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ASSOCIATIONS BETWEEN SUICIDE IDEATION AND DEMOGRAPHIC FACTORS, MEDICAL COMORBIDITIES, MEDICATIONS, AND AXIS-I MENTAL DISORDERS AMONG OLDER ADULTS WHO PRESENT TO PRIMARY CARE

Luke Anthony Fera

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DISORDERS AMONG OLDER ADULTS WHO PRESENT TO PRIMARY CARE

(Spine title: Clinical Associations with Suicide Ideation among Older Adults)

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by

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Graduate Program in Epidemiology and Biostatistics

A thesis submitted in partial fulfillment
of the requirements for the degree of
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entitled:

Associations Between Suicide Ideation and Demographic Factors, Medical Comorbidities, Medications, and Axis-I Mental Disorders among Older Adults who Present to Primary Care

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ABSTRACT

In the present study, associations between suicide ideation and demographic factors, medical comorbidities, medications, and Axis-I mental disorders among 745 patients age 65 years and older recruited from primary care practices in the Northeastern United States were assessed. Cross-sectional associations between various risk indices and patient self-reported suicide ideation were evaluated using multivariate logistic regression. Findings indicated that single and widowed participants were more likely to report suicide ideation than were married participants. Expression of suicide ideation was further associated with presence of major depressive disorder, minor depression, an anxiety disorder, more functional impairment, sleep disturbance, and vision impairment. Use of benzodiazepines or other sedatives was significantly associated with suicide ideation independent of having an anxiety disorder. Having a history of suicide ideation emerged as the strongest predictor of current suicide ideation. These findings have implications for enhancing clinical detection of suicide risk and improving treatment with older adults in a primary care context.

Keywords: suicide, suicide ideation, older adult, risk factor, demographic factor, comorbidities, medications, mental disorder, primary care

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DEDICATION

I would like to dedicate this work to my wife and soulmate, Catherine Fera, for her steadfast love, enduring support, and constant encouragement throughout my academic endeavours. I would also like to dedicate this work to my parents for their prayers, positive attitude, and generosity. This project is also dedicated to my cousin, Michael Mason, who died by suicide in 2001.

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CHAPTER 1: LITERATURE REVIEW

1.1 Introduction

Suicide is a significant public health concern worldwide. An estimated 900 000 people die by suicide around the world each year. This represents one death every 40 seconds.[1] Globally, suicide rates are significantly higher among men than among women.[2] The suicide rate for Canadian men in 2004 was 17.3 per 100 000, and 5.4 per 100 000 for women.[3] Suicide is the 9th leading cause of death in Canada.[4] In particular, adults age 65 years and over have higher rates of suicide than do younger cohorts[5], and this trend has been longstanding.[6, 7] The prevalence of late-life suicides may increase in coming years because older adults continue to comprise a greater proportion of the population due to longer life expectancies than previous generations. By 2021, adults age 65 years and older will account for almost 18% of Canada's population.[8] Another related explanation involves the movement of the baby boom cohort, a group with already high suicide rates, towards retirement age.[9] Thus, more individuals than ever before are moving into a phase of life in which suicide rates are high.

Suicide is a highly complex and individualized phenomenon which involves biological, psychological, and social factors. Yet, in most circumstances, suicide is preventable.[1] Improved risk detection ultimately leads to better prevention.[10] From a public health perspective, primary care providers are in a unique position to detect suicide risk among older adults who seek medical care, since older adults present to primary care providers before other providers.[11] Although a great deal of research has focused on risk factors for suicide in later life, few studies have addressed which of these factors are most germane in a primary care context. Fewer studies have addressed factors associated with suicide ideation among older adults in primary care. Suicide ideation is associated with death by suicide[12, 13] and can be considered a precursor to suicide. The fact that older adults tend to minimize or underreport suicidal symptoms presents challenges to suicide risk detection and prevention.[14, 15] It is therefore critically important that primary care clinicians are able to identify suicide ideation during their assessments of older adults.

The purpose of the present study is to identify a set of potential risk factors associated with suicide ideation among a sample of adults age 65 years and older who presented to primary care providers. This study will specifically investigate demographic variables, medical comorbidities, medications, and Axis-I mental disorders. Since the target audience of my research includes primary care providers, a fundamental goal of this project is to provide clinically relevant information about the presentation of suicide ideation among older adults in a primary care context.

1.2 Nomenclature

There is currently no universally accepted nomenclature for categorizing suicidological concepts. Previous efforts to develop a set of terms for epiphenomena of suicidology have been made, including the "Tower of Babel" article published by O'Carroll and colleagues in 1996.[16] A number of subsequent letters and articles were published in response to this article in an effort to further standardize the nomenclature. As a result, the "Tower of Babel" article was revised by Silverman and colleagues in 2007, following a consensus process involving the Centers for Disease Control and the American Foundation for Suicide Prevention to include currently preferred constructs and language.[17, 18] Further initiatives to redefine terms were put forward by the United States Food and Drug Administration due to inconsistent classification of potentially suicidal events in randomized controlled trials of selective serotonin reuptake inhibitors.[19] In 2006, a group of Canadian researchers proposed a set of evidence-based clinical practice guidelines for the assessment of suicide risk and the treatment and prevention of suicide among older adults.[10] These Canadian guidelines also contained a glossary of suicide nomenclature based on the available literature. The following operational definitions are used in this manuscript and have been adopted directly from work by O'Carroll and colleagues[16] and the Canadian Coalition for Seniors' Mental Health[10]:

1. Suicide: Death from injury, poisoning, or suffocation where there is implicit or explicit evidence that the injury was self-inflicted *and* the decedent intended to kill himself/herself.[16]

2. Suicide-related behaviour: Potentially self-injurious behaviour for which there is implicit or explicit evidence *either* that (a) the individual intended at some (nonzero) level to kill himself/herself; *or* (b) the individual wished to use the appearance of intending to kill himself/herself in order to attain some other end.[16] (Note: The term "suicidal behaviour" will be used interchangeably with "suicide-related behaviour".)

3. Suicidality: A spectrum of activities related to thoughts and/or behaviours that are associated with suicide risk.[10]

4. Suicide ideation: Any self-reported thoughts of engaging in suicide-related behaviour.[10]

5. Death ideation: Any self-reported recurrent thoughts of dying or of wishing for one's death; may include passive wishes for death and does not include the explicit wish to end one's own life or thinking of someone else's death.[10]

Following currently preferred language, the term "older adult" will be used to refer to individuals ≥ 65 years of age.

1.3 Literature Review Methods (Search Strategy)

The literature was searched focusing on published, peer-reviewed articles related to suicide risk factors and treatments in older adults employing the following electronic databases:

1. PubMed;
2. MEDLINE(R) that included in-process and other non-indexed citations, and the following databases: ACP Journal Club, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Cochrane Methodology Register, Database of Abstracts of Reviews of Effects, Health Technology Assessment, and NHS Economic Evaluation Database;
3. EMBASE;
4. PsycINFO;
5. CINAHL.

The literature search was limited to articles published in the English language. The following keywords were searched in each database: suicide, ideation, risk factor, depression, treatment, elder, elderly, late life, older adult, and senior. Keywords were searched using Boolean operators to maximize both the yield and efficiency of the literature search. Duplicate citations were removed from the search results. Since this search yielded many review articles, references cited in the review articles were also identified and included.

Broad inclusion criteria were applied to identify all published, peer-reviewed articles regarding suicide risk factors and treatments in older adults, although there is currently a paucity of such literature.[12] To ensure all relevant studies were captured, a two-phase approach was conducted. Initially, studies that were published in English and contained the aforementioned keywords were collected and reviewed. Abstracts were initially reviewed to determine a study's applicability. Studies were excluded if the outcomes of a study were not germane to suicide in older adults (e.g., studies of suicide in younger populations). Editorials, case reports, and case series were also excluded because they are not designed to assess the effect of risk factors and treatments on suicide and suicide-related behaviour.

1.4 The Epidemiology of Suicide

Suicide is a major public health concern worldwide. Suicide is the 9th leading cause of death in Canada[4] and the 11th leading cause of death in the United States[20] based on the most recent mortality data available. In 2005, there were a total of 3743 officially reported deaths by suicide in Canada; 2857 men and 886 women.[21] This corresponds to a crude mortality rate of 11.6 per 100 000 persons for both sexes. The 2005 age-adjusted suicide rate for both sexes was 10.9 per 100 000, whereas the age-adjusted suicide rate for men was 16.9 per 100 000 and 5.10 per 100 000 for women, respectively.[21] Thus, suicide is over three times more prevalent among Canadian men compared to women across all age groups.

There were over 34 500 deaths by suicide in the United States in 2007.[22] The 2007 crude suicide mortality rate for both sexes in the United States was 11.48 per 100 000 persons. The age-adjusted mortality rate was 11.26 per 100 000 for both sexes, 18.41 per 100 000 for men, and 4.67 per 100 000 for women, respectively.[22] On average, suicide is four times more common among American men compared to women. With respect to adults over 65 years of age, the age-adjusted suicide rate was over seven times higher among American men (28.56 per 100 000) compared to women (3.88 per 100 000).[22]

Since 1950, suicide rates for all age groups in Canada increased gradually until 1980, when the overall crude rate reached a maximum of 14.0 per 100 000 (Figure 1).[23] The suicide rate remained constant between 1980 and 1995, and began to decline after 1995 (Figure 1). The reasons for the stabilization in the suicide rate between 1980 and 1995 have not been elucidated, but possible explanations might include adoption of better prevention strategies, availability of better treatments for depression (e.g., selective serotonin reuptake inhibitors), a cohort effect, or natural variation.

Among Canadian men, the suicide rate had also increased between 1950 and 1980, and the rate has decreased since 1995. Among women, the suicide rate has ranged from 3.50 to 6.80 per 100,000 since 1950, and has been substantially lower and apparently more stable than has the suicide rate in men (Figure 1).[23]

Figure 1. Suicide rates for men, women, and the total population in Canada from 1950 to 2004 (figure taken directly from WHO mortality statistics).[23]
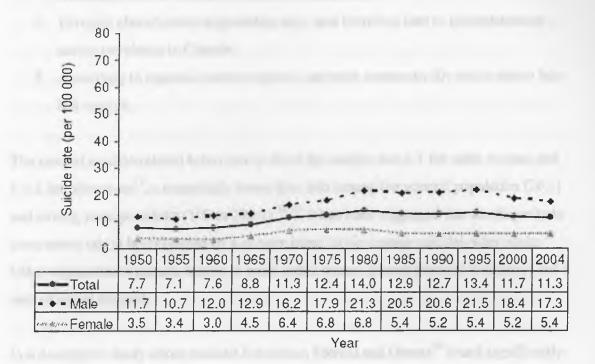

	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2004
—•—Total	7.7	7.1	7.6	8.8	11.3	12.4	14.0	12.9	12.7	13.4	11.7	11.3
- ◆ - Male	11.7	10.7	12.0	12.9	16.2	17.9	21.3	20.5	20.6	21.5	18.4	17.3
⋯▲⋯Female	3.5	3.4	3.0	4.5	6.4	6.8	6.8	5.4	5.2	5.4	5.2	5.4

Year

Table 1. Crude suicide rate for Canadians age 65 and over.[24]

Age group (years)	2005 Suicide Rate (per 100 000)		
	Total	Men	Women
65 to 69	11.6	18.3	5.3
70 to 74	9.5	17.0	2.9
75 to 79	13.1	22.7	5.5
80 to 84	10.5	19.4	4.9
85 to 89	9.6	21.4	3.7
≥ 90	7.6	20.1	3.2

Older adults have higher rates of suicide compared to younger cohorts.[25] Table 1 displays the most recent Canadian suicide rates for older adults, stratified by age and sex. Notwithstanding higher suicide rates in older adults, national-level mortality statistics likely underestimate the true number of suicides for the following reasons:

1. Deaths by suicide with more equivocal circumstances are often excluded, or miscategorized as natural or undetermined deaths.[26]

2. Forensic classification approaches vary, and therefore lead to inconsistencies across provinces in Canada.

3. According to regional coroner reports, coroners systematically under-detect late-life suicide.

The ratio of suicide-related behaviour to death by suicide was 6:1 for older women and 1.5:1 for older men[27], substantially lower than that among the general population (20:1) and among younger adults (100 to 200:1).[28, 29] It has been suggested that the disparity in these ratios might be explained by a greater intent to die among suicidal older adults.[28] Other explanations include access to more lethal means, poorer physical resiliency, and a lack of social support.

In a descriptive study about suicidal behaviour, Merrill and Owens[30] found significantly higher scores on a measure of suicide intent among adults age 65 and older compared to younger adults. Another descriptive study of patients who were evaluated by a psychiatric consultation service after engaging in suicidal behaviour reported greater premeditation by older adults between 60 and 90 years of age than by a younger cohort of individuals who engaged in suicidal behaviour.[31] Other investigators have concluded that, despite increased premeditation, older adults are less likely to report suicide ideation to others.[32] Older adults who take their own lives tend to use violent and highly lethal means. A rigorous population-based case-control study conducted with data from Ontario by Juurlink and colleagues in 2004 found that older men who died by suicide typically used firearms or hanging, while older women died mostly by self-poisoning, hanging, or suffocation.[33] These observations lend to the hypothesis that older adults who are suicidal utilize more lethal means compared to younger cohorts, and might further explain why rates of suicide are higher in older adults.

1.5 Risk Factors for Suicide in Older Adults

Age (older), sex (male), and ethnicity (white) have consistently been identified as risk indices for suicide through official North American mortality statistics.[34] However, the multidimensional process of suicide results from complex interactions between biological, psychological and social factors, suggesting numerous additional risk processes. Until recently, few studies of suicidal behaviour throughout the life course evaluated the risk associated with particular characteristics that might influence whether a person takes his or her own life; still fewer focused on later life.[34] Very few studies have examined protective or resiliency factors.[12]

Several factors may have contributed to a paucity of research on risk factors for suicide in older adults. Suicide is a low base rate occurrence, necessitating extraordinarily large sample sizes in order to ascertain outcomes with adequate power in prospective cohort studies. Prospective cohort studies are the epidemiologic design of choice for identifying risk factors for a particular disease or condition, because outcomes are collected in real time, risk ratios can be produced, and prospective cohort studies are subject to less bias than other designs. Given the statistical rarity of suicide, the cost of recruiting a sufficiently large sample size is prohibitive, limiting the availability of such data. Only two prospective cohort studies of risk factors for suicide in older adults were identified from the literature search, although the results were published as nested case-control studies.[35, 36] Ethical issues related to the need for clinical follow-up of high-risk samples may also discourage researchers from conducting prospective cohort studies.[37]

Case-control studies are well-suited for detecting rare outcomes, such as suicide in older adults; however, they can be subject to the influence of selection bias, ascertainment of status bias, information bias, and recall bias due to their retrospective design.[38, 39] Also, case-control studies produce odds ratios rather than risk ratios. Odds ratios can provide an estimate of the relative risk of an outcome comparing one group to another only when the rare disease assumption holds, that is, when the outcome in question has a low prevalence in the general population.[40] Risk ratios allow for comparisons of incidence between

groups, but they can only be calculated in prospective studies. Most of the current evidence base of risk factors for suicide in older adults comes from case-control studies.

Another retrospective design used to identify suicide risk factors is the psychological autopsy study (PA). The overall aim of psychological autopsy is to gather information about the circumstances of an individual's death to try to understand the contributing factors for that person's death by suicide. Information about the individual who died by suicide is gathered from coroners, relatives, friends, caregivers, others familiar with the person, and relevant medical and/or hospital records.[41] The psychological autopsy is an essential method for suicide research, because sensitive information about thoughts and feelings are not available in population databases. Because of their reliance on proxy informants, PA studies are susceptible to selection bias, recall bias, information bias, and reporting bias. For example, informants might over-report stressful life events and depression symptoms as explanations for the death by suicide. Numerous case-control studies cited below have interviewed informants of individuals who died by suicide using a semi-structured format, a standard procedure in PA studies. These studies are sometimes referred to as "case-control psychological autopsies" or "controlled psychological autopsies". A further discussion of specific methodological limitations in late-life suicide risk factor research follows in Section 1.6.

The prediction of individual deaths by suicide is generally considered impossible.[42, 43] Suicide prediction refers to the foretelling of whether suicide will or will not occur at some future time, based on the presence or absence of a number of defined factors, within definable limits of statistical probability.[43] There is currently no known factor (e.g., psychological test, clinical technique, biological marker) which is sufficiently specific and sensitive to enable suicide prediction.[12, 34, 43] This caveat prevents researchers from constructing causal epidemiologic models. Still, large longitudinal studies, such as the Canadian Longitudinal Study on Aging[44], could provide useful public health data on long-term predictors and protective factors for suicide.

In order to optimize care, it is advantageous for mental health providers, including primary care physicians to be aware of factors that potentially increase the risk for suicide in their patients. To that end, I will now review the current literature on the primary risk factors for late-life suicide. Much of the data on risk factors for late-life suicide comes from a limited number of psychological autopsy studies, case-control studies, and nested case-control studies. Since these studies will be cited throughout the literature review, a summary table of methodologic details for selected studies follows in Table 2.

Suicide Ideation and Suicidal Behaviour

Older adults who report suicide ideation, or who have had a history of suicide ideation or previous suicidal behaviour are at high risk for suicide.[34] Although a past history of suicidal thoughts or behaviour is an important correlate of risk for suicide, individuals with no past history of suicide ideation or behaviour accounted for approximately 58% of suicide cases in one study.[13] These investigators reported that 73% of those individuals who died by suicide had expressed thoughts of death or suicide to a friend, family member, acquaintance, or physician.[13] Estimates from 3 community surveys of older adults have indicated that suicide ideation is present in between 2.3%, 15.3%, and 15.9% of respondents sampled, respectively.[45-47] The variation in these prevalence estimates is likely due to sampling and measurement differences, along with different operational definitions of suicide ideation.

The Berlin Aging Study (BASE), a multidisciplinary longitudinal study of older adults, used the suicide item on the Hamilton Depression Rating Scale (HDRS) to assess suicide ideation in adults ≥ 70 years of age.[48] The HDRS is a 21-item, clinician-administered measure that is used to rate depression symptom severity, and has been widely used in medical research. The results of the Berlin Aging Study showed that 14.7% of subjects felt that life was not worth living, 5.4% wished to be dead, and an additional 1.0% endorsed suicidal ideas or gestures.[48]

Table 2. Methodologic details of selected observational studies that were frequently cited throughout the manuscript.

Citation(s)	Study design	Location	Sample groups	Outcomes	Comments
Turvey[36]	Nested case-control	CT, MA, IA, NC	20 SD; 400 matched LC; all age ≥ 65 years	Medical, cognitive, and physical disability variables obtained through direct interviews with cases and controls	Sleep quality and social support variables were assessed using non-validated measures
Ross[35]	Nested case-control	Los Angeles, CA	19 SD; 228 matched LC; median age of 73 years	Demographic, medical, mental outlook, and health practices variables obtained through questionnaires for cases and controls	Mental outlook was assessed using a non-validated measure
Waern[13, 49, 50]	Case-control PA	Sweden	85 SD; 153 LC; all age ≥ 65 years	*DSM-IV* Axis I disorders obtained from MRR for cases and controls; life events and psychosocial factors obtained from proxy informants for cases, direct interviews for controls; burden of illness rated by a clinician for cases and controls	Outcome variables were adjusted for age or age and sex only
Tsoh[51]	Case-control PA	Hong Kong	67 SD; 91 LC; all age ≥ 65 years	*DSM-IV* Axis I disorders obtained using MRR and SCID via proxy informants for cases, direct interviews for controls; sociodemographic factors; medical comorbidities, functional status, personality factors	
Chiu[52]	Case-control PA	Hong Kong	70 SD; 100 LC; all age ≥ 60 years	*DSM-III-R* Axis-I disorders obtained using SCID via proxy informants for cases, direct interviews for controls	Results were from uncontrolled analyses
Conwell[53]	Case-control PA	Monroe County, NY	84 SD; 196 LC; all age ≥ 60 years	*DSM-III-R* Axis-I disorders obtained using SCID via proxy informants for cases, direct interviews for controls; depression symptom severity; ADL impairment; functional impairment	Results were from uncontrolled analyses
Duberstein[54, 55]	Case-control PA	Monroe County, NY	86 SD; 86 matched LC; all age ≥ 60 years	*DSM-III-R* Axis-I disorders obtained using SCID with proxy informants for cases and controls; socioeconomic variables including family indicators of social integration and social/community indicators of social integration; stressful life events	
Beautrais[56]	Case-control PA	New Zealand	22 SB + 31 SD; 269 LC; all age ≥ 55 years	*DSM-III-R* Axis-I disorders obtained using SCID with proxy informants for cases and controls; stressful life events, physical illnesses, social interaction	SB and SD were not independently compared to LC; results were from uncontrolled analyses
Juurlink[33]	Case-control	Ontario	1329 SD; 5315 matched LC; all age ≥ 66 years	Medical illnesses defined using prescription database records for cases and controls	Prescription records were used as a proxy for medical illnesses
Quan[57]	Case-control	Alberta	822 SD; 922 MVA; all age ≥ 55 years	Psychiatric and physical illnesses based on ICD-9 codes for cases and controls using record linkage to administrative databases of Alberta Health and Wellness; medication use based on BC PharmaCare database	

Note: SD = suicide death cases; SB = suicidal behaviour cases; LC = living control; MVA = controls who died by motor vehicle accident; MRR = medical record review; SCID = Structured Clinical interview for *DSM-IV*.

Women were significantly more likely to report suicide ideation than men ($p = 0.004$).[48] Furthermore, older persons had a higher risk of being rated as suicidal by an experienced psychiatrist; there was a significant trend towards more intense suicide ideation among older age groups ($p = 0.036$).[48]

In 2001, Scocco and colleagues surveyed 666 Italian adults over 65 years of age and found that 11% of respondents had, at some point over the course of their lifetime, self-reported thoughts that life was not worth living.[58] Ten percent had reported a wish for death, with significantly more women reporting a wish for death compared to men.[58]

In a Chinese case-control study of suicide in older adults by Chiu and colleagues, 28.6% of those who died by suicide had a past history of suicidal behaviour.[52] A Swedish case-control study reported that a history of suicidal behaviour was present in 42% of individuals who died by suicide (men 30%, women 56%).[13] Twenty percent of that study's cases exhibited suicidal behaviour (men 15%, women 28%) in the final year of life. A New Zealand case-control study reported an odds ratio of 36.3 for lifetime history of suicidal behaviour comparing cases to controls (95% CI: 14.77 to 89.32; $p < 0.0001$).[56] This finding was consistent with U.S. results from Conwell and colleagues published in 2001 ($OR = 10.8$; 95% CI: 2.4 to 48.6)[37] and 2000 ($\chi^2 = 12.35$; $p < 0.001$).[53]

Suicide mortality rates are significantly higher in older men compared to older women; however, the available literature consistently indicates that women are more likely to engage in suicidal behaviour than men. The reasons for the observed differences in these rates have not yet been definitively elucidated.[34] Moreover, older persons are less likely to report suicide ideation compared to younger adults[59], potentially impeding risk detection in this population.

Presence of Mental Disorders

The available research on risk factors for suicide among older adults consistently indicates that mental disorders are highly prevalent among those who die by suicide. Turvey and colleagues conducted a large, multisite, community-based prospective cohort study among older adults in the United States.[36] A nested case-control design with a 1:20 case-to-control ratio was employed to ascertain outcomes in this study. Individuals who died by suicide were significantly more likely to report depressive symptoms, measured using the Center for Epidemiological Studies–Depression Scale (CES-D), than were controls ($OR = 1.34$; 95% CI: 1.14 to 1.59; $p = 0.0006$). A cohort of adults living in a retirement community in Southern California ($n = 11\,888$) was followed prospectively for several years in the early 1980s to identify risk factors for traumatic deaths (including suicide).[35] Also utilizing a nested case-control design, the investigators determined that older adults in this retirement community who died by suicide were more likely to have a low mental outlook summary score (a non-validated measure of depression used by these researchers) compared to controls ($OR = 6.1$; 95% CI: 2.0 to 19.0; $p = 0.002$). To assess whether depression was a risk factor for suicide on both a short-term and long-term basis, the investigators dichotomized the results into two categories: ≤ 3 years since initial assessment and > 3 years since initial assessment. The investigators identified a trend between suicide and increasing severity of depression that remained significant in both categories ($p = 0.0009$, χ^2 test for trend), although this association was more pronounced three years after initial assessment. This finding suggests that depression can confer risk for suicide even a number of years into the future, which would necessitate intervention and follow-up.

Evidence from PA and other case-control studies is similar to the evidence from the two nested case-control studies cited above, in that all case-control studies implicate mental disorders as a risk factor for suicide in older adults. However, compared to the nested case-control studies, point estimates in PA studies are larger in magnitude and confidence intervals are wider. A further discussion of these differences appears in Section 1.6.

In Chiu and colleagues' controlled PA study in China[52], the odds ratio of mood disorders comparing individuals who died by suicide with living controls was 59.24 (95% CI: 20.68 to 169.65). Mood disorders included major depression, adjustment disorder with depressed mood, and dysthymic disorder. These authors defined a serious mental disorder as current mental illness requiring psychiatric hospitalization, severe dementia, or severe substance abuse. There was no difference in the frequency of mood disorders between men and women who died by suicide. Rubenowitz and colleagues reported an odds ratio of suicide comparing men with a serious mental disorder to men who did not have a serious mental disorder of 99.8 (95% CI: 28.5 to 389.0).[13] The odds ratio of suicide among women with a serious mental disorder compared to women who did not have a serious mental disorder was 61.6 (95% CI: 16.7 to 227.1).[13]

In a controlled PA study by Waern and colleagues in Sweden, odds ratios comparing those who died by suicide with controls for any category of DSM-IV Axis I disorder, bipolar disorder, major depressive disorder, dysthymic disorder, and minor depressive disorder ranged from 13.9 to 113.1; however, confidence intervals were wide for each point estimate.[49] Older adults who died by suicide were more likely to have a psychotic disorder than controls ($OR = 10.7$; 95% CI: 1.3 to 89.8). Investigators from Rochester, New York found that older adults who died by suicide were more likely to have an active mental disorder ($OR = 55.0$; 95% CI: 12.11 to 972.17), and more likely to have had a mental disorder for at least one year prior to death by suicide ($OR = 19.00$; 95% CI: 3.94 to 341.21) versus controls.[54] These observations were similar to previous results published by the same group of investigators in 2000.[53]

Given the limitations of PA studies, perhaps the most convincing evidence for mental illness as a risk factor for suicide comes from two well-designed case-control studies performed in Canada.

Quan and colleagues[57] conducted a case-control study using several electronic medical record linkage procedures to abstract data for cases and controls, reducing the influence of recall bias, a problem in PA studies, in which proxy informants are used to collect a

large portion of the study's data. Cases (n = 920) included all individuals in Alberta who were officially reported to have died by suicide between 1984 and 1995. Controls (n = 1050) included all motor vehicle collision-related deaths for the same time period. All individuals studied were 55 years of age and over. The odds ratio of depression comparing cases (suicide) to controls (motor vehicle collision) was 6.70 (95% CI: 4.72 to 9.50), whereas the odds ratio for all mental disorders was 2.16 (95% CI: 1.68 to 2.76). Both point estimates were adjusted for demographic factors and medical comorbidities.

Juurlink and colleagues[33] conducted a similar study on adults 66 years or older in Ontario. Suicide cases (n = 1329) were identified consecutively between 1992 and 2000. Deaths by suicide were ascertained from records of the Chief Coroner's Office of Ontario. Four control patients per case (n = 5315) were selected using the Registered Persons Database in Ontario. The Registered Persons Database includes information on each person registered to receive health care in Ontario. Data on each person was obtained from the Ontario Drug Benefit program database. The results of multivariate analysis from this large population study indicated strong associations between suicide and psychosis and agitation (OR = 2.60; 95% CI: 1.93 to 3.50), depression (OR = 3.94; 95% CI: 3.27 to 4.75) and bipolar disorder (OR = 3.58; 95% CI: 1.57 to 8.18) compared to controls.

Personality Factors

Limited research has indicated that personality factors, such as increased neuroticism, decreased extraversion, decreased openness, decreased agreeableness, and increased contentiousness, may confer risk for suicide.[55, 60, 61] A British case-control PA study reported that older adults who died by suicide were almost five times as likely to have a personality disorder compared to age- and sex-matched controls who died by natural causes (OR = 4.7; 95% CI: 1.2 to 15.1).[62] However, the mode of case identification and the sources of information available for cases and controls were different, creating the possibility of selection bias.

It has been hypothesized that suicidal behaviour is associated with high neuroticism, or the disposition of experiencing negative or unstable affect, such as sadness and anxiety. A cross-sectional American study of older depressed inpatients found that individuals with high neuroticism scores were significantly more likely to report death ideation.[60] Similar findings were reported in a Chinese case-control PA study, albeit using univariate analyses.[51]

In a cross-sectional study of psychiatric inpatients and outpatients living in Rochester, NY, Heisel and colleagues determined that another personality trait, openness to experience (OTE), might increase the likelihood of reporting *suicide ideation*.[63] Yet, other researchers have found that elevated openness to experience could protect against *death by suicide*.[51, 64] Heisel and colleagues suggest that increased OTE might reduce the risk of death by suicide by increasing attention from one's social network, facilitating treatment adherence and enhancing clinical vigilance.[63] Further research is necessary to clarify the effect of personality characteristics on suicidal behaviour in older adults.

Presence of Medical Illness

The presence and number of physical comorbidities is associated with increased suicide risk in older adults. Table 3 lists comorbidities that were statistically significant predictors of suicide in older adults from one nested case-control study[36] and four case-control studies.[33, 50, 51, 57]

Juurlink and colleagues found a statistically significant trend between a patient's total number of physical illnesses and the estimated relative risk for suicide compared to patients with no reported illness.[33] As the number of physical illnesses increased, the risk for death by suicide also increased ($p < 0.001$, χ^2 test for trend). Patients with the greatest number of physical illnesses in that study (≥ 7) had about a 9-fold greater risk for suicide compared to those without illness. Similar conclusions were reached by Turvey et al. in a nested case-control study, but statistical significance was not reached ($p = 0.06$), likely due to a small number of individuals who died by suicide ($n = 20$).[36]

Table 3. Medical comorbidities associated with suicide in studies of older adults.

Medical comorbidity	Citation	Study Design	Odds ratio (95% CI)
Cancer	Quan[57]	Case-control	1.73 (1.16, 2.58)*
Malignancy	Tsoh[51]	Case-control	24.3 (2.8, 214.1)*
Any malignancy	Waern[50]	Case-control	3.4 (1.2, 9.8)†
Chronic lung disease	Juurlink[33]	Case-control	1.30 (1.06, 1.58)*
Chronic pulmonary disease when married	Quan[57]	Case-control	1.86 (1.22, 2.83)*
Seizure disorder	Juurlink[33]	Case-control	2.41 (1.42, 4.07)*
Visual impairment	Waern[50]	Case-control	7.0 (2.3, 21.4)†
Neurological disorders including stroke	Waern[50]	Case-control	3.8 (1.5, 9.4)†
Arthritis	Tsoh[51]	Case-control	11.5 (2.4, 56.1)*
Fracture since age 50	Turvey[36]	Nested case-control	3.39 (1.16, 9.40)§

Note: *indicates that results are from multivariate analyses; †indicates that results are from univariate analyses; §indicates that the authors do not specify which type of analysis.

Older adults who die by suicide are more likely to suffer from moderate (*OR* = 1.24; 95% CI: 1.04 to 1.47) to severe pain (*OR* = 4.07; 95% CI: 2.51 to 6.59) compared to controls.[33] Even the perception and/or anticipation of poor physical health or physical illness can be associated with suicide among older adults, which underscores the contributing role of psychological processes. In a nested case-control study conducted by Turvey and colleagues, the odds ratio of poor perceived health comparing older adults who died by suicide to controls was 3.36 (95% CI: 1.21 to 10.16; *p* = 0.02).[36] In another study of late-life suicide which focused on perceived physical illness, family discord, and financial strain, the odds ratio of perceived physical illness was 6.24 (95% CI: 1.28 to 51.24), comparing suicide cases to controls.[54]

Other medical comorbidities, such as vision or hearing impairment, might confer risk for suicide in older adults. De Leo and colleagues[65] reported on a case series of 19 older individuals who died by suicide who had vision and hearing deficits. Data were collected using coroner post-mortem reports and police reports to the coroner. In 11 of the 12 deaths involving vision deficits, substantial anxiety and fear surrounding progressive sight loss was reported, and the authors posit that this may likely have been a contributing factor to suicide. Of seven deaths by suicide that involved hearing impairment, the authors indicated that hearing impairment was reported as a contributing factor to suicide in only two cases. Firm conclusions regarding the associations among vision and hearing impairment and suicide cannot be drawn from this case series. In the current study, we will investigate the relation between visual impairment and suicide ideation in a primary care sample of older adults.

Anxiety Disorders

Few studies have indicated that anxiety is associated with death by suicide in older adults. Waern and colleagues found that older adults who died by suicide were 3.6 times more likely than controls to have an anxiety disorder (95% CI: 1.3 to 10.0), although these results were from univariate analyses.[49] Juurlink and colleagues observed an adjusted odds ratio of 3.22 (95% CI: 3.27 to 4.75) for anxiety disorders among older adults who died by suicide in Ontario.[33]

Sleep Disorders

Ross and colleagues determined that individuals in a nested case-control study who slept for nine hours or longer per night were at a higher risk of death by suicide ($OR = 4.5$; 95% CI: 1.5 to 13.1; $p = 0.006$).[35] In a study by Turvey and colleagues, persons who died by suicide were less likely to have high sleep quality (defined as a higher score on a 5-item sleep scale) compared to controls ($OR = 0.72$; 95% CI: 0.58 to 0.87; $p = 0.0009$).[36] When interpreting these results, it is important to remember that sleeping problems are often taken as symptomatic of depression, but may also comprise a unique disorder.

1.6 Limitations of Research on Risk Factors for Suicide in Older Adults

Most of the evidence for suicide risk factors in older adults comes from case-control designs including psychological autopsy studies, nested case-control studies, and traditional case-control studies. Given the retrospective nature of sampling, data collection, and outcomes assessment in case-control studies, they are more susceptible to bias and confounding than prospective cohort studies.[38] Whenever case-control designs are employed, care must be taken by the investigators to ensure that bias and confounding are minimized. When bias occurs and confounding is not adequately controlled for, measures of association become distorted and negatively impact a study's validity.[39] Furthermore, none of the studies included in this review tested for interactions to describe potential effect moderators. Additional methodological issues that were encountered upon reviewing the available literature cited in Section 1.5 will now be addressed.

The Quantity of Analytic Studies

Twelve studies on risk factors for suicide in older adults met the broad inclusion criteria for this review specified in Section 1.2.[13, 33, 35, 36, 49-54, 56, 57] Of the 12 case-control studies cited, two studies reported outcomes on the same sample of patients recruited from upstate New York[53, 54], two studies reported outcomes on the same participants from Hong Kong[51, 52], and three studies reported outcomes on the same cohort in Sweden.[13, 49, 50] Thus, approximately 60% of late-life suicide risk factor research identified in this comprehensive review comes from three samples. Strictly from a sampling perspective, it can be difficult to generalize the results of these studies to populations other than those that generated the cases and controls. For example, suicide data from the county level may not be an accurate representation of what is occurring at the state or national level. Thus, an international need for large, prospective, epidemiologic studies of risk factors for suicide in older adults exists, given the significant public health concern that late-life suicide presents worldwide.

Selection of Controls

Using epidemiologic recommendations proposed by Koepsell and Weiss[39], an ideal *control group* in a case-control study of suicide outcomes is one that:
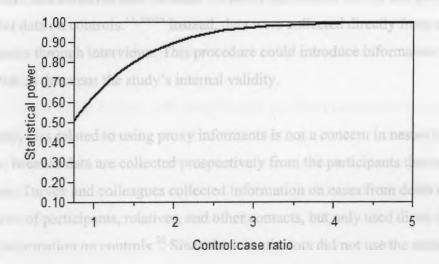
1. consists of individuals who came from the same underlying population which gave rise to the cases;

2. consists of individuals who had the same degree of exposure to suicide risk factors as the cases;

3. allows outcomes to be measured accurately, and in the same manner used for cases. For example, if proxy informants are used to collect information on cases, proxy informants should also be used to collect information on controls.

Only one case-control study of risk factors for suicide in older adults made use of a control group comprised of *deceased* individuals.[57] The remaining studies all used living controls, which could introduce selection bias. It is reasonable to assume that deceased controls would represent a more accurate comparison group than living controls, to the extent that the cause of death is not related to death by suicide. For example, Quan and colleagues selected all suicides in Alberta between 1984 and 1995 as cases, and all motor vehicle collision-related deaths during that same time period as controls.[57] Group comparability could be reduced if individuals who die by motor vehicle collision represent a different population compared to individuals who die by suicide. For example, individuals who die by motor vehicle collision tend to be younger men, drug and alcohol abusers, and individuals who exhibit risk-taking behaviours.[66]

Matching on known confounders increases statistical precision in case-control studies. For example, seven of 12 case-control studies cited in Section 1.5 matched on age within one year[13, 33, 35, 36, 49, 50, 54], but three studies matched age within two years[13, 49, 50], and one study matched age within five years.[54] All seven studies accounted for matching factors in the analysis by using conditional logistic regression, and age was included as a covariate in each analysis.

Another method of increasing a case-control study's statistical power is to oversample controls. This is especially relevant in case-control studies of suicide outcomes, since the number of cases available for analysis is often limited. The ratio of cases to controls was 1:1 in four studies[51, 52, 54, 57] and 1:2 in thre studies.[13, 49, 50] The ratio of cases to controls in the remaining studies was at least 1:4.[33, 35, 36, 53] Increases in power are negligible beyond a ratio of approximately one case to four controls (Figure 2).[38, 39]

Figure 2. Statistical power to detect effect of exposure in a hypothetical case-control study as a function of control:case ratio. Assumptions: true odds ratio = 2.0, 2-tailed significance test at $\alpha = 0.05$.

Information Bias

Information bias occurs in cohort studies when measurement of exposure or outcome data differs in quality (accuracy) between the comparison groups.[67] Overcoming information bias in case-control studies of suicide-related outcomes is particularly difficult. Most studies used psychological autopsy methods to collect data.[41] Typically, proxy informants are interviewed to collect data on suicide cases. Proxy informants are usually close relatives of the person who died by suicide, such as a spouse, child, caregiver, or other relative who knows the individual's life and medical history well. Investigators also rely on available medical records for information on individuals who die by suicide.

Proxy informants may be at risk of reporting and recalling facts about a person's exposures and outcomes incorrectly, which could lead to bias, affecting a study's internal and external validity. Heterogeneity among informant types may also contribute to systematic measurement error. For example, an individual's spouse might be able to provide more accurate information about an exposure or outcome of interest compared with an individual's child or best friend. Some investigators used multiple informants for some deaths and not others. Another evident source of information bias is the extent to which data can be collected from medical records for each suicide. This procedure would vary for each person who died by suicide, with some individuals having more precise information available for analysis than others.

Six studies that collected data on cases via proxy informants did not use proxy informants to collect data on controls.[13, 49-53] Instead, data were collected directly from control participants through interviews. This procedure could introduce information bias into the study, which threatens the study's internal validity.

Generally, bias related to using proxy informants is not a concern in nested case-control designs, because data are collected prospectively from the participants themselves. However, Turvey and colleagues collected information on cases from death registers and interviews of participants, relatives, and other contacts, but only used direct interviews to collect information on controls.[36] Since the investigators did not use the same methods to collect information on both cases and controls (i.e., they did not restrict information sources on cases to participants only), they were not able to maximize the benefits of the nested design.

Case-control studies that utilize population or medical databases to obtain information on all participants eliminate the need for proxy interviews, which effectively reduces the possibility of recall and reporting bias. However, it is recognized that some of the most important variables associated with suicide risk pertain to internal thoughts and feelings. These variables are often not available in databases. Furthermore, electronic records may present limitations if they are flawed or if data are missing. Nevertheless, the two

Canadian case-control studies mentioned previously used this record linkage method to assess risk factors for suicide among older adults.[33, 57] Both of these studies represent among the best evidence currently available on suicide risk factors in later life. Many variables identified as being associated with suicide in controlled PA studies were collected and tested in the larger context of these Canadian studies. It is likely that estimates from the Canadian studies are more reliable than estimates from other studies for two major reasons:

1. Large sample sizes allowed for greater statistical precision; confidence intervals were narrower in the Canadian studies compared to controlled PA studies; and,

2. Data were collected from electronic records using the same procedure for each group, reducing the likelihood of information bias, recall bias and reporting bias.

1.7 Health Services Use Among Older Adults at Risk for Suicide

A review article about contact with mental health providers prior to death by suicide concluded that older adults who die by suicide tend to have more contact with primary care providers in the respective month and year before suicide compared to younger cohorts.[11] Canadian estimates are consistent with this finding, indicating that a majority of suicidal older adults visited a physician in the month before death (73% of cases compared to 49% of controls; $p < 0.001$).[33] Of the patients who died by suicide in this study who saw a physician in the preceding month, 75% registered for three or more visits.[33] Ten patients died by suicide on the same day on which they saw a psychiatrist.[33] Despite the fact that older adults at risk for suicide tend to present to primary care providers well within an optimal treatment timeframe, rates of suicide among older adults remain the highest of any age cohort in North America. It has been proposed that lack of clinician expertise in detecting suicide risk may impede identification of at-risk older adults[34], and that enhanced training is specifically needed to properly assess suicide risk.[12]

Physician perceptions of patients may also hinder risk detection of suicidal older adults. A major obstacle reported in a study of suicide management strategies for older adults was the belief among primary care physicians that their patients would be non-compliant with treatment.[68] This finding is perhaps one explanation for the reluctance of primary care providers to refer at-risk older adults to mental health specialists.[69]

CHAPTER 2: METHODS & RESEARCH OBJECTIVES

2.1 Study Design

The current study comprises a secondary analysis of a longitudinal study that investigated depression, subsyndromal depression[70], perceived family criticism, medical comorbidities, and functional status among older primary care patients.[71] The original study included four years of follow-up data. The investigators attempted to recruit all patients age 65 years and older who sought care at primary care offices in internal medicine and family medicine, including private practice and hospital-based clinic settings on selected days in the Rochester, New York area. Only results from baseline and the first annual follow-up will be reported in the current study, because complete data were not available for the second and third follow-up periods at the time of writing.

2.2 The Sample Population

Patients were considered eligible for study inclusion if they were 65 years or older at the time they presented to a primary care recruitment location in the Rochester, New York area (population 207 000). Rochester is at the centre of a larger urban area, which encompasses and extends beyond Monroe County. This area, which is part of the Western New York region, had a population of over one million persons as of 1 July 2005.

In order to obtain a sample that was representative of older adults who present to primary care medical practices in the Rochester, New York area, no exclusion criteria were applied. Although this can be considered a convenience sampling technique, it is commonly used in clinical research settings, and it is known that convenience samples are good estimates of random samples when a sampling start date is specified a priori, subjects are consecutively recruited without bias, and the sample size is large.[72] Of 2014 potentially eligible subjects, 1144 were screened for recruitment, and 745 were enrolled in the study.

2.3 Ethics Approval

Interviewers described the study to patients and obtained written informed consent employing procedures approved by the University of Rochester Research Subjects Review Board. Study safety procedures dictated that when a research interview elicited or raised questions about any type or severity of suicide ideation, the rater immediately reviewed the case with an experienced supervising psychiatrist, who then intervened to the extent necessary and allowable as per standard clinical practice, typically including discussion of the concerns with the patient's primary care provider. In principle, patients judged to be at imminent risk of self-harm could have been brought for emergency psychiatric evaluation at an appropriate local facility, although this proved to not be necessary for any patient during this study.

2.4 Sample Size

The existing database from this cross-sectional study contained information on 745 participants. Therefore, the available data determined the sample size for this secondary analysis, and a sample size calculation was not performed.

2.5 Data Collection Procedures

All participants who provided written informed consent subsequently completed in-person interviews by a trained interviewer in their homes, or research offices at the University of Rochester Medical Center. These semi-structured interviews included the Structured Clinical Interview for *DSM-IV* Axis-I disorders (SCID), a validated and widely used method for establishing presence of mental disorders in research contexts.[73] Presence of mental disorders based on the SCID was determined at a consensus conference of study investigators and interviewers.[70, 71] The consensus conference consisted of an experienced geriatric psychiatrist and two clinical psychologists who discussed the SCID results for each participant, along with the study's research assistants.

The SCID results along with the discussion were used to consensually determine whether a participant met criteria for a given *DSM-IV* Axis-I mental disorder.

In addition to the SCID, several measures of functional impairment (i.e., Karnofsky Performance Status Scale and Cumulative Illness Rating Scale) were administered at the interview, and these measures are described in Section 2.6. Demographic variables, data on medical comorbidities, and data on medications were obtained from participants' self-reports at the interview and through review of patient medical records. A complete listing of these variables and how they were coded is available in Tables 3 and 4.

Participants completed an in-person follow-up interview one year after the initial assessment. The purpose of the follow-up interview was primarily to re-administer the Karnofsky Performance Status Scale, the Cumulative Illness Rating Scale, and assess the course of medical comorbidities and depressive symptoms.

2.6 Study Objective: Determining Associations with Suicide Ideation

The objective of the current study was to investigate a set of potential risk indices associated with presence vs. absence of suicide ideation as reported by study participants 65 years of age and older in a primary care setting. Evidence from the literature on late-life suicide describes a variety of factors which are thought to increase risk (Chapter 1), but it is not clear if these factors are associated with suicide ideation, a related construct, especially among older adults who seek primary care. This knowledge gap complicates detection of older patients who are at risk for suicide or suicide-related behaviour. Clinically, it is important for primary care providers to be aware of correlates of suicide ideation among older adults for the following reasons:

1. Suicide ideation is an independent risk factor for suicide and suicide-related behaviour (Section 1.5);
2. Suicide ideation usually manifests well before suicide-related behaviours, providing a window of opportunity for timely intervention;

3. Knowledge of relevant risk factors for suicide ideation can be used to improve mental health assessments, which ultimately improves the identification of at-risk individuals.

Risk indices related to *DSM-IV* Axis-I mental disorders, medical comorbidity, functional impairment, and medications were assessed in this sample, and are described below.

Measures: Dependent Variable

Suicide ideation, the dependent variable of interest in this study, was measured as a composite outcome based on information from the suicide item on the Hamilton Depression Rating Scale (HDRS)[74] and a similar suicide item on the SCID.

The HDRS is used to identify depression symptom severity and has been used previously in community-residing populations[75] and primary care samples.[76, 77] It is a 24-item, interviewer- or clinician-rated scale in which each item corresponds to a symptom of depression, including suicide ideation or suicide-related behaviour. It also includes items on other symptoms, such as anxiety and paranoia. An overall score is calculated by summing the ratings for each symptom. Higher scores indicate more severe depressive symptoms.

The HDRS suicide item consists of 4 levels of suicide-related behaviour: 0) "absent"; 1) "feels like life is not worth living or any thoughts of possible death to self"; 2) "wishes he/she were dead"; 3) "suicidal ideas or gestures"; 4) "attempts at suicide". Interrater reliability measured using the intraclass correlation coefficient (ρ) ranges from 0.49 to 0.92[78-80], and test-retest reliability measured using Pearson's r ranges from 0.64 to 0.67 among older adults.[81, 82]

In the context of a semi-structured clinical interview, the SCID suicide item taken from the mood disorder module inquires about death ideation, suicide ideation, self-harm, and whether a patient has a suicide plan. The interviewer records which, if any, of these

symptoms are present, and grades symptom severity on a scale of 1 to 3 (1 = not present; 2 = subthreshold; 3 = threshold). No psychometric data could be found on the SCID suicide item.

In the current study, suicide ideation was identified as present if the participant scored greater than 0 on the HDRS suicide item, *or* if a participant scored greater than 1 on the SCID suicide item. The goal of this approach was to capture any possible suicide ideation, since older adults tend to underreport depressive and suicide-related symptoms.[14, 15, 83, 84] Furthermore, the HDRS requests patients to report symptoms over the past week, while the SCID applies to symptoms over the past month. Thus, using both the HDRS and the SCID suicide items to assess suicide ideation provides for a more comprehensive outcome measure. Investigators have used the HDRS suicide item alone as a dependent variable in statistical analysis[85] and together with the SCID suicide item to produce a composite outcome measure.[86]

Measures: Independent Variables

<u>Axis-I mental disorder</u> diagnoses based on the SCID and consensus conference were coded as present or absent, and included:

1. Major depressive disorder.
2. Minor depression, operationalized as depression not otherwise specified.
3. Cognitive disorder, which included amnestic disorder not otherwise specified, cognitive disorder not otherwise specified, and dementia not otherwise specified.
4. Anxiety disorder, which included generalized anxiety disorder, post-traumatic stress disorder, panic disorder, obsessive-compulsive disorder, specific phobia, agoraphobia, and social phobia.
5. Substance abuse disorders, which included substance-induced mood disorders, alcohol abuse, amphetamine abuse, cocaine abuse, cannabis abuse, and opioid abuse.

Medical comorbidity was determined based on physician review of the patient's medical records. The following medical comorbidities were recorded as present or absent: arthritis, cancer, chronic obstructive pulmonary disease (COPD), cardiovascular disease (CVD), hearing impairment, vision impairment, diabetes, hypertension, hypothyroidism, neurologic disorder, and sleep disturbance. To establish the patient's overall medical illness burden, the Cumulative Illness Rating Scale (CIRS)[87] was scored. The CIRS is a multimorbidity instrument that takes into account the number of medical problems within 13 body organ systems and weights them according to their severity. It has been used extensively in older adult populations.[88] Higher scores on the CIRS indicate a higher overall burden of illness. Psychometric data on the CIRS is limited, but investigators of a Canadian study of primary care patients reported that the intraclass correlation coefficient ranged from 0.78 to 0.89 among nurses who scored the measure based on review of medical records.[89]

Functional impairment was measured using the Karnofsky Performance Status Scale (KPSS),[90, 91] a clinician-rated measure that classifies patients according to their functional impairment. It has been widely used and validated since its development in 1948[92], and has shown good correlations with other functioning and well-being measures.[93] KPSS scores range from 0 to 100, with higher scores indicating less functional impairment. In a study that evaluated use of the KPSS in determining outcomes and risk among older outpatients, higher scores on the KPSS were significantly correlated with fewer days in hospital ($r = -0.17$), more survival days ($r = 0.30$), and a greater number of days residing in a community setting ($r = 0.38$).[92] Similarly, KPSS scores were also significantly correlated with scores from 2 other measures of functional ability, the Physical Self-Maintenance Scale[94] ($r = 0.73$) and the Instrumental Activities of Daily Living Scale[94] ($r = 0.66$).[92]

Given the absence of evidence on what constitutes typical care received by older adults with suicide ideation in primary care practice, it is important to learn what pharmacological treatments are being naturalistically provided to them. Ostensibly, primary care physicians may or may not be aware of the presence of their patients'

suicide ideation; thus, the treatments that these patients receive likely reflects symptom presentation and/or clinician appraisal of patients' symptoms.

Evidence from randomized controlled trials and clinical practice guidelines indicate that pharmacological treatment is a recommended intervention for individuals who manifest depressive and suicidal symptoms.[10, 95-97] Thus, information gathered on prescription patterns would allow one to determine whether such treatments correspond to appropriate care.[10, 95] Based on physician review of the patient's medical record, 4 medication classes were recorded as present or absent: heterocyclic antidepressants, selective serotonin reuptake inhibitors (SSRIs) or other antidepressants, benzodiazepines or other sedatives, and narcotic analgesics.

2.7 Statistical Methods

Univariate and multivariate statistical methods were used to identify a set of predictors of suicide ideation among adults age 65 years and older who seek primary care. The dependent variable in all analyses was presence of suicide ideation. A complete-case analysis was specified a priori, recognizing that missing data are inevitable in large sets of quantitative data, and may present a limitation to a study's validity. All statistical and graphical analyses were conducted using SAS version 9.1 (Carey, NC) and JMP version 7.0 (Carey, NC). All statistical tests were two-tailed, with an a priori alpha set at 0.05 as the threshold for statistical significance.

Univariate Exploratory Analyses

Initially, descriptive statistics were calculated to assess the distribution of independent variables. Histograms were used to visually explore the data. Means, standard deviations, medians, and ranges were calculated for continuous variables. A Spearman correlation matrix was also constructed for continuous variables. Proportions and counts were used to describe discrete variables. Associations between suicide ideation and the independent variables at the univariate level were assessed using logistic regression to obtain point

estimates of the odds ratios with 95% confidence intervals. Each variable was considered separately in this analysis. Odds ratios for continuous variables comparing participants who endorsed suicide ideation to those who did not endorse suicide ideation correspond to a one-unit increase in the respective independent variable. A complete listing of independent variables and how they were assessed is provided in Table 4.

Table 4. A listing of independent variables used in both univariate and multivariate logistic regression modelling.

Discrete variables	Group
Sex	Male, female
Ethnicity	American Indian/Alaska Native, Asian, Black, Hawaiian/Other Pacific Islander, White, other
Marital status	Single, married, divorced, widowed
Religion	Buddhist, Catholic, Hindu, Jewish, Mormon, Muslim, other, none
Employment status	Full-time, part-time, retired, unemployed, disability, student
Arthritis	Present, absent
Cancer	Present, absent
COPD	Present, absent
Cardiovascular disease	Present, absent
Hearing impairment	Present, absent
Vision impairment	Present, absent
Diabetes	Present, absent
Hypertension	Present, absent
Hypothyroidism	Present, absent
Neurologic disorder	Present, absent
Sleep disturbance	Present, absent
Heterocyclic antidepressants	Present, absent
SSRIs/other antidepressants	Present, absent
Benzodiazepines/other sedatives	Present, absent
Narcotic analgesics	Present, absent
Cognitive disorder	Present, absent
Major depressive disorder	Present, absent
Minor depression	Present, absent
Anxiety disorder	Present, absent
Substance abuse disorder	Present, absent

Continuous variables	Coding
Age	Measured in years
CIRS score	Score from 0 to 52
KPSS score	Score from 0 to 100

Note: COPD = chronic obstructive pulmonary disease; SSRI = selective serotonin reuptake inhibitors; CIRS = Cumulative Illness Rating Scale; KPSS =Karnofsky Performance Status Scale.

Multivariate Modelling

Next, a predictive modelling approach was employed based on guidelines proposed by Harrell and colleagues[98] to construct the three regression models in the current study. The results of univariate logistic regression (Section 3.2) were used to guide subsequent multivariate model building. Selection of independent variables to be analyzed with multivariate logistic regression was not based strictly on statistical significance from univariate analysis ($p < 0.05$), but also on clinical relevance and the literature review (Chapter 1). For example, minor depression was not statistically significant at the univariate level, but it was included in all models because it is known to be associated with suicidality among older adults.[34]

To ensure the validity of the multivariate modelling process, model assumptions of logistic regression were tested. The assumption of linearity on the logit scale was assessed for each independent variable by visually inspecting the levels of each variable plotted against the sample risks. Accordingly, there was no evidence of non-linearity on the logit scale. Since no plausible interactions were identified a priori, the additivity assumption, which assumes no interaction, was satisfied. Overfitting was not an issue in this analysis, since the number of regression coefficients in each model was well within recommended guidelines.[98] Results from a Spearman correlation matrix for each model constructed did not indicate collinearity among the three continuous variables analyzed (age, KPSS score, and CIRS score) (i.e., $|\rho| < 0.30$ in each model). Spearman correlations were chosen in order to avoid the parametric assumptions of Pearson's r.

Demographic factors, which included age, sex, and marital status, were covaried in all regression models. These demographic factors may be particular to the current sample, and may not be similar to other populations to which the results of this study might be generalized. Thus, these variables were controlled for in an attempt to increase the current study's generalizability. Furthermore, demographic factors are linked with risk for suicide and may confound prediction of suicide ideation, a related construct. Sex (male, female) was modelled using 1 degree of freedom. Marital status (single, married,

divorced, widowed) was modelled using 3 degrees of freedom, with "married" set as the reference category. The design variable coding for marital status is provided in Table 5.

Table 5. Design variable coding for marital status.

Marital status	Design variable matrix			
	D_{i1}	D_{i2}	D_{i3}	D_{i4}
Single	1	0	0	0
Divorced	0	1	0	0
Widowed	0	0	1	0
Married (reference)	0	0	0	0

Note: 1 = present; 0 = absent.

The following statistics will be reported for each logistic regression model:

1. A whole model test, which compares the whole model fit to a model that omits all regressor effects except the intercept. A χ^2 test statistic will be calculated, where the null hypothesis specifies that all regression coefficients are simultaneously equal to 0 (i.e., a significant result is desired for this test). This test is analogous to the whole model F-ratio test produced in multiple linear regression models.

2. The R^2 statistic, providing a measure of the variance in the dependent variable explained by the independent variables in the model.

3. A goodness of fit test, which addresses whether there is enough information using the independent variables in the current model, or whether more complex terms (such as interactions or polynomials) should be added. A χ^2 test statistic is calculated, in which the null hypothesis specifies that there is little to be gained by introducing additional variables to the model (i.e., a non-significant result is desired for this test).

4. The estimated regression coefficient and its standard error.

5. Odds ratios for parameter estimates and their associated Wald 95% confidence limits and *p*-values. Odds ratios will be generated using maximum likelihood estimation of parameter values.

Each of the regression models that were constructed will now be described.

Model 1: An Exploratory Model

The purpose of the first regression model was to initially explore the potential associations of all demographic variables, medical diagnoses, medications, and mental disorder variables with suicide ideation in a simultaneous fashion. The independent variables to be analyzed will be organized into blocks of similar variables and entered into the model in a step-by-step fashion, as follows:

- Block 1: Demographic variables. Demographic variables included sex, age, and marital status.
- Block 2: Cognitive disorder, assessed based on review of participants' medical records.
- Block 3: Medical comorbidities. Medical comorbidities included overall physical functioning measured by the CIRS, medical factors measured using the KPSS, neurologic disorder, sleep disturbance, decreased vision, and cardiovascular disease, all of which were assessed as present or absent based on the patient interview and review of medical records.
- Block 4: Medications. Medications included heterocyclic antidepressants, other antidepressants (including SSRIs), benzodiazepines/other sedatives, and narcotic analgesics.
- Block 5: Axis-I mental disorders. Axis-I mental disorders included substance abuse disorder, minor depression, major depressive disorder, bipolar disorder, and anxiety disorder, assessed with the SCID.

The rationale for this procedure was to observe the change in R^2 after the successive addition of each block of independent variables to the model. Cognitive disorder was not included in Block 5 in order to adjust for its effect prior to the addition of subsequent blocks to the model.

Model 2: The Main Effects Model

Next, associations between suicide ideation and the significant predictors observed in Model 1 were assessed, controlling for demographic factors. This analysis comprised the main effects model. The purpose of this analysis was to reduce the total number of independent variables analyzed, accomplished by including only the significant predictors of suicide ideation from Model 1. Parsimonious (reduced) models may contribute to greater generalizability,[98] an especially relevant consideration, given that a broad audience of primary care physicians is the intended audience of the current study's results and conclusions.

Model 3: Suicide Ideation at Follow-up

The previous analyses focused on data from the first year of the original study, whereas the current regression model addresses suicide ideation one year later. This analysis will assess factors that might be associated with suicide ideation after a longer time period had elapsed. This information could be useful to clinicians who are treating patients with ongoing/chronic/unresolved suicide ideation.

In the present regression, suicide ideation at 1-year follow-up was the dependent variable of interest. The same independent variables analyzed in Model 2 were regressed in Model 3. Suicide ideation at year 1 was accounted for by including it as a covariate in the current regression model. This created a conservative predictive model of suicide ideation at year 2.

CHAPTER 3: RESULTS

3.1 Patient Characteristics at Baseline

Patient characteristics stratified by presence vs. absence of suicide ideation are provided in Table 6. Patients who reported suicide ideation were more likely to be unmarried than those who did not report suicide ideation ($p = 0.0023$). Participants who endorsed suicide ideation were marginally more likely to have completed less formal education (mean = 13.37 years; $SD = 3.06$) compared to participants who did not endorse suicide ideation (mean = 14.07 years; $SD = 2.61$) ($p = 0.0501$). Age, sex, and marital status were included in all analyses at the multivariate level to account for their potential effect as confounders.

3.2 Results of Univariate Exploratory Analyses

Descriptive statistics were computed for each independent variable under investigation. The results for this analysis, stratified by suicide ideation status, are presented in Table 7. A Spearman rank correlation matrix was constructed for continuous independent variables (Table 8).

Univariate logistic regression was used to identify associations between expression of suicide ideation and the independent variables listed in Table 7. Unadjusted odds ratios for each independent variable and their associated 95% Wald confidence intervals and p-values appear in Table 7. Odds ratios were not calculated for ethnicity, religion, and employment status because the model could not converge due to low frequencies within strata, even after collapsing the variables.

Compared to participants who were married, participants who were widowed ($OR = 2.13$; 95% CI: 1.27 to 3.58; $p < 0.01$) or single ($OR = 3.73$; 95% CI: 1.62 to 8.59; $p < 0.01$) were significantly more likely to report suicide ideation (Table 7). Patients with a higher burden of medical illness (CIRS) and more functional impairment (KPSS) were more

likely to report suicide ideation. Having completed more years of formal education protected against suicide ideation in univariate analysis.

Table 6. Demographic characteristics stratified by suicide ideation status.

| Demographic Characteristic | Suicide Ideation Status | | p-value* |
	Yes (n = 82)	No (n = 659)	
Age (years), mean (SD)	75.30 (6.96)	75.12 (6.86)	0.8100
Sex			
Female, n (%)	59 (72)	409 (62)	0.0810
Marital status, n (%)			
Married	30 (37)	362 (55)	
Widowed	35 (43)	198 (30)	**0.0023**
Divorced	7 (9)	66 (10)	
Single	10 (11)	33 (5)	
Ethnicity, n (%)			
White	79 (96)	606 (92)	
Black	3 (4)	40 (6)	
American Indian/Alaska Native	0 (0)	4 (0.6)	
Hawaiian/Other Pacific Islander	0 (0)	0	N/A
Asian	0 (0)	2 (0.3)	
Other	0 (0)	7 (1)	
Religion, n (%)			
Protestant	30 (36)	303 (46)	
Roman Catholic	33 (40)	211 (32)	
Jewish	7 (9)	79 (12)	0.1096
Other	5 (6)	40 (6)	
None	7 (9)	26 (4)	
Practices religion, n (%)			
Yes	60 (73)	521 (79)	0.2000
Employment status, n (%)			
Retired	74 (90)	547 (83)	
Part-time	6 (7)	59 (9)	N/A
Full-time	0 (0)	40 (6)	
Other¶	2 (3)	13 (2)	
Education (years), mean (SD)	13.37 (3.06)	14.07 (2.61)	0.0501

Note: *p-values for continuous variables from t-tests, p-values for discrete variables from Pearson χ^2 tests; N/A indicates cell counts less than 5, thus the Pearson χ^2 test was not calculated; ¶other includes unemployed, disability, or student.

Cardiovascular disease, vision impairment, neurologic disorder, and sleep disturbance were associated with self-reported suicide ideation in the present analysis (Table 7). Furthermore, SCID-identified mental disorders (major depressive disorder, anxiety disorder, substance abuse disorder), were significantly associated with suicide ideation.

Older adults who were taking SSRIs or other antidepressants were significantly more likely to report suicide ideation. Benzodiazepines were also associated with increased likelihood of reporting suicide ideation. In a separate analysis, it was found that 91% of the 83 patients in this study who were prescribed a benzodiazepine or other sedative *did not* meet criteria for a *DSM-IV* anxiety disorder diagnosis based on SCID interviews. Although older adults in this sample who endorsed suicide ideation were almost twice as likely to meet diagnosis criteria for a substance abuse disorder, they were over three times as likely to have been prescribed a narcotic analgesic (Table 7).

Table 7. Summary statistics stratified by suicide ideation status and unadjusted odds ratios for each independent variable comparing patients who endorsed suicide ideation with patients who did not endorse suicide ideation.

| Independent variable | Suicide ideation status | | Odds ratio of suicide ideation | 95% Wald confidence interval | p-value |
	Yes (n = 82)	No (n = 659)			
Age (years)			1.00	(0.97, 1.04)	0.8165
Mean (SD)	75.30 (6.96)	75.12 (6.86)			
Median	74.50	75.00			
Range	65.00 to 92.00	65.00 to 97.00			
Education (years)			0.92	(0.85, 0.99)	**0.0267**
Mean (SD)	13.37 (3.06)	14.07 (2.61)			
Median	13.00	14.00			
Range	0.00 to 17.00	0.00 to 17.00			
CIRS score			1.10	(1.03, 1.18)	**0.0073**
Mean (SD)	8.41 (3.67)	7.45 (2.95)			
Median	9.00	7.00			
Range	1.00 to 17.00	1.00 to 19.00			
KPSS score			0.96	(0.95, 0.98)	**<0.0001**
Mean (SD)	70.80 (15.15)	79.05			
Median	70.50	83.00			
Range	25.00 to 95.00	32.00 to 94.00			
Sex (vs. male), n (%)			1.56	(0.95, 2.63)	0.0865
Marital status (vs. married), n (%)					
Widowed	35 (43)	198 (30)	2.13	(1.27, 3.58)	**0.0042**
Divorced	7 (9)	66 (10)	1.33	(0.56, 3.17)	0.5146
Single	10 (11)	33 (5)	3.73	(1.62, 8.59)	**0.0020**
Arthritis, n (%)	53 (65)	415 (63)	1.09	(0.68, 1.79)	0.7327
Cancer, n (%)	11 (14)	72 (11)	1.31	(0.63, 2.49)	0.4425
COPD, n (%)	16 (19)	79 (12)	1.60	(0.85, 2.87)	0.1280
Cardiovascular disease, n (%)	33 (40)	191 (29)	1.61	(1.00, 2.58)	**0.0496**
Hearing impairment, n (%)	17 (21)	178 (27)	0.71	(0.40, 1.22)	0.2378
Vision impairment, n (%)	14 (17)	40 (6)	3.11	(1.57, 5.89)	**0.0007**
Diabetes, n (%)	16 (19)	138 (21)	0.90	(0.48, 1.58)	0.7114
Hypertension, n (%)	61 (74)	481 (73)	1.06	(0.64, 1.84)	0.8154
Hypothyroidism, n (%)	29 (20)	138 (21)	0.92	(0.50, 1.60)	0.7686
Neurologic disorder, n (%)	29 (35)	132 (20)	2.16	(1.30, 3.53)	**0.0024**
Sleep disturbance, n (%)	67 (82)	356 (54)	3.80	(2.19, 7.03)	**< 0.0001**
Cognitive disorder, n (%)	15 (18)	53 (8)	2.41	(1.26, 4.40)	**0.0057**
Heterocyclic antidepressants, n (%)	5 (6)	31 (5)	1.32	(0.44, 3.21)	0.5786
SSRIs/other antidepressants, n (%)	35 (43)	113 (17)	3.63	(2.23, 5.88)	**<0.0001**
Benzodiazepines/other sedatives, n (%)	20 (24)	63 (9)	3.07	(1.71, 5.34)	**0.0001**
Narcotic analgesics, n (%)	10 (12)	28 (4)	3.14	(1.40, 6.58)	**0.0033**
Substance abuse disorder, n (%)	24 (29)	125 (19)	1.73	(1.02, 2.87)	**0.0358**
Major depressive disorder, n (%)	44 (54)	145 (22)	4.07	(2.54, 6.54)	**<0.0001**
Minor depression, n (%)	27 (33)	191 (29)	1.22	(0.74, 1.98)	0.4254
Anxiety disorder, n (%)	15 (18)	40 (6)	3.56	(1.82, 6.68)	**0.0001**

Note: CIRS = Cumulative Illness Rating Scale; KPSS = Karnofsky Performance Status Scale; COPD = chronic obstructive pulmonary disease.

Table 8. Spearman correlation matrix for continuous independent variables.

Variable	Age	Education	KPSS	CIRS
Age	1.0000	-0.1202*	-0.3082*	0.2590*
Education	-0.1202*	1.0000	0.2049*	-0.1387*
KPSS	-0.3082*	0.2049*	1.0000	-0.3090*
CIRS	0.2590*	-0.1387*	-0.3090*	1.0000

Note: *$p < 0.0001$; KPSS = Karnofsky Performance Status Scale; CIRS = Cumulative Illness Rating Scale.

Statistically significant predictors of suicide ideation from exploratory analyses were subsequently included in the multivariate logistic regression models which are presented below.

3.3 Multivariate Associations with Suicide Ideation

Next, an exploratory multivariate logistic regression model was constructed in order to examine the effect of each independent variable on suicide ideation while controlling for the other variables in the model (Model 1, Table 9). After controlling for demographic variables, medical comorbidities, medications, and Axis-I mental disorders, presence of a cognitive disorder was not associated with suicide ideation (Table 9). Patients who were rated by a physician as having more functional impairment (i.e., a lower KPSS score) were more likely to report suicide ideation. Furthermore, participants who reported a sleep disturbance were significantly more likely to report suicide ideation, as were older adults who reported vision impairment. Of the four medication classes available for analysis in the current study, only benzodiazepines or other sedatives were independently associated with a statistically significant increased likelihood of reporting suicide ideation. Individuals who met *DSM-IV* criteria for minor depression based on the SCID were significantly more likely to report suicide ideation compared to individuals without this diagnosis, although minor depression was previously not a significant predictor of

suicide ideation in univariate analyses. Presence of major depressive disorder and of an anxiety disorder was also associated with increased suicide ideation.

To assess the variability in suicide ideation accounted for by each block of independent variables, R^2 values were calculated (Table 9). The overall R^2 for the fitted model was 0.2464, indicating that approximately 25% of the variation in suicide ideation was accounted for by the independent variables in the model. The lack of fit χ^2 test result indicates that the addition of higher order covariates or interaction terms would not be expected to increase the model's fit ($p = 1.0000$), thus interactions were not tested.

Table 9. Exploratory modelling results with suicide ideation as the outcome variable for the effect of demographic factors, medical comorbidities, and Axis-I mental disorders on suicide ideation at baseline (year 1 of the original study).

Independent variable	Estimated regression coefficient (β)	Standard error	Odds ratio of reporting suicide ideation	95% Wald confidence interval	p-value	R^2 for block
Block 1: Demographic variables						
Sex (vs. male)	-0.0097	0.3392	0.99	(0.51, 1.93)	0.9771	
Age	-0.0152	0.0231	0.99	(0.94, 1.03)	0.5089	
Marital status (vs. married)						0.0309
Widowed	0.7122	0.3318	2.04	(1.06, 3.91)	**0.0318**	
Divorced	-0.0478	0.5137	0.95	(0.35, 2.61)	0.9258	
Single	1.3683	0.4959	3.93	(1.49, 10.38)	**0.0058**	
Block 2: Presence of a cognitive disorder						
Cognitive disorder	0.2767	0.4400	1.32	(0.56, 3.12)	0.5293	0.0123
Block 3: Medical comorbidities & functioning						
KPSS score	-0.0300	0.0124	0.97	(0.95, 0.99)	**0.0160**	
CIRS score	-0.1054	0.0591	0.90	(0.80, 1.01)	0.0747	
Neurologic disorder	0.4066	0.3445	1.50	(0.77, 2.95)	0.2378	0.0857
Sleep disturbance	0.8724	0.3257	2.39	(1.26, 4.53)	**0.0074**	
Vision impairment	0.8871	0.4133	2.43	(1.08, 5.46)	**0.0319**	
Cardiovascular disease	0.3989	0.3289	1.49	(0.78, 2.84)	0.2253	
Block 4: Medications						
Heterocyclics	-0.3416	0.5991	0.711	(0.22, 2.30)	0.5686	
SSRIs/other antidepressants	0.4326	0.2989	1.54	(0.86, 2.77)	0.1478	0.0426
Benzodiazepines/other sedatives	0.8786	0.3330	2.41	(1.25, 4.62)	**0.0083**	
Narcotic analgesics	0.2684	0.4765	1.31	(0.51, 3.33)	0.5732	
Block 5: Axis-I mental disorders						
Substance abuse disorder	0.3869	0.3307	1.47	(0.77, 2.82)	0.2420	
Major depressive disorder	1.7818	0.4114	5.94	(2.64, 13.83)	**<0.0001**	0.0749
Minor depression	1.1459	0.4108	3.15	(1.41, 7.04)	**0.0053**	
Anxiety disorder	0.9387	0.3871	2.56	(1.20, 5.46)	**0.0153**	

Note: $n = 722$; Whole model $\chi^2 = 117.68$, $p < 0.0001$; Lack of fit $\chi^2 = 385.11$, $p = 1.0000$; Whole model $R^2 = 0.2464$.

Next, a main effects logistic regression model (Model 2) was constructed. In an effort to achieve a more parsimonious model, only the demographic covariates and statistically significant associations observed in Model 1 (Table 10) were included. This reduced the total number of independent variables from 18 in Model 1 to 10 in the current main effects model. All of the associations that were significant in Model 1 remained significant in this analysis (Table 10). To asses the proportion of variance in suicide ideation contributed by each independent variable in the model, R^2 values are reported for each variable in addition to the R^2 for each block of variables (Table 10).

The overall R^2 for the main effects model decreased slightly to 0.2097 compared to 0.2464 in the exploratory model. This was expected, given the reduced number of independent variables. Again, the addition of higher order covariates or interaction terms was not expected to increase the model's fit ($p = 1.0000$, lack of fit χ^2 test), so interactions were not tested in this analysis.

Table 10. Results of the main effects logistic regression model with suicide ideation as the outcome variable that included statistically significant associations and demographic factors from Model 1.

Independent variable	Estimated regression coefficient (β)	Standard error	Odds ratio of reporting suicide ideation	95% Wald confidence interval	*p*-value	R^2	R^2 for block
Block 1: Demographic variables							
Sex (vs. male)	-0.1364	0.3051	0.87	(0.48, 1.59)	0.5827	0.0049	
Age	-0.0156	0.0213	0.99	(0.94, 1.03)	0.6548	0.0000	
Marital status (vs. married)							0.0309
Widowed	0.7671	0.3200	1.15	(1.15, 4.03)	**0.0165**	0.0251	
Divorced	0.1298	0.4855	1.14	(0.44, 2.95)	0.7892	0.0000	
Single	1.2714	0.4893	3.57	(1.37, 9.30)	**0.0094**	0.0009	
Block 2: Medical comorbidities & functioning							
KPSS score	-0.0294	0.0096	0.97	(0.95, 0.98)	**0.0021**	0.0373	
Sleep disturbance	0.8336	0.3193	2.30	(1.23, 4.30)	**0.0373**	0.0379	0.0856
Vision impairment	0.8148	0.3912	2.26	(1.05, 4.86)	**0.0021**	0.0104	
Block 3: Medications							
Benzodiazepines/other sedatives	0.9612	0.3231	2.62	(1.39, 4.93)	**0.0029**	0.0204	0.0204
Block 4: Axis-I mental disorders							
Major depressive disorder	1.8648	0.3904	6.46	(3.00, 13.87)	**<0.0001**	0.0616	
Minor depression	1.2511	0.3990	3.49	(1.60, 7.64)	**0.0017**	0.0005	0.0728
Anxiety disorder	0.8937	0.3729	2.44	(1.18, 5.08)	**0.0166**	0.0107	

Note: $n = 722$; Whole model $\chi^2 = 105.43$, $p < 0.0001$; Lack of fit $\chi^2 = 394.58$, $p = 1.0000$; whole model $R^2 = 0.2097$.

A third regression model was constructed to predict the presence of suicide ideation in the second year of the longitudinal study, controlling for Time 1 variables (Table 11). Given that not all of the participants completed a follow-up interview, the sample size for the present analysis was decreased to $n = 467$, reducing statistical power. In total, 66

participants endorsed suicide ideation, and 399 did not endorse suicide ideation at year 2. At Time 1, 82 individuals endorsed suicide ideation.

The only statistically significant predictor of self-reported suicide ideation at the 1 year follow-up point was having reported suicide ideation at baseline (Table 11). Although the remaining independent variables in the model did not reach statistical significance, their point estimates were consistent in magnitude and direction with those in Model 2. KPSS score, sleep disturbance, and anxiety disorder approached statistical significance in this model ($p = 0.07$ for each variable).

R^2 values for each independent variable and each block of independent variables are reported in Table 11. Having a history of suicide ideation was significantly more predictive of reporting suicide ideation at year 2 than the combined effect of the medical comorbidities (R^2 for suicide ideation at year 1 = 0.0866 vs. R^2 for medical comorbidities block = 0.0706). Although none of the individual medical comorbidity variables reached statistical significance in the current model, these variables together explained approximately the same amount of variance in Time 2 suicide ideation as in previous regression analyses (Tables 9 and 10).

The R^2 for the current whole model ($R^2 = 0.2236$) was consistent with values observed in Models 1 and 2 and it is not likely that the addition of higher order covariates or interaction terms would improve the current model's fit ($p = 1.0000$, lack of fit χ^2 test), thus interactions were not tested in Model 3.

Table 11. Results of a predictive model of suicide ideation at year 2, controlling for suicide ideation status at year 1.

Independent variable	Estimated regression coefficient (β)	Standard error	Odds ratio of reporting suicide ideation	95% Wald confidence interval	p-value	R^2	R^2 for block
Suicide ideation at year 1	2.0826	0.3635	8.03	(3.94, 16.36)	<0.0001	0.0866	0.0866
Block 1: Demographic variables							
Sex (vs. male)	-0.1474	0.3381	0.86	(0.45, 1.67)	0.6629	0.0079	
Age	0.0411	0.0252	1.04	(0.99, 1.10)	0.1022	0.0067	
Marital status (vs. married)							0.0165
Widowed	0.2281	0.3598	1.26	(0.62, 2.54)	0.5260	0.0164	
Divorced	0.2771	0.5372	1.32	(0.46, 3.78)	0.6060	0.0000	
Single	-0.6676	0.6890	0.51	(0.13, 1.98)	0.3226	0.0001	
Block 2: Medical comorbidities & functioning							
KPSS score	-0.0221	0.0120	0.98	(0.96, 1.00)	0.0652	0.0289	
Sleep disturbance	0.6638	0.3606	1.94	(0.96, 3.94)	0.0657	0.0022	0.0706
Vision impairment	0.1534	0.4862	1.17	(0.45, 3.02)	0.7525	0.0395	
Block 3: Medications							
Benzodiazepines/other sedatives	0.4656	0.4054	1.59	(0.72, 3.53)	0.2508	0.0103	0.0103
Block 4: Axis-I mental disorders							
Major depressive disorder	0.5690	0.4139	1.77	(0.79, 3.53)	0.1693	0.0242	
Minor depression	0.4043	0.3843	1.50	(0.71, 3.18)	0.2929	0.0001	0.0396
Anxiety disorder	0.9087	0.4955	2.48	(0.94, 6.55)	0.0666	0.0153	

Note: $n = 467$; Whole model $\chi^2 = 85.06$, $p < 0.0001$; Lack of fit $\chi^2 = 295.42$; $p = 1.0000$; Whole model $R^2 = 0.2236$; N/A = not applicable

Suicide ideation at year 1 accounted for a sizeable proportion of the total variance in the follow-up regression analysis. For this reason, and the fact that the sample size was reduced in Model 3 compared to Models 1 and 2, a post hoc logistic regression model was computed using year 2 data without including suicide ideation at year 1 as a covariate. The results of this analysis are presented in Table 12. KPSS score, sleep disturbance, major depressive disorder, and anxiety disorder were all significantly

associated with suicide ideation in follow-up when baseline suicide ideation was not included in the predictive model.

Table 12. Results of a regression model to examine suicide ideation at year 2, without controlling for suicide ideation status at year 1.

Independent variable	Estimated regression coefficient (β)	Standard error	Odds ratio of reporting suicide ideation	95% Wald confidence interval	p-value	R^2	R^2 for block
Block 1: Demographic variables							
Sex (vs. male)	-0.2014	2.1807	0.82	(0.44, 1.51)	0.5218	0.0018	
Age	0.0316	0.3144	1.03	(0.99, 1.08)	0.1823	0.0081	
Marital status (vs. married)							0.0164
Widowed	0.3386	0.3362	1.40	(0.73, 2.71)	0.3139	0.0021	
Divorced	0.1701	0.5062	1.19	(0.44, 3.20)	0.7369	0.0022	
Single	-0.3406	0.6290	0.74	(0.22, 2.53)	0.6283	0.0022	
Block 2: Medical comorbidities & functioning							
KPSS score	-0.0297	0.0109	0.97	(0.95, 0.99)	**0.0064**	0.0291	
Sleep disturbance	0.9078	0.3436	2.48	(1.26, 4.86)	**0.0082**	0.0385	0.0706
Vision impairment	0.3725	0.4444	1.45	(0.61, 3.47)	0.4019	0.0030	
Block 3: Medications							
Benzodiazepines/other sedatives	0.6615	0.3692	1.94	(0.94, 4.00)	0.0732	0.0269	0.0269
Block 4: Axis-I mental disorders							
Major depressive disorder	1.0075	0.3769	2.74	(1.31, 5.73)	**0.0075**	0.0007	
Minor depression	0.5580	0.3643	1.75	(0.86, 3.57)	0.1256	0.0071	0.0239
Anxiety disorder	.1.1319	0.4533	3.10	(1.28, 7.54)	**0.0125**	0.0161	

Note: $n = 467$; Whole model $\chi^2 = 52.21$, $p < 0.0001$; Lack of fit $\chi^2 = 328.57$; $p = 1.0000$; whole model $R^2 = 0.1378$.

CHAPTER 4: DISCUSSION AND CONCLUSIONS

Over the next several decades, individuals between the ages of 65 and older are projected to comprise a significant proportion of the Canadian population, in part because of decreasing overall mortality rates, and the aging of the baby-boom cohort.[99] Therefore, it is important for primary care providers to be aware of clinically relevant factors associated with suicide ideation among older adults.

The purpose of the present study was to identify factors associated with suicide ideation in a representative cohort of adults 65 years of age and older who presented to primary care in the Rochester, NY area. Few investigators to date have attempted to explore associations between reported suicide ideation and demographic variables, medical comorbidities, medications, and selected Axis-I mental disorders within the context of primary care. Yet, it is known that suicidal older adults tend to seek care from primary care providers.[11] Thus, primary care providers are in a unique position to detect at-risk older adults during routine assessments. Furthermore, assessment of suicide ideation can be challenging in this population, because older adults tend to underreport depressive symptoms and suicide ideation.[12, 83, 84] Ultimately, the major findings of this study identify a set of clinically relevant risk indices that can be used to guide primary care providers in assessing suicide ideation among older adults.

Participants in the present study who were widowed or single were more likely to report suicide ideation compared to participants who were married, even after controlling for medical and mental health comorbidities, and medications. These results are consistent with findings from a controlled psychological autopsy study by Duberstein and colleagues of older adults who died by suicide.[55] The odds ratio for suicide comparing widowed individuals to married individuals was 4.81 (95% CI: 1.82 to 15.61) in that study, and the odds ratio for single/divorced participants was 15.1 (95% CI: 2.00 to 16.56). Other research has supported the hypothesis that marriage protects against suicide across the lifespan[100-103], and that negative life events or transitions, involving the loss of a spouse or close relative may increase suicide risk in older adults.[13] Another possible

explanation for these findings is that single or widowed older adults experience less social support than do married persons, which could also elevate suicide risk.[12, 36, 54, 56] Simple questions about the older adult's living arrangements and the strength of relationships with family members and friends can provide important cues to determine an individual's level of social functioning.[104] Evidence-based psychotherapeutic interventions, which include behavioural therapy and medications, might be beneficial to older adults who are experiencing negative life events or transitions.[97, 105, 106]

The prevalence of most chronic diseases increases with age.[107] Epidemiologic data from studies conducted in several countries confirm that patients with multiple medical comorbidities continue to comprise a significant portion of primary care practices.[108-110] It has been estimated that 98% of Canadians age 65 years and older who present to primary care practices have more than one diagnosis.[110] A major focus of the current study was to investigate the role of medical comorbidities among older adults who report suicide ideation. Given that thoughts of suicide frequently precede suicidal behaviour and death by suicide, it is important for clinicians to understand which medical factors are associated with suicide ideation among older adults, in order to improve risk detection and potentially decrease risk for suicide prevention in primary care. Therefore, it is important for physicians to be familiar with the older adult's current medical history and a patient's perception of their overall burden of physical illness when assessing suicide risk.

In the present study, cardiovascular disease, decreased vision, neurologic disorder, and sleep disturbance were significantly associated with suicide ideation in univariate analyses. Higher scores on the Cumulative Illness Rating Scale (CIRS), a measure of overall burden of medical illness, and higher scores on the Karnofsky Performance Status Scale (KPSS), a measure of functional impairment, were also associated with suicide ideation in univariate analyses. However, after controlling for demographic variables, medications, and Axis-I mental disorders in an exploratory regression analysis, only functional impairment measured by the KPSS, sleep disturbance, and vision impairment remained significantly associated with suicide ideation.

Little research has been conducted to identify associations between functional impairment and suicide-related outcomes. In a controlled psychological autopsy study, Conwell and colleagues used the KPSS to measure functional impairment, and reported that older adults who died by suicide had a greater degree of functional impairment compared to primary care controls.[53] Préville and colleagues determined that older adults from Québec who died by suicide were more likely to have had functional impairment six months prior to death, although these results are from an uncontrolled psychological autopsy study.[111] The same group of investigators reported comparable results from a controlled PA study.[112] Similar to past research where death by suicide was the outcome, older adults with more functional impairment in the present study were also more likely to report suicide ideation, in both univariate and multivariate analyses. These findings indicate that having an understanding of an older adult's level of functioning may be useful in identifying those who might be struggling with suicidal thoughts, and prompt clinical assessment of suicide ideation. Future research might focus on identifying factors that moderate the relationship between functional impairment and suicide ideation, such as age, sex, and personality factors.

Vision impairment or loss may contribute to varying degrees of psychological suffering.[65] In the current study, participants with vision impairment were more than twice as likely to report suicide ideation compared to participants without vision impairment. Although there is no specific psychophysiological reaction to decreased vision, one typical patient reaction is depression of varying duration and severity.[65] Cholden[113], Blank[114], and Shultz[115] have linked a grief reaction to vision loss, in which patients mourn the loss of the sighted self. In a qualitative study of older adults who died by suicide, De Leo and colleagues reported that vision deterioration was a contributing factor in 11 of 12 deaths by suicide, based on coroner reports.[65] Similarly, in a Swedish case-control study, older adults who died by suicide were seven times more likely to have a visual impairment compared to controls.[50]

The current findings and those of other investigators support the hypothesis that vision problems could predispose an older adult to thoughts of suicide. Thus, the psychological

consequences of vision loss among older adults should not be underestimated. Physicians who care for older adults' vision should be prepared to refer the patient to mental health specialists when necessary.

Although largely ignored in the early evolution of sleep medicine, interest in the need to improve recognition of sleep disorders in primary care patient populations is beginning to increase.[116] A number of epidemiologic studies and population-based surveys have consistently shown that up to 50% of adults over age 65 experience some disruption of sleep, and that sleep disturbances among this cohort are generally associated with poor physical health and depression – factors that are also known to elevate suicide risk.[117-119] Participants with a sleep disturbance in the present study were more than twice as likely to report suicide ideation compared to participants without a sleep disturbance. This finding was statistically significant even after adjusting for use of benzodiazepines or other sedatives, medications commonly prescribed to treat sleep disorders in primary care patients. Similar associations between suicide and sleep disturbances have been described by other researchers who have studied suicide in later life using nested case-control studies.[35, 36] Primary care physicians might bear in mind that whenever they assess older adult patients for sleep disturbances, these may be precipitated by underlying medical and psychological comorbidities.[120]

In the present study, medical comorbidities accounted for a consistent proportion of the total variance explained in suicide ideation across logistic regression analyses. These results provide further support for the conclusion that medical factors, particularly functional impairment, vision impairment, and sleep disturbances, are associated with suicide ideation among older adults who present to primary care. When assessing suicide ideation in older individuals, it is prudent for primary care providers to be familiar with medical comorbidities that are likely to increase risk for suicidality. Furthermore, knowledge of the patient's current medical history can provide the physician with valuable information about the patient's overall suicide risk profile.

Within a primary care context, an analysis of what medications might be associated with reporting suicide ideation among older adults has not been explored in past research endeavours. A guiding hypothesis for this analysis was that information gathered from an analysis of prescription patterns would allow one to determine, at least descriptively, whether pharmacological treatments correspond to appropriate care.[10, 95] Data on four medication classes were available for evaluation in the present study: heterocyclic antidepressants, SSRIs or other antidepressants, benzodiazepines or other sedatives, and narcotic analgesics.

In univariate analyses, patients who were taking SSRIs/other antidepressants, benzodiazepines/other sedatives, and narcotic analgesics were significantly more likely to report suicide ideation compared with patients who were not taking these respective medications (Table 6). The observation that older adults who report suicide ideation were more likely to be taking an SSRI or other antidepressant was not unexpected given significant associations between depression and suicide. Furthermore, this finding suggests that this group of patients may have been receiving pharmacological treatment consistent with clinical practice guideline recommendations for suicide ideation[10], depression[95], or both. Although treatment recommendations for older adults at risk for suicide and depression overlap, and the two constructs are related, primary care physicians should bear in mind that not all older adults who are suicidal are depressed, and not all depressed older adults are suicidal.[12, 34] Moreover, it has been suggested by Shneidman[121] and Heisel[122] that depression and suicide ideation are both clinically and theoretically distinct phenomena, and that the treatment of the two as identical is mistaken. Thus, patients should be independently assessed for suicide ideation and depression, and appropriate treatments should be initiated accordingly.

A notable prescription pattern that was identified in this study was the use of benzodiazepines or other sedatives among individuals who endorsed suicide ideation. In clinical practice, benzodiazepines are commonly prescribed to treat depressive symptoms, symptoms of anxiety, and sleep impairment. Participants in the current study who were prescribed a benzodiazepine were threefold more likely to report suicide

ideation compared to those who were not prescribed a benzodiazepine. This observation was confirmed after adjusting for presence of an anxiety disorder, indicating that use of benzodiazepines or of other sedatives was independently associated with reporting suicide ideation in this sample. Previous researchers have established that use of benzodiazepines comprises an independent risk factor for suicide in older adults.[123] In a large population-based case-control study, the adjusted odds ratio for suicide among individuals taking a benzodiazepine was 4.46 (95% CI: 3.25 to 6.11), although these investigators did not control for sleep disorders.[123] It is recommended that physicians use caution when prescribing benzodiazepines to older adults who report suicide ideation.[124]

Patients in the current study who were prescribed narcotic analgesics were also significantly more likely to report suicide ideation in univariate analyses. This result was consistent with past studies that have suggested that narcotics elevate the risk of death by suicide among older adults. In a Canadian study, Voaklander and colleagues identified an association between suicide and narcotic analgesics of similar magnitude ($OR = 2.57$) after controlling for demographics, medical comorbidity, and use of other medications.[123] These investigators also discovered a dose-response effect illustrating that individuals taking stronger narcotics were at greater risk for suicide.[123] A similar risk gradient was reported in an earlier Canadian case-control study.[33] Toxicologic analyses among adults age 65 years and older who died by suicide in New York City revealed a significant trend between analgesic use at or close to the time of death and increasing age.[125] Analgesics, which included narcotics, were detected among 42% of individuals $\geq$ 85 years compared with 21% of individuals 75 to 84 years and 12% of individuals 65 to 74 years ($\chi^2 = 10.32$; $p = 0.006$). Furthermore, these older adults were marginally more likely to receive analgesics over antidepressants.

One explanation for the current findings and those of previous researchers in terms of narcotic prescriptions is that suicidal older adults often present with chronic somatic pain, which could appear as a more salient clinical feature than the patient's negative affect.[126, 127] Effective chronic pain management, which can include the use of opiates, may substantially increase a patient's overall quality of life, but the hazards of opioid therapy

might be greater among suicidal older adult populations. Disadvantages to prescribing narcotics to individuals in this cohort include the potential for substance abuse, and the potential for these medications to be used as lethal means. In Ontario, suicide comprised 24% of all deaths related to opioid use between 1991 and 2004, an estimate that was not, however, exclusive to older adults.[128] In addition to regular follow-up and reassessment, two strategies to mitigate the potential risks of narcotic therapy in older patients might include:

1. A wariness to prescribe narcotic analgesics to older adults with a substance abuse disorder, especially since other non-narcotic pain strategies have been suggested.[129]
2. Having narcotics dispensed to patients in smaller quantities to reduce the risk of using the medication for suicide.

Academic literature on suicide in later life has consistently implicated *DSM-IV* Axis-I mental disorders, and particularly mood disorders, as important risk factors for suicide. Strong associations between depression and death by suicide have been reported in virtually all observational studies where this was a primary outcome measure.[13, 33, 35, 36, 49, 51-54, 56, 57, 123] Relatively few investigations have explored the role of depression in the experience of reporting suicide ideation among older adults, despite recommendations to routinely assess for suicide ideation in primary care.[130] Although suicide ideation and depression are different psychological entities, patients often present with overlapping symptoms in a clinical setting. It was therefore hypothesized that suicide ideation and Axis-I mental disorders would be associated in the present study.

In univariate analyses, major depressive disorder, cognitive disorder, anxiety disorder, and substance abuse disorder were associated with reporting suicide ideation, and were included in subsequent regression models. Minor depression was not significant at the univariate level. However, in multivariate analyses, patients with minor depression were 3.5 times as likely to endorse suicide ideation compared to those without minor depression, and patients with major depressive disorder were almost 6.5 times as likely to

endorse suicide ideation. Both of these statistically significant findings were expected and consistent with past research on death by suicide.[12] Recognizing that depression and suicide ideation are not mutually exclusive, proper assessment and treatment of depression among older adults is crucial to identifying suicide ideation and suicidal behaviour.[86, 105, 131-136]

Few researchers have suggested a link between anxiety disorders and death by suicide among older adults.[33, 49] A novel finding of the present study was that patients with an anxiety disorder were over twice as likely to report suicide ideation, even after controlling for benzodiazepine use. From a primary care standpoint, this result highlights the importance of routinely screening for suicide ideation among older adults who have been diagnosed with an anxiety disorder or present with symptoms of anxiety. Recent American epidemiologic data indicate that the prevalence of older patients with a diagnosed *DSM-IV* anxiety disorder is approximately 7%[137], whereas the prevalence of anxiety symptoms is at least 19%.[138] These data indicate that primary care physicians are likely to routinely encounter older adults with symptoms of anxiety in their practices, although not necessarily in the context of current *DSM-IV* anxiety disorder nosology. Primary care physicians might also bear in mind that anxiety often co-occurs with depression in later life[139], and individuals with symptoms of both anxiety and depression are potentially at a greater risk of experiencing suicide ideation.

In order to determine which demographic factors, medical comorbidities, medications, and Axis-I mental disorders were associated with suicide ideation over a longer time period, regression analyses were constructed using data obtained one year after the initial baseline interview. Presence of suicide ideation at baseline was strongly associated with reporting suicide ideation in follow-up. Individuals with a past history of suicide ideation were 8 times more likely to report suicide ideation one year later. Although a past history of suicide ideation was the only statistically significant association observed in the present follow-up analysis, it independently accounted for almost 9% of the total variance in the regression model, reinforcing the conclusion that a past history of suicide ideation is a robust predictor of future suicide ideation among older adults. This finding is

clinically germane because it illustrates that suicide ideation can be chronic or recurrent in nature, which has implications for assessment and treatment at the primary care level. Thoughts of suicide and suicidal feelings should always be assessed repeatedly among older patients.[140] Primary care providers should remain vigilant in following up with older adults with a past history of suicide ideation to ensure that the patient's status does not worsen. Patients with more intense or persistent suicide ideation (e.g., the development of a suicide plan) should be referred to specialized mental health services, since these individuals may be at elevated risk for suicidal behaviour.

Other than history of suicide ideation, no other statistically significant associations were identified in the regression analysis examining suicide ideation at year 2. Functional impairment measured using the KPSS, sleep disturbance, and anxiety disorder approached statistical significance, but did not meet threshold criteria at the $p < 0.05$ level, most likely due to a smaller sample size compared to previous regression models. Furthermore, past history of suicide ideation accounted for almost 40% of the explained variance in this model. This reduces the likelihood of finding significant associations between suicide ideation and the other variables analyzed. Given this limitation, it is noteworthy that the odds ratio estimates for KPSS, sleep disturbance, and anxiety disorder remained consistent in magnitude and direction with Models 1 and 2. When past history of suicide ideation was not included as a covariate in Model 3, functional impairment, sleep disturbance, major depressive disorder, and anxiety disorder were found to be statistically significant predictors of suicide ideation in follow-up.

The current study has numerous strengths and limitations that should be considered when interpreting the results. This investigation comprised a secondary analysis, in which the original data came from a naturalistic study that occurred over the course of four years. Although naturalistic studies are ideal for detecting changes over time, they do not make use of control groups. This limits the investigator to strictly non-causal inferences arising from cross-sectional analyses.

Investigators who use secondary data sources are inherently limited by the fact that the data were collected to answer a different research question. The original study addressed primary outcomes related to depression, perceived family criticism, medical comorbidities, and functional status among older primary care patients[70, 71], not suicide ideation, as in the current study. As a result, a continuous measure specifically designed for assessing suicide ideation among older adults, such as the Geriatric Suicide Ideation Scale (GSIS)[141], was not included in the original study. It was therefore necessary to dichotomize suicide ideation as present or absent, based on measures that were available in the existing dataset, and methods of previous investigators.[85, 86] Dichotomization procedures present a statistical limitation whenever a variable can otherwise be measured as continuous, since information is lost during the categorization process. Review of participants' medical records also poses a limitation to the extent that the medical record lacks completeness or is outdated.

In the current study, suicide ideation was operationalized using the suicide items from the Hamilton Depression Rating Scale and the SCID. The HDRS suicide item has demonstrated adequate inter-rater reliability and retest reliability when administered to older adults. No psychometric data for the SCID suicide item were identified in the literature, which is a limitation.

In order to obtain a representative cohort of adults age 65 years and older who presented to primary care, the original investigators did not apply any specific exclusion criteria. Of 2014 potentially eligible subjects, 1144 were screened for recruitment, and 745 were enrolled in the study. This translates to a recruitment rate of approximately 37%. A greater proportion of individuals declined to participate in the original study. To the extent that non-participants had substantially different characteristics than the participants, the possibility of selection bias arises, which could distort the results. This presents a potential limitation of the current study. The implications for missing data are similar. A study's internal validity is threatened when data are not missing at random, which can reduce generalizability. However, less than 15% of the 745 participants analyzed had missing data on any given variable. For these reasons, data were assumed to

be missing completely at random, and a complete-case analysis was conducted. Nonetheless, missing data still represent a limitation of this study.

At the time of writing, only data from years 1 and 2 of the original four-year naturalistic study were available for analysis. This precluded an extended analysis of changes in suicide ideation over time. Another challenge of assessing suicide ideation at follow-up is the fact that suicide ideation is not a static entity. Indeed, an older adult's level of suicide ideation can change depending on life circumstances, including transitions and improvement or decline in physical or mental health. In both a research and clinical context, these factors are ideally measured frequently over the course of a year, rather than just once per year, as in the current study. Thus, the lengthy period of time elapsed between assessments presents a limitation to the generalizability of this study, assuming that older adults visit their primary care providers on more than one occasion per year. A related conceptual limitation is that older adults tend to under-report suicidal symptoms, which decreases the probability of detection, especially over a lengthy follow-up interval.

The present study also has statistical limitations. In follow-up analyses, the sample size decreased due to attrition, which decreased statistical power. Despite the numerous independent variables analyzed, R^2 estimates ranged from 0.14 to 0.25 across four multivariate logistic regression models. This indicates that there are probably additional important factors associated with reporting thoughts of suicide among older adults who present to primary care practices that have not yet been identified. Furthermore, it is difficult to ascertain whether the range of R^2 estimates computed in this study are consistent with other similar studies, because previous investigators have not reported R^2 estimates.

Despite these shortcomings, the current study had several strengths that facilitated the identification of factors associated with suicide ideation among older adults within a primary care context. Exclusion criteria were purposefully few in the current study, with the intent of recruiting a broad cross-section of older adults who present to primary care.

This recruitment method likely increases the study's generalizability and clinical relevance. A large quantity of data were collected on each patient, which promoted an extensive analysis of demographic variables, medical comorbidities, medications, and Axis-I mental disorders in relation to suicide ideation.

This project provides a strong starting point for future research into suicide ideation among older adults in a primary care context. Additional research is required to identify factors associated with reporting suicide ideation in a primary care context. Future research might focus on the associations between personality factors and suicide ideation among older primary care patients. In a controlled psychological autopsy study of depressed older inpatients, Duberstein and colleagues reported that higher levels of neuroticism and higher levels of openness to experience were associated with suicide ideation.[60] These authors hypothesize that suicide risk is increased in older persons with low openness to experience because of their restricted adaptability to the challenges of aging, and because their distress may be more difficult for others to detect.[37, 60]

Group differences among older adults who report suicide ideation might also represent an area of forthcoming research. For example, differences in reporting suicide ideation may exist among individuals between the ages of 75 and 85 years compared to those age 85 years and older. Women tend to report depressive symptoms more frequently than men.[132] A similar trend was observed for suicide ideation in the current study, but this did not reach statistical significance in any analysis. In our study, the vast majority of participants reported their ethnicity as white, preventing a finer subgroup analysis on this variable. Little research has explored the effect of socioeconomic status, urban vs. rural residential location, culture, religiosity, meaning in life, and protective or resiliency factors within the context of reporting suicide ideation among older adults.[34] Other investigators might focus on older adults who report suicide ideation within the context of experiencing chronic pain symptoms, since this association has not been identified to date.

In the future, researchers may wish to replicate the current study's findings to determine which factors are associated with suicide ideation over a longer period of time, perhaps within a larger prospective cohort or longitudinal study. Furthermore, it would be germane to identify whether these results are replicable in different health care systems (e.g., publicly funded vs. privately funded).

The ultimate goal of this project was to identify factors associated with suicide ideation that are clinically relevant to health care providers in a primary care setting in order to improve detection of suicide risk among older adults. Until now, this specific research objective had not been previously undertaken. Hopefully, the results of the current study will contribute to the literature with respect to older adults who present to primary care providers with suicide ideation, stimulate new research questions, and lead to better mental health assessments for older adults.

The present study indicated that widowed and single individuals might be at increased risk of expressing suicide ideation. Older adults in this sample who were functionally impaired or visually impaired also tended to report suicide ideation, as did older adults with sleep disturbances. Use of medications, such as benzodiazepines and sedatives, were associated with suicide ideation. In order to optimize care, it would be prudent to assess for suicide ideation regularly among older adults with major depressive disorder, minor depression, or anxiety disorder. Most importantly, the greatest predictor of suicide ideation among older adults in a primary care context that was identified in the current study is a past history of suicide ideation. These results have the potential to improve mental health assessments among older adult patients. The associations identified in this project can be incorporated into a primary care physician's interviewing framework when the goal of assessment is to detect or rule out suicide ideation. Asking the patient questions about their living arrangements, social network, activities of daily living, physical health, mental health, alcohol and/or drug use might provide a context for difficult questions about suicide, and reveal patients who are in need of specific risk assessment and precautions.[10, 142, 143] Future researchers might consider assessing this strategy to determine whether it improves the detection of suicide ideation among older

adults in a primary care context and whether doing such improves treatment provision and clinical outcomes.

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