrative data, other variables not available within the ICES core datasets that may be available to researchers in the future including information derived from social media or other wearable technologies (e.g., daily living, social connectedness, etc.), would assist in generating a more holistic representation of the older adult demographic through data.

5.1.2 *Implications for Practice/Policy*

A clear implication for practice and policy arising from this work is that clinicians need to be aware that older adult suicide happens, and that there are significant predictors of suicide that should be considered in screening assessments. Ongoing training and evaluation of health care providers should also be conducted to improve screening assessments and interventions with older adults, especially surrounding mental illness as this was a major predictor found in this population-based study. Health care providers or informaticians should also take on a proactive role toward advocating for the needs of older adults, by helping to develop solutions that can better identify individuals who are at risk of suicide, and in the generation of well-rounded, needs-targeted, and data-informed suicide prevention policies for older adult populations. 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 (Buccieri et al., 2019; Gaetz et al., 2016; Ross et al., 2018).

5.2 Strengths and Limitations

5.2.1. *Strengths*

The findings from this population-based research study gave new insights and understanding of the complexity of suicide in older adults in Ontario, Canada. The rich, interlinked population-level data provided an overview of the prevalence and the factors directly associated with older adult suicide, which could be essential in facilitating decision-making processes surrounding suicide prevention programs and policies provincially and nationally. Additionally, the constant consultation and collaboration with experts in the field of mental health, epidemiology, nursing, and health informatics, provided a breadth of information and knowledge necessary to successfully complete this research project.

5.2.2. *Limitations*

There are several limitations that should be considered when interpreting the findings of this study. First, suicide deaths are commonly misclassified or underreported (Deuter et al., 2016; WHO, 2014; WHO, 2019); thus, the accuracy of suicide deaths listed in this study may not fully express the true number of older adult suicides in Ontario, Canada. Second, as with studies utilizing secondary data (Connelly et al., 2016; Smith et al., 2011; Thygesan et al., 2014), the variables selected for inclusion in the study were limited to the health care administrative data held by ICES, and in some cases, were not as specific as would have been preferred. In this study, certain variables were excluded because they were not available or well-defined. These included chronic pain (i.e., poorly documented and coded in administrative data); new diagnosis of specific mental illnesses (i.e., difficult to assume unique or new diagnosis of mental health); and various specific social determinants of health (i.e., disability, food insecurity, social support networks, religions, and other social/health inequities). In addition to these variables, the exclusion criteria in this study meant that the health inequities of other older adult sub-cohorts (i.e. newcomers, homeless, and 2SLGBTQ+) could not be further assessed. With the reported rise of home shelter usage among homeless older adults in Canada (Gaetz et al., 2016), economic barriers of newcomers accessing health care services during a three-month wait period prior to provincial coverage (Sanchez et al., 2016), and lack of mental health services stemming from traumatic experiences faced by 2SLGBTQ+ Canadian older adults (Ross et al., 2018), it is essential that these factors along with other health inequities and unmet needs be further included and explored in future research to determine appropriate support. Finally, data surrounding Medical Assistance in Dying (MAiD) was excluded from this study to focus solely on suicide deaths. Further study related to the more contemporary differences of MAiD compared to suicide death in older adults should be examined in future research.

Chapter 6

6 Conclusion

With an average of 200 deaths of older adults (aged 65+) in Ontario per year for five years (2011-2015), it is essential to be aware that suicide exists in the older adult population. Although not an exhaustive list, the predictive and protective factors highlighted in this population-based study provide a better understanding of the complexity of suicide in older adults, which could provide insights for the creation or improvement of suicide prevention programs and policies. Further, in the future, the integration of real-time data approaches into various digital health technologies to better predict older adult suicide will be an important next step for practitioners and clinicians to consider.

References

Ahmed, H, Hossain, M., Aftab, A., Soron, T., Alam M., Chowdhury, M, & Uddin, A. (2017). Suicide and depression in the World Health Organization South-East Asia region: A systematic review. *WHO South-East Asia Journal of Public Health, 6*(1), 60-66. http://origin.searo.who.int/publications/journals/seajph/issues/seajphv6n1p60.pdf

Antoniou, T., Zagorski, B., Loutfy, M., Strike, C., & Glazier, R. (2011). Validation of Case-Finding Algorithms Derived from Administrative Data for Identifying Adults Living with Human Immunodeficiency Virus Infection.(Research Article). *PLoS ONE*, *6*(6), e21748. https://doi.org/10.1371/journal.pone.0021748

Austin, P. (2009). Using the Standardized Difference to Compare the Prevalence of a Binary Variable Between Two Groups in Observational Research. *Communications in Statistics - Simulation and Computation*, *38*(6), 1228–1234. https://doi.org/10.1080/03610910902859574

Austin, P., Daly, P., & Tu, J. (2002). A multicenter study of the coding accuracy of hospital discharge administrative data for patients admitted to cardiac care units in Ontario. *American Heart Journal*, *144*(2), 290–296. https://doi.org/10.1067/mhj.2002.123839

Bakst, S., Braun, T., Zucker, I., Amitai, Z., & Shohat, T. (2015). The accuracy of suicide statistics: are true suicide deaths misclassified? *Social Psychiatry and Psychiatric Epidemiology*, *51*(1), 115–123. https://doi.org/10.1007/s00127-015-1119-x

Beam, A., & Kohane, I. (2018). Big Data and Machine Learning in Health Care. *JAMA : the Journal of the American Medical Association*, *319*(13), 1317–1318. https://doi.org/10.1001/jama.2017.18391

Bilsen, J. (2018). Suicide and youth: Risk factors. *Frontiers in Psychiatry, 9*(540), 1-5. https://doi.org/10.3389/fpsyt.2018.00540

Borges, G., Acosta, I., & Sosa, A. (2015). Suicide ideation, dementia and mental disorders among a community sample of older people in Mexico. *International Journal of Geriatric Psychiatry*, *30*(3), 247–255. https://doi.org/10.1002/gps.4134

Buccieri, K., Oudshoorn, A., Frederick, T., Schiff, R., Abramovich, A., Gaetz, S., & Forchuk, C. (2019). Hospital discharge planning for Canadians experiencing homelessness. *Housing, Care and Support, 22*(1), 4-14. https://doi.org/10.1108/hcs-07-2018-0015

Butcher, H., & Ingram, T. (2018). Evidence-based practice guideline: Secondary prevention of late-life suicide. *Journal of Gerontological Nursing, 44*(11), 20-32. https://doi.org/10.3928/00989134-20180907-01

Cabello, M., Miret, M., Ayuso-Mateos, J., Caballero, F., Chatterji, S., Tobiasz-Adamczyk, B., Haro, J., Koskinen, S., Leonardi, M., & Borges, G., (2019). Cross-national prevalence and factors associated with suicide ideation and attempts in older and young-and-middle age people. *Aging & Mental Health,* 1-11. https://doi.org/10.1080/13607863.2019.1603284

Cai, X., Perez-Concha, O., Coiera, E., Martin-Sanchez, F., Day, R., Roffe, D., & Gallego, B. (2016). Real-time prediction of mortality, readmission, and length of stay using electronic health record data. *Journal of the American Medical Informatics Association : JAMIA*, *23*(3), 553–561. https://doi.org/10.1093/jamia/ocv110

Canada Health Infoway. (2018, April). *Connected health information in Canada: A benefits evaluation study, Report*. https://www.infoway-inforoute.ca/en/component/edocman/3510-connected-health-information-in-canada-a-benefits-evaluation-study-document/view-document?Itemid=101

Canadian Association for Suicide Prevention [CASP]. (2009, Sept.). *The CASP blueprint for a Canadian national suicide prevention strategy*. https://suicideprevention.ca/resources/Documents/SuicidePreventionBlueprint0909.pdf

Canadian Institute for Health Information [CIHI]. (2020). *Codes and classification*. https://www.cihi.ca/en/submit-data-and-view-standards/codes-and-classifications#:~:text=ICD%2D10%2DCA%20(International,meet%20Canadian%20morbidity%20data%20needs.

Canadian Medical Association [CMA]. (2016, September). *The state of seniors' health care in Canada*. https://www.cma.ca/sites/default/files/2018-11/the-state-of-seniors-health-care-in-canada-september-2016.pdf

Canadian Mental Health Association [CMHA]. (2016, Feb. 27). *Preventing suicide*. https://cmha.ca/documents/preventing-suicide

Centre for Addiction and Mental Health [CAMH]. (2020). *Suicide*. https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/suicide

Centre for Suicide Prevention. (2018). *What's the difference between suicide and Medical Assistance in Dying (MAiD) in Canada*. https://www.suicideinfo.ca/resource/suicide-physician-assisted-death/

Cheung, G., Merry, S., & Sundram, F. (2018). Do suicide characteristics differ by age in older people? *International Psychogeriatrics, 30*(3), 323-330. https://doi.org/10.1017/S1041610217001223

Choi, N., DiNitto, D., Marti, C., & Conwell, Y. (2019). Physical health problems as a late-life suicide precipitant: Examination of coroner/medical examiner and law enforcement reports. *The Gerontologist, 59*(2), 356-367. https://doi.org/10.1093/geront/gnx143

Christakis, N., & Fowler, J. (2010). Social Network Sensors for Early Detection of Contagious Outbreaks. *PloS One*, *5*(9), e12948–. https://doi.org/10.1371/journal.pone.0012948

Cipriani, G., Vedovello, M., Lucetti, C., Di Fiorino, A., & Nuti, A. (2013). Dementia and suicidal behavior. *Aggression and Violent Behavior*, *18*(6), 656–659. https://doi.org/10.1016/j.avb.2013.07.016

Conejero, I., Olié, E., Courtet, P., & Calati, R. (2018). Suicide in older adults: Current perspectives. *Clinical Interventions in Aging, 13*, 701-712. https://doi.org/10.2147/CIA.S130670

Connelly, R., Playford, C., Gayle, V., & Dibben, C. (2016). The role of administrative data in the big data revolution in social science research. *Social Science Research*, *59*, 1–12. https://doi.org/10.1016/j.ssresearch.2016.04.015

Corna, L., Cairney, J., & Streiner, D. L. (2010). Suicide ideation in older adults: Relationship to mental health problems and service use. *Gerontologist, 50*(6), 785-797. https://doi.org/10.1093/geront/gnq048

Couillet, A., Terra, J., Brochard, N., & Chauliac, N. (2017). Barriers to the prevention of suicide in nursing homes: A qualitative study of the social representations of

caregivers. *Crisis: The Journal of Crisis Intervention and Suicide Prevention, 38*(6), 423-432. https://doi.org/10.1027/0227-5910/a000466

Cox, K., Nock, M., Biggs, Q., Bornemann, J., Colpe, L., Dempsey, C., Heeringa, S., McCarroll, J., Ng, T., Schoenbaum, M., Ursano, R., Zhang, B., & Benedek, D. (2017). An examination of potential misclassification of army suicides: Results from the army study to assess risk and resilience in service members. *Suicide & Life-Threatening Behavior*, *47*(3), 257–265. https://doi.org/10.1111/sltb.12280

Crisis Services Canada. 2020. *Local resources and support*. https://www.crisisservicescanada.ca/en/looking-for-local-resources-support/

Crosby, A., Ortega, L., & Melanson, C. (2011, Feb.). Self-directed violence surveillance: Uniform definitions and recommended data elements, Version 1.0. *Centers for Disease Control and Prevention, National Center for Injury Prevention and Control Division of Violence Prevention*. Atlanta, Georgia. https://www.cdc.gov/violenceprevention/pdf/self-directed-violence-a.pdf

Decady, Y. & Greenberg, L. (2014, July). *Ninety years of change in life expectancy*. Statistics Canada, Catalogue no. 82-624-X, ISSN 1925-6493. https://www150.statcan.gc.ca/n1/en/pub/82-624-x/2014001/article/14009-eng.pdf?st=1E89keoN

Department of Justice. (2016). *Legislative background in Medical Assistance in Dying (Bill C-14)*. Ottawa, ON: Government of Canada. https://www.justice.gc.ca/eng/rp-pr/other-autre/ad-am/ad-am.pdf

Deuter, K., Procter, N., Evans, D., & Jaworski, K. (2016). Suicide in older people: Revisioning new approaches: Suicide in older people. *International Journal of Mental Health Nursing, 25*(2), 144-150. https://doi.org/10.1111/inm.12182

Diehl-Schmid, J., Jox, R., Gauthier, S., Belleville, S., Racine, E., Schüle, C., Turecki, G., Richard-Devantoy, S. (2017). Suicide and assisted dying in dementia: what we know and what we need to know. A narrative literature review. *International Psychogeriatrics*, *29*(8), 1247–1259. https://doi.org/10.1016/S2215-0366(14)70224-X.

Dobrow, M., Bytautas, J., Tharmalingam, S., & Hagens, S. (2019). Interoperable electronic health records and health information exchanges: Systematic review. *JMIR Medical Informatics*, *7*(2), e12607–. https://doi.org/10.2196/12607

Dolan, D., Grainger, J., Maccallum, N., Creatura, D., Forrester, J., & Shiller, S. (2012). The Institute for Clinical Evaluative Sciences: 20 years and counting. *Healthcare Quarterly*, *15*(4), 19–22. https://doi.org/10.12927/hcq.2012.23194

Dombrovski, A. Aslinger, E., Wright, A., & Szanto, K. (2018). Losing the battle: Perceived status loss and contemplated or attempted suicide in older adults. *International Journal of Geriatric Psychiatry, 33*(7), 907-914. https://doi.org/10.1002/gps.4869

Doolan, D., & Froelicher, E. (2009). Using an existing data set to answer new research questions: A methodological review. *Research and Theory for Nursing Practice*, *23*(3), 203–215. https://doi.org/10.1891/1541-6577.23.3.203

Downar, J., Fowler, R., Halko, R., Huyer, L., Hill, A., & Gibson, J. (2020). Early experience with medical assistance in dying in Ontario, Canada: a cohort study. *Canadian Medical Association Journal (CMAJ)*, *192*(8), E173–E181. https://doi.org/10.1503/cmaj.200016

Erlangsen, A., Stenager, E., & Conwell, Y. (2015). Physical diseases as predictors of suicide in older adults: A nationwide, register-based cohort study. *Social Psychiatry and Psychiatric Epidemiology, 50*(9), 1427-1439. https://doi.org/10.1007/s00127-015-1051-0

Erlangsen, A., Zarit, S., & Conwell, Y. (2008). Hospital-diagnosed dementia and suicide: A longitudinal study using prospective, nationwide register data. *American Journal of Geriatric Psychiatry, 16*(3), 220-228. https://doi.org/10.1097/01.JGP.0000302930.75387.7e

Ferguson, N.S. Reis, J.A. Rabbetts, L., Ashby, H., Bayes, M., McCracken, T, & Procter, N.G. (2018). The effectiveness of suicide prevention education programs for nurses: A systematic review. *The Journal of Crisis Intervention and Suicide Prevention, 39*(2), 96- 109. https://doi.org/10.1027/0227-5910/a000479

Fleet, J.L., Dixon, S.N., Shariff, S.Z., Quinn, R., Nash, D., Harel, Z., & Garg, A. (2013). Detecting chronic kidney disease in population-based administrative databases using an algorithm of hospital encounter and physician claim codes. *BMC Nephrology,* 14, 81. https://doi-org.proxy1.lib.uwo.ca/10.1186/1471-2369-14-81

Gaetz, S., Dej, E., Richter, T., & Redman, M. (2016). *The state of homelessness in Canada 2016*. Toronto: Canadian Observatory on Homelessness Press. https://homelesshub.ca/sites/default/files/SOHC16_final_20Oct2016.pdf

Gershon, A., Wang, C., Guan, J., Vasilevska-Ristovska, J., Cicutto, L., & To, T.. (2009a). Identifying Patients with Physician-Diagnosed Asthma in Health Administrative Databases. *Canadian Respiratory Journal*, *16*(6), 183–188. https://doi.org/10.1155/2009/963098

Gershon, A., Wang, C., Guan, J., Vasilevska-Ristovska, J., Cicutto, L., & To, T. (2009b). Identifying individuals with physcian diagnosed COPD in health administrative databases. *COPD: Journal of Chronic Obstructive Pulmonary Disease*, *6*(5), 388–394. https://doi.org/10.1080/15412550903140865

Grimmond, J., Kornhaber, R., Visentin, D., & Cleary, M. (2019). A qualitative systematic review of experiences and perceptions of youth suicide. *PloS One*, *14*(6), e0217568–. https://doi.org/10.1371/journal.pone.0217568

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

Haroon, N. N., Austin, P. C., Shah, B. R., Wu, J., Gill, S. S., & Booth, G. L. (2015). Risk of dementia in seniors with newly diagnosed diabetes: A population-based study. *Diabetes Care, 38*(10), 1868-1875. https://doi.org/10.2337/dc15-0491

Hiebert, B., Leipert, B., Regan, S., & Burkell, J. (2018). Rural Men's Health, Health Information Seeking, and Gender Identities: A Conceptual Theoretical Review of the Literature. *American Journal of Men's Health*, *12*(4), 863–876. https://doi.org/10.1177/1557988316649177

Holmes, W., & Rinaman, W. (2014). *Statistical Literacy for Clinical Practitioners [electronic resource] / by William H. Holmes, William C. Rinaman.* (1st ed.) [eBook edition]. Chapter 15: Logistic Regression. Springer International Publishing. https://doi.org/10.1007/978-3-319-12550-3

Hux, J., Ivis, F., Flintoft, V., & Bica, A. (2002). Diabetes in Ontario: Determination of prevalence and incidence using a validated administrative data algorithm. *Diabetes Care*, *25*(3), 512–516. https://doi.org/10.2337/diacare.25.3.512

ICES (2019-May-15). Validated ICES-derived cohorts. Document V.2. Modified by Jenny Gatov. Reviewed by Mariam Vermeulen. 1-8. Pdf file. ICES Intranet.

ICES (2020a). About ICES. ICES Main Website. https://www.ices.on.ca/About-ICES

ICES (2020b). Working with ICES Data. ICES Main Website. https://www.ices.on.ca/Data-and-Privacy/ICES-data/Working-with-ICES-Data

ICES. (2017, June 6). *Data description for deliverables*. Word document file, 1-9. ICES Intranet.

Jaakkimainen RL , Bronskill SE, Tierney M, Hermann N, Green D, Young J, Ivers N, Butt D, Tu K. Identification of physician-diagnosed Alzheimer's disease and related dementias in population-based administrative data: a validation study using family physicians' electronic medical records. *Journal of Alzheimer's Disease, 54*(2016): 337-349. https://link-gale-com.proxy1.lib.uwo.ca/apps/doc/A466717063/AONE?u=lond95336&sid=AONE&xid=eff94672

Ju, Y., Park, E., Han, K., Choi, J. W., Kim, J. L., Cho, K. H., & Park, S. (2016). Low socioeconomic status and suicidal ideation among elderly individuals. *International Psychogeriatrics, 28*(12), 2055-2066. https://doi.org/10.1017/S1041610216001149

Juurlink, D., Herrmann, N., Szalai, J., Kopp, A., & Redelmeier, D. (2004). Medical illness and the risk of suicide in the elderly. *Archives of Internal Medicine, 164*(11), 1179-1184. https://doi.org//10.1001/archinte.164.11.1179

Kiosses, D., Szanto, K., & Alexopoulos, G. (2014). Suicide in older adults: The role of emotions and cognition topical collection on geriatric disorders. *Current Psychiatry Reports, 16*(11). https://doi.org/10.1007/s11920-014-0495-3

Kjølseth, I., Ekeberg, Ø., & Steihaug, S. (2010). Why suicide? Elderly people who committed suicide and their experience of life in the period before their death. *International Psychogeriatrics, 22*(2), 209-218. https://doi.org/10.1017/S1031661209990949

Klaassen, Z., Wallis, C., Chandrasekar, T., Goldberg, H., Sayyid, R., Williams, S., Moses, K., Terris, M., Nam, R., Urbach, D., Austin, P., Kurdyak, P. & Kulkarni, G. (2019). Cancer diagnosis and risk of suicide after accounting for prediagnosis psychiatric care: A matched-cohort study of patients with incident solid-organ malignancies. *Cancer, 125*(16), 2886-2895. https://doi.org/10.1002/cncr.32146

Klonsky, D., May, A., & Saffer, B. (2016). Suicide, suicide attempts, and suicidal ideation. *Annual Review Clinical Psychology, 12*, 307-330. https://www2.psych.ubc.ca/~klonsky/publications/AnnualReview2016.pdf

Lapierre, S., Erlangsen, A., Waern, M., De Leo, D., Oyama, H., Scocco, P., Gallo, J., Szanto, K., Conwell, Y., Draper, B., & Quinnett, P. (2011). A systematic review of elderly suicide prevention programs. *Crisis: The Journal of Crisis Intervention and Suicide Prevention*, *32*(2), 88–98. https://doi.org/10.1027/0227-5910/a000076

Leenars, A. (2001). Suicide in the Canadian elderly. In De Leo, D. (Ed.). *Suicide and euthanasia in older adults*. Hogrefe & Huber Publishers: Toronto, ON, Canada.

Leung, K., Lu-McLean, D., Kuziemsky, C., Booth, R., Collins Rossetti, S., Borycki, E., & Strudwick, G. (2019). Using Patient and Family Engagement Strategies to Improve Outcomes of Health Information Technology Initiatives: Scoping Review. *Journal of Medical Internet Research*, *21*(10), e14683–. https://doi.org/10.2196/14683

Link, K., Garrett-Wright, D., & Jones, M. (2020). The Burden of Farmer Suicide on Surviving Family Members: A Qualitative Study. *Issues in Mental Health Nursing: Depression Across the Globe*, *41*(1), 66–72. https://doi.org/10.1080/01612840.2019.1661048

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

Ma-Kellams, C., Or, F., Baek, J., & Kawachi, I. (2016). Rethinking Suicide Surveillance: Google Search Data and Self-Reported Suicidality Differentially Estimate Completed Suicide Risk. *Clinical Psychological Science*, *4*(3), 480–484. https://doi.org/10.1177/2167702615593475

Mackridge, A., & Rowe, P. (2018). *A practical approach to using statistics in health research : From planning to reporting* [eBook edition]. Chapter 11: Kruskal-Wallis. Wiley. https://ebookcentral-proquest-com.proxy1.lib.uwo.ca

Marty, M., Segal, D. L., & Coolidge, F. L. (2010). Relationships among dispositional coping strategies, suicidal ideation, and protective factors against suicide in older adults. *Aging & Mental Health, 14*(8), 1015-1023. https://doi.org/10.1080/13607863.2010.501068

Masocco, M., Pompili, M. Vanacore, N., Innamorati, M., Lester, D., Girardi, P., Tatarelli, R. & Vichi, M. (2010). Completed suicides and marital status according to the Italian region of origin. *Psychiatric Quarterly, 81*(1) 57-71. https://doi.org/10.1007/s11126-009-9118-2

McConnell, D., Hahn, L., Savage, A., Dubé, C., & Park, E. (2016). Suicidal ideation among adults with disability in western Canada: A brief report. *Community Mental Health Journal, 52*(5), 519-526. https://doi.org/10.1007/s10597-015-9911-3

McLaren, S., Gomez, R., Gill, P. & Chesler, J. (2015). Marital status and suicidal ideation among Australian older adults: The mediating role of sense of belonging. *Psychogeriatrics, 27*(1), 145-154. https://doi.org/10.1017/S11041610214001501

Mezuk, B., Ko, T. M., Kalesnikava, V. A., & Jurgens, D. (2019). Suicide among older adults living in or transitioning to residential long-term care, 2003 to 2015. *JAMA Network Open, 2*(6), e195627-e195627. https://doi.org/10.1001/jamanetworkopen.2019.5627

Miller, M., Mogun, H., Azrael, D., Hempstead, K., & Solomon, D. (2008). Cancer and the risk of suicide in older Americans. *Journal of Clinical Oncology, 26*(29), 4720-4724. https://doi.org/10.1200/JCO.2007.14.3990

Nakanishi, M., & Endo, K., (2017). National suicide prevention, local mental health resources, and suicide rates in Japan. *Crisis, 38*(6), 384-392. https://doi.org/10.1027/0227-5910/a000469

Navaneelan, T. (2017, June). *Suicide rates: An overview*. https://www150.statcan.gc.ca/n1/pub/82-624-x/2012001/article/11696-eng.htm

Nicol, J. & Tiedemann, M. (2018, September, Rev.). *Bill C-14: An act to amend the criminal code and to make related amendments to other acts (medical assistance in dying), Legislative Summary*. Publication No. 42-1-C14-E. Library of Parliament: Ottawa, Canada. https://lop.parl.ca/sites/PublicWebsite/default/en_CA/ResearchPublications/LegislativeSummaries/421C14E

Niederkrotenthaler, T., Braun, M., Pirkis, J., Till, B., Stack, S., Sinyor, M., Tran, U., Voracek, M., Cheng, Q., Arendt, F., Scherr, S., Yip, P., & Spittal, M. (2020). Association between suicide reporting in the media and suicide: systematic review and meta-analysis. *BMJ*, *368*, m575–. https://doi.org/10.1136/bmj.m575

Olson, R. (2011). infoEXCHANGE: Suicide and language [Editorial]. 1-4. *Centre for Suicide Prevention, CMHA Alberta.*

Park, J., Han, M., Kim, M., Yoon, M., Ko, S., Cho, H., & Chung, Y. (2014). Predictors of suicidal ideation in older individuals receiving home-care services. *International Journal of Geriatric Psychiatric, 29*(4), 367-376. https://doi.org/10.1002/gps.4012

Pitman, A. Osborn, D., King, M., Erlangsen, A. (2014). Effects of suicide bereavement on mental health and suicide risk. *Lancet Psychiatry*. 1(1) 86-94. https://doi.org/10.1016/S0140-6736(14)60345-7

Public Health Agency of Canada [PHAC]. (2014, September). *The Chief of Public Health Officer's (Dr.Gregory Taylor) report on the state of public health in Canada.* Catalogue no. HP2-10/2014E-PDF, ISSN 1924-7087. https://www.phac-aspc.gc.ca/cphorsphc-respcacsp/2014/assets/pdf/2014-eng.pdf

Public Health Agency of Canada [PHAC]. (2019). *Working together to prevent suicide in Canada: 2018 progress report.* Catalogue no. HP32-10E-PDF, ISSN 2562-377X. Ottawa: Government of Canada. https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/64-03-18-2232-ProgressReport-SuicidePrevention_EN-06-eng.pdf

Public Health Agency of Canada [PHAC]. (2020, March). *Suicide in Canada: Key statistics (infographics)*. https://www.canada.ca/en/public-health/services/publications/healthy-living/suicide-canada-key-statistics-infographic.html

Quinn, R., Laupacis, C., Austin, E., Hux, X., Garg, R., Hemmelgarn, J., & Oliver, J. (2010). Using Administrative Datasets to Study Outcomes in Dialysis Patients: A Validation Study. *Medical Care*, *48*(8), 745–750. https://doi.org/10.1097/MLR.0b013e3181e419fd

Richman, J. (1995). The lifesaving function of humor with the depressed and suicidal elderly.*Gerontologist, 35*(2), 271-273. https://doi.org/10.1093/geront/35.2.271

Rosella, L., Kornas, K., Huang, A., Bornbaum, C., Henry, D., & Wodchis, W. P. (2018). Accumulation of chronic conditions at the time of death increased in Ontario from 1994 to 2013. *Health Affairs (Project Hope), 37*(3), 464-472. https://doi.org/10.1377/hlthaff.2017.1150

Ross, L., Gibson, M., Daley, A., Steele, L., & Williams, C. (2018). 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, 13*(8), 1-23. https://doi.org/10.1371/journal.pone.0201437

Sabodash, V., Mendez, M., Fong, S., & Hsiao, J. (2013). Suicidal Behavior in Dementia: A Special Risk in Semantic Dementia. *American Journal of Alzheimer's Disease & Other Dementias*, *28*(6), 592–599. https://doi.org/10.1177/1533317513494447

Sanchez, J., Cheff, R., Hassen, N., & Katakia, D. (2016). *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*. Toronto: Wellesley Institute. https://www.wellesleyinstitute.com/wp-content/uploads/2016/07/Examining-Health-in-the-Three-Month-Wait-Part-One.pdf

Sanderson, M., Bulloch, A., Wang, J., Williams, K., Williamson, T., & Patten, S. (2020). Predicting death by suicide following an emergency department visit for parasuicide with administrative health care system data and machine learning. *EClinicalMedicine*, *20*, 100281–. https://doi.org/10.1016/j.eclinm.2020.100281

Schmidt, C. (2012). Trending now: Using social media to predict and track disease outbreaks. *Environmental Health Perspectives*, *120*(1), A30–A33. https://doi.org/10.1289/ehp.120-a30

Schultz, S., Rothwell, D., & Chen, Z. (2013). Identifying cases of congestive heart failure from administrative data: a validation study using primary care patient records. *Chronic Diseases and Injuries in Canada*, *33*(3), 160–166. http://search.proquest.com/docview/1442472455/

Serrano, A., Garcia-Guzman, J., Xydopoulos, G., & Tarhini, A. (2018). Analysis of Barriers to the Deployment of Health Information Systems: a Stakeholder Perspective. *Information Systems Frontiers*, *22*(2), 455–474. https://doi.org/10.1007/s10796-018-9869-0

Seyfried, L., Kales, H. C., Ignacio, R. V., Conwell, Y., & Valenstein, M. (2011). Predictors of suicide in patients with dementia. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 7*(6), 567-573. https://doi.org/10.1016/j.jalz.2011.01.006

Shah, T., Clark, A., Seabrook, J., Sibbald, S., & Gilliland, J. (2019). Geographic accessibility to primary care providers: Comparing rural and urban areas in Southwestern Ontario. *The Canadian Geographer*, *64*(1), 65–78. https://doi.org/10.1111/cag.12557

Smith, A., Ayanian, J., Covinsky, K., Landon, B., McCarthy, E., Wee, C., & Steinman, M. (2011). Conducting high-value secondary dataset analysis: An introductory guide and resources. *Journal of General Internal Medicine*, *26*(8), 920–929. https://doi.org/10.1007/s11606-010-1621-5

Sommer-Rotenberg, D. (1998). Suicide and language. *Canadian Medical Association. Journal*, *159*(3), 239–240. http://search.proquest.com/docview/204778135/

Spiwak, R., Elias, B., Bolton, J., Martens, P., & Sareen, J. (2012). Suicide policy in Canada: Lessons from history. *Canadian Journal of Public Health, 103*(5), 338-341. https://search.proquest.com/docview/1323767420/fulltextPDF/FF451442AF474D2CPQ/1?accountid=15115

Statistics Canada. (2017, May). *A portrait of the population aged 85 and older in Canada* [Census]. https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016004/98-200-x2016004-eng.cfm

Statistics Canada. (2019, Sept.). *Deaths and age-specific mortality rates, by selected grouped causes, Table 13-10-0392-01*. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039201

Steele, L. S., Glazier, R. H., Lin, E., & Evans, M. (2004). Using administrative data to measure ambulatory mental health service provision in primary care. Medical Care, 42(10), 960-965. https://doi.org/10.1097/00005650-200410000-00004

Strand, S., Cadwallader, S., Firth, D., Updated/last revised July 20, 2011. Using statistical regression methods in education research. Module 4: Binary Logistic Regression. RESTORE at National Centre for Research Methods, University of Warwick. http://www.restore.ac.uk/srme/www/fac/soc/wie/research-new/srme/modules/mod4/index.html

Szumilas M. (2010). Explaining odds ratios. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *19*(3), 227–229. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2938757/

Tharmalingam, S., Hagens, S., & Zelmer, J. (2016). The value of connected health information: perceptions of electronic health record users in Canada. *BMC Medical Informatics and Decision Making*, *16*(1), 93–. https://doi.org/10.1186/s12911-016-0330-3

Thompson, E. & Langendoerfer, K., (2016). Older men's blueprint for "being a man". *Men and Masculinities, 19*(2), 119-147. https://doi.org/10.1177/1097184x15606949

Thygesen, L., & Ersbøll, A. (2014). When the entire population is the sample: Strengths and limitations in register-based epidemiology. *European Journal of Epidemiology*, *29*(8), 551–558. https://doi.org/10.1007/s10654-013-9873-0

Torous, J., Larsen, M., Depp, C., Cosco, T., Barnett, I., Nock, M., & Firth, J. (2018). Smartphones, sensors, and machine learning to advance real-time prediction and interventions for suicide prevention: A review of current progress and next steps. *Current Psychiatry Reports*, *20*(7), 1–6. https://doi.org/10.1007/s11920-018-0914-y

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

Tu, K., Chen, Z., & Lipscombe, L. (2008). Prevalence and incidence of hypertension from 1995 to 2005: a population-based study.(Research)(Survey)(Statistical data). *CMAJ: Canadian Medical Association Journal*, *178*(11), 1429–1435. https://doi.org/10.1503/cmaj.071283

Van Hecke, T. (2012) Power study of anova versus Kruskal-Wallis test, Journal of Statistics and Management Systems, 15:2-3, 241-247, https://doi.org/10.1080/09720510.2012.10701623

Van Orden, K., Wiktorsson, S., Duberstein, P., Berg, A. I., Fässberg, M., & Waern, M., Ph.D. (2014). Reasons for attempted suicide in later life. *American Journal of Geriatric Psychiatry, 23*(5), 536-544. https://doi.org/10.1016/j.jagp.2014.07.003

Vartanian, T. (2011). Secondary Data Analysis. Chapter 2: What is a secondary dataset & Chapter 3: Advantages, disadvantages, feasibility and appropriateness of using secondary data. Oxford University Press, Inc. New York, New York.

Voaklander, D., Rowe, B., Dryden, D., Pahal, J., Saar, P., & Kelly, K. (2008). Medical illness, medication use and suicide in seniors: a population-based case–control study. *Journal of Epidemiology and Community Health*, *62*(2), 138–13846. https://doi.org/10.1136/jech.2006.055533

Vogel, L. (2011). Canada suicide prevention efforts lagging, experts say. *Canadian Medical Association Journal, 183*(1), E27-E28. https://doi.org/10.1503/CMAJ.109.3724

Wald R, Quinn RR, Adhikari NK, et al. Risk of chronic dialysis and death following acute kidney injury. Am J Med. 2012;125(6):585-593. https://doi.org/10.1016/j.amjmed.2012.01.016

Walsh, C., Ribeiro, J., & Franklin, J. (2017). Predicting Risk of Suicide Attempts Over Time Through Machine Learning. *Clinical Psychological Science*, *5*(3), 457–469. https://doi.org/10.1177/2167702617691560

Wiebe, E., Shaw, J., Kelly, M., & Wright, A. (2020). Suicide vs medical assistance in dying (MAiD): A secondary qualitative analysis. *Death Studies, 44*(12), 802-807. https://doi.org/10.1111/dom.13646

Weisman, A., Tomlinson, G. A., Lipscombe, L. L., Perkins, B. A., & Hawker, G. A. (2019). Association between allopurinol and cardiovascular outcomes and all-cause mortality in diabetes: A retrospective, population-based cohort study. Diabetes, Obesity and Metabolism, 21(6), 1322-1329. https://doi.org/10.1111/dom.13656 https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2017.1150

Widdifield, J., Bombardier, C., Bernatsky, S., Paterson, J., Green, D., Young, J., … Tu, K. (2014). An administrative data validation study of the accuracy of algorithms for identifying rheumatoid arthritis: the influence of the reference standard on algorithm performance. *BMC Musculoskeletal Disorders*, *15*(1), 216. https://doi.org/10.1186/1471-2474-15-216

Worche, D. & Gearing, R. (2010). Chapter 11: Older adult suicide. *Suicide Assessment and Treatment: Empirical and Evidence-Based Practices*. Springer Publishing Company: New York, NY.

World Health Organization [WHO]. (2014). *Preventing suicide: A global imperative*. https://apps.who.int/iris/bitstream/handle/10665/131056/9789241564779_eng.pdf?sequence=1

World Health Organization [WHO]. (2016, April). *Multisectoral action for a life course approach to healthy ageing: draft global strategy and plan of action on ageing and health*. [Sixty-Ninth World Health Assembly: Provisional Agenda item 13.4, 1-37]. http://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_17-en.pdf?ua=1

World Health Organization [WHO]. (2018). *National suicide prevention strategy: Programs, examples and indicators*.

https://apps.who.int/iris/bitstream/handle/10665/279765/9789241515016-eng.pdf?ua=1

World Health Organization [WHO]. (2019). *Suicide in the world: Global health estimates*. https://www.who.int/publications/i/item/suicide-in-the-world

World Health Organization [WHO]. (2020). *Suicide*. http://www.emro.who.int/health-topics/suicide/feed/atom.html

Zhang, W., Ding, H., Su, P., Duan, G., Chen, R., Long, J., & Tian, W. (2016). Does disability predict attempted suicide in the elderly? A community-based study of elderly residents in Shanghai, China. *Aging & Mental Health, 20*(1), 81-87. https://doi.org/10.1080/13607863.2015.1031641

Appendices

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

Table A2: Databases and codes used to define medical conditions

MEDICAL CONDITIONS	DEFINITION
Congestive Heart Failure (CHF) [3]	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. <u>OHIP</u> OHIP diagnostic code: 428

	<u>CIHI-DAD, CIHI-SDS</u> ICD-9 diagnostic code: 428 ICD-10 diagnostic code: I500, I501, I509
Acute Myocardial Infarction (MI) [4]	The OMID Database was used to identify patients with a history of acute MI using OHIP, CIHI-DAD, and CIHI-SDS. <u>OHIP</u> 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. <u>CIHI-DAD, CIHI-SDS</u> CCI procedure codes: 3IS10, 3IP10, 2HZ28, 1IJ50, 1IJ57, or 1IJ76 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 [5]	The ASTHMA database was used to identify patients with asthma, based on ≥1 Hospitalization or ≥2 OHIP (ambulatory claims) in a two-year period. <u>OHIP</u> OHIP diagnostic code: 493 <u>CIHI-DAD</u> ICD-9 diagnostic code: 493 ICD-10 diagnostic codes: J45, J46

Chronic Obstructive Pulmonary Disease (COPD) [6]	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 [7,8]	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) [9,10]	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
Chronic Liver Disease (CLD) [11,12]	The DAD, NACRS and OHIP databases were used to identify patients with CLD, using the following definitions: (1) Any hospitalization or ED visit with a diagnosis code, OR (2) Any OHIP claim with both a feecode and diagnosis code OHIP OHIP diagnostic codes: 070, 571, 573 OHIP fee codes: Z551 and Z554 DAD 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. Refer to Appendix B, Table B1 (BC_CLD) for detailed description of the listed codes
Chronic Kidney Disease (CKD) [11,13-16]	The DAD, NACRS and OHIP databases were used to identify patients with CLD OHIP OHIP diagnostic codes: 403, 580, 581, 585. DAD 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. Refer to Appendix B, Table B2 (BC_CKD) for detailed description of the listed codes
Chronic Dialysis User [16,17]	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. OHIP OHIP fee codes: R849, G323, G325, G326, G860, G862, G863, G865, G866, G082, G083, G085, G090, G091, G092, G093, G094, G095. DAD CCI procedure codes:1PZ21HQBS, 1PZ2HQBR, 1PZ21HPD4 Refer to Appendix B, Table B3 (BC_CDU) for detailed description of the listed codes
Rheumatoid Arthritis [18]	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) OHIP OHIP diagnostic codes: 714 DAD ICD-10 diagnostic codes: M05, M06.
Crohn's/Ulcerative Colitis [19]	The OCCC database was used to identify patients with Crohn's/Ulcerative Colitis, using the following definition for older adults (65+): (1) Two years of OHIP eligibility *and* ≥5 Hospitalization/ED/OHIP in a four-year period *and* ≥1 ODB claim for IBD medication OHIP OHIP diagnostic codes: 555, 556. DAD ICD-10 diagnostic codes: K50, K51.

Human Immunodeficiency Virus (HIV) [20]	The HIV database was used to identify patients with HIV, based on ≥3 OHIP claims in a three-year period. OHIP OHIP diagnostic codes: 042, 043, 044. DAD ICD-10 diagnostic codes: B20, B21, B22, B23, B24.
Cancer [21]	The OCR database was used to identify patients with a history of cancer in Ontario, except for non-melanoma skin cancer. For recent diagnosis of cancer, this definition was used: "New" Dx of cancer are those beginning within 2 year prior to index date
Dementia [22]	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 [23,24]	The DAD, OMHRS, and OHIP databases were used to identify patients with psychotic disorders, based on 1 hospitalization with a diagnosis code OR 2 claims in 2 years or less with both a feecode 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 [23,24]	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 feecode and diagnosis code from the following code list: OHIP OHIP diagnosis 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 [23,24]	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 feecode and diagnosis code from the following code list: OHIP OHIP fee codes: K005, K007, K623, A001, A003, A004, A005, A006, A07, 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) [23,24]	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 feecode 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, 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

Table A3: Databases and codes used to define Mortality

MORTALITY	DEFINITION
SUICIDE [25-29]	The ORGD database was used to gather data on suicide deaths in older adults, based on the following: (1) COD in: E950-E959, OR (2) COD_UNDERLYING_ICD10 in: X60-X84, OR (3) MANNER_OF_DEATH = "4" ICD-9 E950, E951, E952, E953, E954, E955, E956, E957, E958, E959 ICD-10 *(a) Poisoning*: X60, X61, X62, X63, X64, X65, X66, X67, X68, X69

	(b) Asphyxiation: X70, X71 *(c) Violence (firearms, explosives, crashes and stabbings)*: X72, X73, X74, X75, X76, X77, X78, X79, X80, X81, X82 *(d) 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 [25,30-33]	The ORGD database was used to gather data on probable suicide deaths in older adults, based on the following: (1) COD in: E980-E987, E989 (2) COD_UNDERLYING_ICD10 in: Y10-Y32, Y34, Y87 <u>ICD-9</u> *(a) Undertermined Poisoning*: E980, E981, E982 *(b) Undertermined Asphyxiation*: E983, E984 *(c) Undetermined injury from Violence (firearms, explosions, stabbing)*: E985, E986 *(d) Undetermined Injury from Fall*: E987 *(e)* E989 <u>ICD-10</u>

	(a) *Poisoning or Undetermined Poisoning*: Y10, Y11, Y12, Y13, Y14, Y15, Y16, Y17, Y18, Y19 (b) *Hanging, Strangulation and Suffocation, Drowning*: Y20, Y21 (c) *Violence (firearms, explosives, crashes and stabbings)*: Y22, Y23, Y24, Y25, Y26, Y27, Y28, Y29, Y30, Y31, Y32, Y34 (d) 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

Table B1: Chronic Liver Disease (BC_CLD) Variable - Definitions of Codes Used [11,12]

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	Oesophageal varices
	K70	Alcoholic liver disease
	K713	Toxic liver diesease 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. alcholic cirrhosis, biliary cirrhosis)
	573	Other diseases of the liver
OHIP fee	Z551	Liver-incision-biosy, needle
	Z554	Liver-incision-biopsy

Table B2: Chronic Kidney Disease (BC_CKD) Variable - Definitions of Codes Used [11,13-16]

CODE TYPE	Codes	Description
DAD DX10CODE - ICD 10	E102	Type 1 diabetes mellitus with incipient diabetic nephropathy
	E112	Type 2 diabetes mellitues 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 haematuria

	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-intersitial nephritis
	N12	Tubulo-interstitial nephritis, not specified as acute or chronic
	N13	Obstructive and reflux uropathy
	N14	Drug- and heavy-metal-induced tubulo-interstitila 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 [16,17]

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 – Heamodialysis - 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 [23,24]

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	Housecall 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 [23,24]

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

Table B6: Mental Illness – Substance Abuse Disorders (BC_SUB) Variable -- Definitions of Codes Used [23,24]

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
DSM-4	291	
	2910	
	29100	
	2911	
	2912	
	29120	
	2913	
	2915	
	29150	
	2918	
	29181	
	29189	
	2919	
	29190	
	292	
	2920	
	29200	
	2921	
	29211	
	29212	
	2922	
	2923	

	29230	
	2927	
	2928	
	29280	
	29281	
	29282	
	29283	
	29284	
	29289	
	2929	
	29290	
	29298	
	303	Alcohol intoxication
	304	Substance dependence
	305	Substance Abuse

Table B7: Mental Illness – Social Problems and Others, not including Dementia (BC_OTH) Variable - Definitions of Codes Used [23,24]

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	Familiy 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
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	299	Autism-Spectrum Disorders
	30016	Factitious Disorder With Predominantly Psychological Signs and Symptoms
	30019	Factitous Disorder, NOS
	301	
	3010	
	3012	
	30120	
	30122	
	3013	
	3014	
	3015	
	30150	
	3016	
	30160	
	3017	
	30170	
	30181	
	30182	
	30183	
	3019	

	30190	
	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 Constpiation and Overflow Incontinence

Table B8: 'Death by Suicide' (OUT_SUIC) Outcome -- Definitions of Codes Used [25-29]

CODE TYPE	Codes	Description
ICD10		**POISONING**
	X60	Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics
	X61	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified
	X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified
	X63	Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system

X64	Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
X65	Intentional self-poisoning by and exposure to alcohol
X66	Intentional self-poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours
X67	Intentional self-poisoning by and exposure to other gases and vapours
X68	Intentional self-poisoning by and exposure to pesticides
X69	Intentional self-poisoning by and exposure to other and unspecified chemicals and noxious substances
ASPHYXIATION	
X70	Intentional self-harm by hanging, strangulation and suffocation
X71	Intentional self-harm by drowning and submersion
VIOLENCE (firearms, explosives, crashes and stabbings)	
X72	Intentional self-harm by handgun discharge
X73	Intentional self-harm by rifle, shotgun and larger firearm discharge
X74	Intentional self-harm by other and unspecified firearm discharge
X75	Intentional self-harm by explosive material
X76	Intentional self-harm by smoke, fire and flames
X77	Intentional self-harm by steam, hot vapours and hot objects
X78	Intentional self-harm by sharp object
X79	Intentional self-harm by blunt object
X80	Intentional self-harm by jumping from a high place
X81	Intentional self-harm by jumping or lying before moving object
X82	Intentional self-harm by crashing of motor vehicle
OTHER	
X83	Intentional self-harm by other specified means

	X84	Intentional self-harm by unspecified means
ICD9	E950	Suicide and self-inflicted poisoning by solid or liquid substances
	E951	Suicide and self-inflicted poisoning by gases in domestic use
	E952	Suicide and self-inflicted poisoning by other gases and vapors
	E953	Suicide and self-inflicted injury by hanging strangulation and suffocation
	E954	Suicide and self-inflicted injury by submersion (drowning)
	E955	Suicide and self-inflicted injury by firearms air guns and explosives
	E956	Suicide and self-inflicted injury by cutting and piercing instrument
	E957	Suicide and self-inflicted injury by jumping from high place
	E958	Suicide and self-inflicted injury by other and unspecified means
	E959	Late effects of self-inflicted injury

Table B9: 'Death by Probable Suicide' (OUT_NONSUIC_PROB) Outcome -- Definitions of Codes Used [25-29]

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
		UNDETERMINED ASPHIXIATION
	E983	Hanging strangulation or suffocation undetermined whether accidentally or purposely inflicted
	E984	Submersion (drowning), undetermined whether accidentally or purposely inflicted
		UNDETERMINED INJURY FROM VIOLENCE (firearms, explosions, stabbing)
	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
	UNDETERMINED INJURY FROM FALL	
	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	Poisonning 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 drus, 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 exposire to other and uspecified chemicals and noxious substances, undetermined intent
	HANGING, STRANGULATION AND SUFFOCATION, DROWNING	
	Y20	Hanging, strangulation and suffocation, undetermined intent

	Y21	Drowning and submersion, undetermined intent
	VIOLENCE (firearms, explosives, crashes and stabbings)	
	Y22	Handgun discharge, undetermined intent
	Y23	Rifle, shorgun 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

References for Appendices A and B:

1. ICES. (2017, June 6). *Data description for deliverables*. Word document file, 1-9. ICES Intranet.
2. ICES (2019-May-15). Validated ICES-derived cohorts. Document V.2. Modified by Jenny Gatov. Reviewed by Mariam Vermeulen. 1-8. Pdf file. ICES Intranet.
3. Schultz, S., Rothwell, D., & Chen, Z. (2013). Identifying cases of congestive heart failure from administrative data: a validation study using primary care patient records. *Chronic Diseases and Injuries in Canada*, *33*(3), 160–166. http://search.proquest.com/docview/1442472455/
4. Austin, P., Daly, P., & Tu, J. (2002). A multicenter study of the coding accuracy of hospital discharge administrative data for patients admitted to cardiac care units in Ontario. *American Heart Journal*, *144*(2), 290–296. https://doi.org/10.1067/mhj.2002.123839
5. Gershon, A., Wang, C., Guan, J., Vasilevska-Ristovska, J., Cicutto, L., & To, T.. (2009a). Identifying Patients with Physician-Diagnosed Asthma in Health Administrative Databases. *Canadian Respiratory Journal*, *16*(6), 183–188. https://doi.org/10.1155/2009/963098
6. Gershon, A., Wang, C., Guan, J., Vasilevska-Ristovska, J., Cicutto, L., & To, T. (2009b). Identifying Individuals with Physcian Diagnosed COPD in Health Administrative Databases. *COPD: Journal of Chronic Obstructive Pulmonary Disease*, *6*(5), 388–394. https://doi.org/10.1080/15412550903140865
7. Hux, J., Ivis, F., Flintoft, V., & Bica, A. (2002). Diabetes in Ontario: Determination of prevalence and incidence using a validated administrative data algorithm. *Diabetes Care*, *25*(3), 512–516. https://doi.org/10.2337/diacare.25.3.512
8. Lipscombe, L., Hwee, J., Shah, L., Booth, G., & Tu, K. (2018). Identifying diabetes cases from administrative data: a population-based validation study. *BMC Health Services Research*, *18*(1), 316. https://doi.org/10.1186/s12913-018-3148-0
9. Tu, K., Campbell, N., Chen, Z., Cauch-Dudek, K., & McAlister, F. (2007). Accuracy of administrative databases in identifying patients with hypertension. *Open Medicine*, *1*(1), e18–e26. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2801913/pdf/OpenMed-01-e18.pdf
10. Tu, K., Chen, Z., & Lipscombe, L. (2008). Prevalence and incidence of hypertension from 1995 to 2005: a population-based study.(Research)(Survey)(Statistical data). *CMAJ: Canadian Medical Association Journal*, *178*(11), 1429–1435. https://doi.org/10.1503/cmaj.071283
11. Weisman, A., Tomlinson, G. A., Lipscombe, L. L., Perkins, B. A., & Hawker, G. A. (2019). Association between allopurinol and cardiovascular outcomes and all-cause mortality in diabetes: A retrospective, population-based cohort study. Diabetes, Obesity and Metabolism, 21(6), 1322-1329. https://doi.org/10.1111/dom.13656. https://onlinelibrary-wiley-com.proxy1.lib.uwo.ca/doi/full/10.1111/dom.13656
12. CHC profile #20180302 (cite the article used there)
13. Fleet, J.L., Dixon, S.N., Shariff, S.Z. *et al.* Detecting chronic kidney disease in population-based administrative databases using an algorithm of hospital encounter and physician claim codes. *BMC Nephrol* 14, 81 (2013). https://doi-org.proxy1.lib.uwo.ca/10.1186/1471-2369-14-81

14. Haroon, N. N., Austin, P. C., Shah, B. R., Wu, J., Gill, S. S., & Booth, G. L. (2015). Risk of dementia in seniors with newly diagnosed diabetes: A population-based study. Diabetes Care, 38(10), 1868-1875. doi:10.2337/dc15-0491
15. Rosella, L., Kornas, K., Huang, A., Bornbaum, C., Henry, D., & Wodchis, W. P. (2018). Accumulation of chronic conditions at the time of death increased in ontario from 1994 to 2013. Health Affairs (Project Hope), 37(3), 464-472. doi:10.1377/hlthaff.2017.1150
16. Wald R, Quinn RR, Adhikari NK, et al. Risk of chronic dialysis and death following acute kidney injury. Am J Med. 2012;125(6):585-593. doi:10.1016/j.amjmed.2012.01.016
17. Quinn, R., Laupacis, C., Austin, E., Hux, X., Garg, R., Hemmelgarn, J., & Oliver, J. (2010). Using Administrative Datasets to Study Outcomes in Dialysis Patients: A Validation Study. *Medical Care*, *48*(8), 745–750. https://doi.org/10.1097/MLR.0b013e3181e419fd
18. Widdifield, J., Bombardier, C., Bernatsky, S., Paterson, J., Green, D., Young, J., … Tu, K. (2014). An administrative data validation study of the accuracy of algorithms for identifying rheumatoid arthritis: the influence of the reference standard on algorithm performance. *BMC Musculoskeletal Disorders*, *15*(1), 216. https://doi.org/10.1186/1471-2474-15-216
19. Benchimol, E., Guttmann, A., Mack, D., Nguyen, G., Marshall, J., Gregor, J., … Manuel, D. (2014). Validation of international algorithms to identify adults with inflammatory bowel disease in health administrative data from Ontario, Canada. *Journal of Clinical Epidemiology*, *67*(8), 887–896. https://doi.org/10.1016/j.jclinepi.2014.02.019
20. Antoniou, T., Zagorski, B., Loutfy, M., Strike, C., & Glazier, R. (2011). Validation of Case-Finding Algorithms Derived from Administrative Data for Identifying Adults Living with Human Immunodeficiency Virus Infection.(Research Article). *PLoS ONE*, *6*(6), e21748. https://doi.org/10.1371/journal.pone.0021748
21. Hall, S., Schulze, K., Groome, P., Mackillop, W., & Holowaty, E. (2006). Using cancer registry data for survival studies: the example of the Ontario Cancer Registry. *Journal of Clinical Epidemiology*, *59*(1), 67–76. https://doi.org/10.1016/j.jclinepi.2005.05.001
22. Jaakkimainen RL , Bronskill SE, Tierney M, Hermann N, Green D, Young J, Ivers N, Butt D, Tu K. Identification of physician-diagnosed Alzheimer's disease and related dementias in population-based administrative data: a validation study using family physicians' electronic medical records. Journal of Alzheimer's Disease, 54(2016): 337-349. *Gale Academic OneFile*, https://link-gale-com.proxy1.lib.uwo.ca/apps/doc/A466717063/AONE?u=lond95336&sid=AONE&xid=eff94672. Accessed 24 May 2020.
23. Steele, L. S., Glazier, R. H., Lin, E., & Evans, M. (2004). Using administrative data to measure ambulatory mental health service provision in primary care. Medical Care, 42(10), 960-965. https://doi.org/10.1097/00005650-200410000-00004
24. Simcoe Muskoka Health Stats (n.d.). *OMHRS (Ontario mental health reporting system)*. Simcoe Muskoka District Health Unit. http://www.simcoemuskokahealthstats.org/resources/data-sources/omhrs

25. Statistics Canada. (2020). *Table 13-10-0394-01 Leading causes of death, total population, by age group*. https://doi.org/10.25318/1310039401-eng
26. Saunders, N. R., Lebenbaum, M., Stukel, T. A., Lu, H., Urquia, M. L., Kurdyak, P., & Guttmann, A. (2017). Suicide and self-harm trends in recent immigrant youth in ontario, 1996-2012: A population-based longitudinal cohort study. BMJ Open, 7(9), e014863. https://doi.org/10.1136/bmjopen-2016-014863
27. World Health Organization [WHO]. (2020). *ICD-10 version:2019*. https://icd.who.int/browse10/2019/en#/X60-X84
28. Canadian Institute for Health Information [CIHI]. (2018). *Canadian coding standards for version 2018 ICD-10-CA and CII*. https://secure.cihi.ca/free_products/CodingStandards_v2018_EN.pdf
29. ICD9Data.com (n.d.). Retrieved from http://www.icd9data.com/2013/Volume1/E000-E999/E950-E959/default.htm
30. Fralick, M., Thiruchelvam, D., Tien, H. C., & Redelmeier, D. A. (2016). Risk of suicide after a concussion. CMAJ : Canadian Medical Association Journal = Journal De l'Association Medicale Canadienne, 188(7), 497-504. https://doi.org/10.1503/Cmaj.150790
31. Zaheer, J., Jacob, B., de Oliveira, C., Rudoler, D., Juda, A., & Kurdyak, P. (2018). Service utilization and suicide among people with schizophrenia spectrum disorders. Schizophrenia Research, 202, 347-353. doi:10.1016/j.schres.2018.06.025
32. Saunders, N. R., Lebenbaum, M., Stukel, T. A., Lu, H., Urquia, M. L., Kurdyak, P., & Guttmann, A. (2017). Suicide and self-harm trends in recent immigrant youth in ontario, 1996-2012: A population-based longitudinal cohort study. BMJ Open, 7(9), e014863. doi:10.1136/bmjopen-2016-014863
33. Grigoriadis, S., Wilton, A. S., Kurdyak, P. A., Rhodes, A. E., VonderPorten, E. H., Levitt, A., Cheung, A., Vigod, S. N. (2017). Perinatal suicide in Ontario, Canada: A 15-year population-based study. CMAJ : Canadian Medical Association Journal = Journal De l'Association Medicale Canadienne, 189(34), E1085-E1092. doi:10.1503/cmaj.170088 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5573543/?tool=pmcentrez&report=abstract

Curriculum Vitae

Name:	Eada Marie Prado Novilla-Surette
Post-secondary Education and Degrees:	Western University London, Ontario, Canada 2018-2020, MHIS Ryerson University Toronto, Ontario, Canada 2009-2014, BScN
Honours and Awards:	MHIS program, Western University (FIMS/FHS) Financial Support Package for MHIS graduate students ($12,000 per year for S.Y. 2018-2019 & 2019-2020, includes Western Research Graduate Scholarship) Daphne Cockwell School of Nursing, Ryerson University Graduated with Honours (2014); Kensington Foundation Award (2012); Sigma Theta Tau International Honor Society of Nursing, Lambda Pi-At-Large (2012); DCSN Bursary (2010); Dean's List (S.Y. 2009-2010); Ontario Scholar (2009)
Related Work Experience	Graduate Research Assistant Western University, 2019-2020 Graduate Teaching Assistant Western University, 2018-2020 Registered Nurse, 2014-present (Implant Surgical Care, Canadian Armed Forces, London Health Sciences Centre, Sunnybrook Health Sciences Centre)

Conference Presentations:

Legacy 2020 Conference. Honouring our Past, Creating Our Future: Transforming Education, Services, Systems and Policies that Impact Health. Arthur Labatt Family School of Nursing, Western University, London, Ontario, Canada. *Trends and Factors Associated with Suicide Deaths in Older Adults*. Oral Paper, accepted for presentation on May 7-8, 2020 – postponed due to COVID-19

Canadian Nursing Students Association (CNSA) 2012 Ontario Regional Nursing Conference. Diversity & Inclusivity VIA Empowerment (DIVE). Student Scholarly Showcase: Oral Presentation of Aesthetic Reflection photographs. Daphne Cockwell School of Nursing, Ryerson University, Toronto, Ontario, Canada. October 19-21, 2012.