Child and Adolescent Emergency Department Presentations for Self-harm: Population-based Data from Ontario, Canada

by

Jennifer Margaret Bethell

A thesis submitted in conformity with the requirements
for the degree of Doctor of Philosophy

Dalla Lana School of Public Health
University of Toronto

Child and Adolescent Emergency Department Presentations for Self-harm: Population-based Data from Ontario, Canada

Jennifer Margaret Bethell

Doctor of Philosophy in Epidemiology

Dalla Lana School of Public Health
University of Toronto

2012

Abstract

Objective: Describe emergency department (ED) presentations for self-harm by youth (12-17 year-olds), including the mental health follow-up they receive after their first-ever presentation, and analyze the association between this mental health follow-up and repeat presentation(s).

Methods: Population-based health services data from Ontario, Canada, covering April 2002 to March 2009, were used to ascertain ED presentations for self-harm by youth (n=16,835). These data were used to create a retrospective cohort (n=3,497) of those making their first-ever presentation, and individually-linked to inpatient admission and ambulatory physician contact data. Mental health follow-up within 30-days of discharge, either from a psychiatrist or from any physician specialty, was assessed. The associations between follow-up and repeat self-harm presentation(s) within the following year were then analyzed.

Results: Conservatively, the overall incidence rate for ED presentations for self-harm by Ontario youth was 239.0 per 100,000 person-years. Rates were higher in girls, increased with age and inversely related to neighbourhood income and community size (population). Self-harm made up a small but severe proportion of ED use by youth. Over half (57.2%) making their first-ever self-harm presentation had no mental health contact with a physician within 30 days of discharge (and several demographic, clinical and health service variables were associated with follow-up). However, mental health follow-up was not associated with reduced odds of repetition or fewer repeat presentations.

Conclusions: ED presentations for self-harm by youth in Ontario are remarkably consistent with those reported from other Western countries. Self-harm is an important public health issue in Canada and requires a comprehensive prevention strategy. These data suggested follow-up youth received after their first-ever ED presentation for self-harm may be inadequate and strategies to improve follow-up may be needed. Still, more research is needed to establish the effect of follow-up on relevant outcomes.

Acknowledgments

Table of Contents

List of Tables

List of Figures

List of Appendices

1. Introduction

Suicide is the second leading cause of death in 15-24 year-olds and the frequency of self-harm in youth is more than twice that of the overall population. At the individual level, the devastation of those affected by suicide and self-harm (including, but not limited to, the individual and their family, friends and care providers) is immense; along with profound grief, there can be anger, guilt and shame over the apparent self-inflicted nature of the acts. But underpinning both the individual and societal responses to suicide and self-harm the question remains: how do we prevent these tragedies?

This thesis provides new knowledge on self-harm in youth. Descriptive health services data offer comprehensive information about the extent of the problem, which will in turn increase awareness and highlight the importance of addressing this public health issue. Analyzing the mental health follow-up these youth receive after presenting to hospital for the first time provides insights about who is receiving this care and the association with self-harm repetition. Ultimately, the results presented in this thesis have the potential to inform future research, policy and practice aimed at preventing suicide and self-harm.

1.1 Thesis Objectives

This thesis was carried out using population-based health services data from the Province of Ontario, Canada to achieve the following substantive and methodological objectives.

1.1.1 Substantive Objectives

Among 12-17 year-olds in the Province of Ontario, Canada:

1. Describe the emergency department presentations for self-harm by calculating incidence rates according to demographic characteristics and the proportion of emergency department presentations related to self-harm, overall and by demographic and clinical characteristics.

2. Describe the mental health services received from a physician within 30 days after a first-ever emergency department presentation for self-harm, overall and by demographic and clinical characteristics.

3. Describe the demographic and clinical characteristics associated with repeat self-harm presentation(s) in the year after a first-ever emergency department presentation for self-harm.

4. Analyze the association between mental health services received from a physician within 30 days after a first-ever emergency department presentation for self-harm and repeat self-harm presentation(s) in the following year.

Objectives 1 to 3 were descriptive analyses, which have never been carried out using these data or study population. (The full list of hypotheses tested, with supporting evidence, is provided in Appendix A). For objective 3, analyses of the number of repeat events were largely exploratory - few previous studies have addressed these differences (see Section 2.4.4).

Objective 4 was to test a pre-defined relationship of interest. Multivariable analyses were used to quantify the association between the exposure (mental health follow-up from a physician) and outcome [repeat self-harm presentation(s)]. The hypothesized relationships (depicted in Figure 1) were informed by both previous research and the results obtained from objectives 1 to 3 above. The hypothesis was, in an adjusted analysis, mental health services received from a physician within 30-days of a first-ever emergency department presentation for self-harm would be associated with a reduction in both odds of repetition within the following year as well as number of repeat presentations during that time.

1.1.2 Methodological Objectives

In carrying out the above research objectives, the following original research study was developed:

1. The largest inception cohort of youth presenting to the emergency department for self-harm was established.

2. Hurdle models were used, for the first time, to study self-harm repetition.

1.2 Student's Role

The student conceived of and designed the study, carried out the analyses and wrote the dissertation. The student did not collect the data; all research was carried out as secondary analysis of existing administrative data (see Section 3.2.1). The Advisory Committee provided advice and guidance throughout. The student has already published two papers on self-harm and using similar data (see Appendices B and C):

- Bethell J, Rhodes AE, Bondy SJ , Lou WY, Guttmann A. Repeat self-harm: application of hurdle models. *British Journal of Psychiatry.* 2010;196:243-244.

- Bethell J, Rhodes AE. Identifying deliberate self-harm in emergency department data. *Health Reports*. 2009;20:35-42.

The first paper was produced prior to initiating work on the thesis and the second was published after (hence, members of the Advisory Committee are listed as co-authors). The contributions of the Advisory Committee will be similarly acknowledged in any future papers and presentations stemming directly from this work.

2. Literature review

2.1 What is Self-harm?

In this thesis, the term self-harm refers to non-fatal self-poisoning or self-injury, irrespective of the apparent purpose of the act.[1] This term encompasses heterogeneous acts and behaviours, including attempted suicide (carried out with at least some intent to end one's own life[2]) as well as non-suicidal self-injury (engaged in with the purposeful intention of hurting one's self without the intent to kill one's self[3]).

Inconsistent terminology has been an acknowledged problem for research on suicide and self-harm. For example, the World Health Organisation (WHO)/EURO Multicentre Study on Suicidal Behaviour, which began in 1989 and included collaboration from 13 European countries, defined cases as "an act with nonfatal outcome, in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences"[4] but publications stemming from this research initiative have used diverse terms, including parasuicide,[5] attempted suicide[6,7] and deliberate self-harm[8] to describe them. In fact, each of these terms has since fallen out of favour: "parasuicide" because of the confusion it created for research and clinical practice, as well as the practical problems of translating it to other languages;[9] "attempted suicide" because it did not acknowledge the diverse motives involved in these acts and behaviours;[10] and, "deliberate self-harm" because, as stated by the UK National Institute for Clinical Excellence (NICE), "for some people, especially those who have been abused as children, acts of self-harm occur seemingly out of the person's control or even awareness, during 'trance-like', or dissociative, states".[1] Still, discourse on terminology in suicide and self-harm research continues. Silverman et al. have recently put forward a nomenclature system; within their classification of "suicide-related behaviours", self-harm was defined as acts without suicidal intent, but where the individual means to "use the appearance of intending to kill himself/herself".[11,12] This important distinction from the definition used in this thesis – that is, specifying self-harm as non-suicidal - has been more commonly applied by American researchers.[13]

In the end, the term and definition for self-harm used in this thesis were chosen for several reasons. First, to acknowledge that only some youth who self-injure or self-poison express suicidal intent

[e.g., among those who self-harm, about half (community samples) to three quarters (hospitalized samples) reported wanting to die as a motivation for the act].[5,14-16] Second, similar to most other large, population-based studies of self-harm using emergency department and inpatient admission records, the administrative data used here were coded in the International Classification of Diseases (ICD),[17] which does not disaggregate suicidal vs. non-suicidal motivations behind self-harm (although there have been examples where supplemental data have been collected for this purpose).[18] Third, the term and definition were most consistent with current research based on samples of individuals presenting to the emergency department.

2.2 Suicide and Self-harm

2.2.1 Separate but Overlapping

Suicide and self-harm can be conceptualized as separate phenomena because, fortunately, most people who self-harm do not die by suicide. A systematic review of 90 studies estimated that among those who present to hospital for self-harm, about 0.5 to 2% will die by suicide within the year and 5% will die by suicide within 9 years.[19] Suicide and self-harm also exhibit distinct patterns in the population; for example, male suicide rates are typically several times higher than those of women[a] whereas the opposite is true for self-harm. In youth in particular, survey data have shown girls are more likely than boys to report self-harm (8.9% vs. 2.6%),[15] suicide attempts (9.3% vs. 4.6%)[21] and non-suicidal self-injury (6.3% vs. 4.6%)[22] in the previous year. In fact, a meta-analysis of 88 population-based survey studies of adolescents found that of the 14 measures of suicidality (thoughts, threats, plans, and attempts) and self-harm, the prevalence was always higher in girls (although not statistically significant for suicide attempts within the previous 1 or 6 months, or lifetime self-harm).[23] Canadian health service data have similarly shown that among 15-19 year olds, the frequency of emergency department presentations for self-harm by girls was more than twice that of boys, although this sex-difference lessened with age.[24]

Suicide and self-harm also very much overlap as self-harm is a strong predictor of youth suicide.[25] A prospective cohort study of 11,583 individuals who presented to a UK emergency department for self-harm between 1978 and 1997 showed that, in the year following a self-harm presentation, the risk of suicide was about 66 times that of the general population.[26] And although the risk of suicide after a self-harm presentation may be lower in youth compared to adults,[26] they are still at a greater

---

[a] Of the 75 jurisdictions that reported suicide statistics to the World Health Organization for the 2002 World Report on Violence and Health, only one (selected areas of China) did not show suicide rates were higher in males.[20]

risk than the general population; prospective cohort data on 15-24 year-olds presenting to the emergency department for self-harm showed the number of deaths by suicide was about ten times higher than expected.[27] Similarly, psychological autopsy studies have reported that between a third and two-thirds of youth who died by suicide had a history of self-harm.[28-31]

2.2.2 Descriptive Epidemiology

Suicide is the second leading cause of death among those aged 15-24 years, both worldwide and in Canada.[32,33] In fact, 2005 Canadian data showed that there were 552 suicide deaths among 10-24 year-olds, more than twice as many deaths as from cancer and second only to unintentional injury.[32] Yet, it is also important to acknowledge that suicide rates among youth tend to be lower than those of older age groups and youth account for a relatively small proportion of all suicides. For example, the overall suicide rate in Canada in 2007 was 11.0 per 100,000 population but 7.6 per 100,000 population among 10-24 year-olds and this age group accounted for 14.1% of suicides that year[34] (and similar patters have been seen in global suicide statistics).[20] Taken together, these data reinforce that suicide is a major cause of mortality for youth, but it is also an important cause of mortality through adulthood.

Self-harm in youth is both common and associated with health and psychosocial problems for the individual and those who care for them. The Child & Adolescent Self-harm in Europe (CASE) Study, an anonymous survey administered to 30,532 14-17 year-old students in seven countries (Australia, Belgium, England, Hungary, Ireland, the Netherlands and Norway) found that 5.4% reported self harm in the previous year.[15] The 2007 Youth Risk Behavior Survey (YRBS), a nationally representative sample of American high school students, showed 6.9% reported attempting suicide in the previous year.[21] A Canadian study of 14-21 year-olds found 16.9% reported a lifetime history of non-suicidal self-harm.[35] In terms of health and psychosocial problems, survey data have also shown that self-harm was associated with factors including (but not limited to) smoking, drug use and misuse, depression, anxiety, low self-esteem and psychiatric morbidity (as assessed with the Clinical Interview Schedule (CIS-R)[36]].[16,37-39] Data from clinical samples of youth presenting to hospital for self-harm have provided even further evidence of the problems associated with self-harm. In a sample of youth presenting to a Canadian pediatric emergency department for suicidality (ideation, planning or attempts), at least 20% were identified as having been abused physically and/or sexually, and 14% were in state guardianship.[40] Similarly, a sample of 15-19 year-old suicide attempters from Helsinki, Finland hospitals found that 41% met criteria for a mood

disorder and 40% met criteria for a substance use disorder.[41] An American sample of 10-18 year-olds presenting to the emergency department for suicidality found that nearly a quarter had been suspended or expelled from school in the previous 6 months.[42] A UK sample of 15-24 year-olds presenting to the emergency department for self-harm found that 32% of boys and 5% of girls reported a criminal record.[27] Aside from the problems for the individual, self-harm can also be a traumatic and distressing experience to those who care for them. A qualitative study of parents of youth who had presented to the emergency department for self-harm found they expressed severe emotional responses, including grief and guilt, and some reported somatic and psychological symptoms, such as sleeplessness, depression and work impairment.[43]

Survey and health service data also show self-harm peaks dramatically among youth. US data suggested self-reported suicide attempts were about six times higher in high school students (6.9%, see YRBS above) than in the adult population [1.1%, from the US 2008 National Survey on Drug Use and Health (NSDUH)].[44] Analysis of Statistics Canada's Canadian Community Health Survey 1.2: Mental Health and Well-Being (a nationally representative sample which included respondents age 15 years and over) also showed younger age to be associated with attempted suicide in the previous year.[45] A telephone survey of 12,006 Australians age 10-100 years found the overall 12-month prevalence of non-suicidal self-injury was 2.6%, but this figure was more than doubled in 10-17 year-olds (5.4%) and 18-24 year-olds (7.0%).[22] Recent Canadian data also demonstrated the dramatic peak of inpatient admissions for self-harm among youth.[46] Similarly, US data showed self-harm was a factor in just over 700,000 emergency department presentations annually[47] and about a quarter of them were by teens.[48] Canadian data from the province of Alberta estimated about 250 emergency department presentations for self-harm per 100,000 population annually, but peaking in 15-19 year-olds at about 500 per 100,000,[24] making it the sixth leading cause of inpatient hospitalization in this age group.[32] This age-related peak in emergency department presentations for self-harm is also mirrored in international data, including those from the United States[48,49], Ireland[50] and England.[51]

2.2.3 Prevention

A 2005 systematic review by Mann and colleagues discussed the evidence from suicide prevention research.[2] Among the strategies reviewed were awareness and education (for public and professionals); screening tools; treatment interventions; restricting access to lethal means; and, media guidelines for reporting suicides. It concluded that the most promising interventions were:

- Detecting and treating mental illness: educating primary care physicians has been found to increase prescriptions for antidepressants and reduce suicide rates. For example, the suicide rate on the Swedish island of Gotland decreased from 19.7 to 7.1 per 100,000 (compared to 25.5 to 24.8 per 100,000 in Sweden as a whole) after introducing a 2-day training program for general practitioners on diagnosing and managing depression.[52]

- Restricting access to means: reducing access to lethal means has been associated with reduced suicide rates. For example, Australia's 1996 gun law reforms reduced firearm suicide rates[53] and other strategies, such as controlling access to pesticides,[54] reducing the amount of paracetamol (acetaminophen) and other non-opiate analgesics per packet,[55] and the use of bridge barriers,[56] have also been implemented and are being assessed.

- Gatekeeper education: educating gatekeepers (individuals who may have the opportunity to identify individuals at risk and then refer them for appropriate assistance) may have reduced suicides as a component of a multi-layered prevention program by the US Air Force; as part of the program, commanders were briefed about resources for referrals to mental health services and the program showed a 33% relative risk reduction in suicide (although it was unclear which component in particular was most effective).[57]

A similar review by Gould and colleagues in 2003,[58] which specifically addressed youth suicide prevention, concluded that although promising preventive and treatment interventions were being developed and trialed, much more research was needed. While the evidence on effective suicide prevention strategies is somewhat sparse, there is even less on preventing self-harm. School-based programs have been recommended by both academics[59] and adolescents themselves[60] but have yet to be implemented and proven effective.

As evidence surrounding population strategies for suicide and self-harm prevention emerges, part of the prevention discourse has included "high-risk"[61] approaches. In particular, improving access to mental health services for at-risk youth[62] and especially those who present to hospital for self-harm.[63,64] As previously discussed, this is a group in which suicide risk is elevated, self-harm often persists and mental disorder is common.[65] As such, the emergency department has been identified as having a key role in suicide and self-harm research[66] and prevention.[67,68]

Few intervention studies, even those conducted among individuals who present to the emergency department for self-harm, have assessed suicide as the outcome of interest (see Section 2.4.1).

However, intervention studies aimed at preventing self-harm repetition have included individual,[69] group[70] and family[71] therapy, emergency department staff training,[72] regular contact by mail[73] or telephone,[74] and "green cards" (on demand admission).[75] Yet, to date, the results of these studies have not been compelling. A 1999 Cochrane review of randomized controlled trials (RCTs) of interventions to prevent self-harm repetition identified 23 studies but concluded there was considerable uncertainty about what interventions may be effective and that the trials to that point were severely hampered by their small sample sizes and poor statistical power.[76] Since then, three reviews of interventions specific to youth who present to clinical settings for suicidality and/or self-harm similarly found limited evidence and studies hampered by methodological weaknesses.[77-79] Although each of the reviews concluded more research was needed in this area, they also acknowledged the complications inherent in conducting research in this population. For example, for RCTs, ethical requirements mean that both the intervention and control group must meet or beat the standard of care. As such, the "treatment as usual" condition has often served as a control rather than placebo or no-contact, for example.[80] However, treatment as usual is highly variable and complicates any interpretation of comparisons with this group.[81] Furthermore, the effects of common treatments, including medication and psychotherapy, are still unclear and this lack of information has been compounded by excluding suicidal youths from trials.[80]

2.3 Mental Health Follow-up

Clinical guidelines for self-harm,[1,82-85] and more generally, those at risk of suicide,[86] have been developed. Although they too have acknowledged problems with the level of evidence to support all of the recommendations, they have stressed the importance of appropriate management both in hospital (e.g., with psychosocial assessments) and as follow-up. However, these aspects of care have not been thoroughly investigated in intervention trials (see Section 2.2.3). As such, researchers are now working to establish this link using observational data. For example, several studies, primarily from England, have investigated psychosocial assessments (i.e., the proportion of individuals who receive them, as well as the determinants and effects of assessment)[87-90] and suggested that psychosocial assessments may have a protective effect on repeat self-harm, mediated by increased referrals for psychiatric follow-up. However, these studies have not been able to link to health services data describing service use following discharge, and therefore, have been unable to describe or test the effects of this follow-up.

Addressing this limitation from previous studies, this thesis was able to link various data sources at the individual level. More specifically, data describing cohort members' ambulatory mental health use was obtained (see Section 2.5) and "follow-up" was operationalised as 30-day mental health contact with a physician. Similar measures have been used in previous studies describing health service patterns of individuals who present to hospital for self-harm.[41,91-93] The proportion of psychiatric admissions that receive at least one psychiatry service contact within 30 days of discharge has also been described more generally as a quality indicator for mental health services.[94] In fact, Hermann et al, using an international expert panel to assess quality indicators for mental health services, ranked this indicator among the highest in terms of importance and soundness and subsequently recommended it (among a total of 12 measures) to the Organization for Economic and Community Development's Health Care Quality Indicators Project (OECD-HCQI). Although it was not designed expressly for a non-admitted (emergency department) samples, 30-day mental health follow-up was chosen here as an appropriate, consistent and useful measure that would contribute to a wider indicator development initiative.

More broadly, follow-up has been described as a component of the "continuity" domain of health system performance.[94,95] Continuity of care is concerned with how an individual experiences care over time; specifically, whether services from different programs, practitioners, organizations, and levels of care/service are uninterrupted and coordinated,[94] including continuity of information, of personal relationships and of clinical management.[96] Continuity of care has been studied to some extent in youth who have been admitted for psychiatric stays. However, a 2004 review of service use among children and adolescents following psychiatric hospitalization concluded that there were few studies of the predictors of aftercare services and little evidence about their effectiveness.[97] Even less is known about follow-up after discharge from the emergency department; more studies of the transition between the emergency department and community mental health care are needed.[66]

For self-harm in particular, the health service patterns of those who present to the emergency department have been investigated in older/all-age[91,92,98] and younger populations,[41,99,100] but research restricted to those making their first-ever presentation is scarce. Yet, this population may be least likely to receive follow-up; European data showed that about a quarter of 15-19 year-olds who presented to hospital for self-harm were not recommended for follow-up[41,101] but those making their first-ever self-harm presentation were referred for specialist follow-up even less often than those making a repeat presentation.[7] Also, the effects of residential characteristics on health service patterns after a self-harm presentation have not been tested. For example, it is unclear whether rural

or remote residence, previously associated with lower pediatric mental health and psychiatry use[102] and supply[103,104] influences health service patterns. Similarly, the hospital in which a person presents for self-harm has been shown to be an important predictor of referral for specialist follow-up[7,90,98] but the hospital characteristics that account for differences in health service use are largely untested. Insights into the patterns of health service use following a young person's first-ever emergency department presentation for self-harm would help to plan the delivery of care for these youth (as effective interventions are trialed and implemented), and to describe gaps between current mental health service use and the care which has been recommended in clinical practice guidelines (i.e., identify populations in which targeted approaches may be needed).

While it is still unclear how often follow-up is received and the factors associated with it, there is even less evidence linking follow-up to outcomes. A 2011 report from the US Suicide Prevention Resource Center and the Substance Abuse and Mental Health Services Administration (SAMHSA) described continuity of care subsequent to discharge from the emergency department as "an underutilized suicide prevention strategy"[64] but the data to support this are limited. A Norwegian study suggested implementing a follow-up system for those who presented to hospital for self-harm contributed to reducing the self-harm presentation rate: from 170 per 100,000 in 1984 to 79 per 100,000 in 1995.[105] A UK cohort study of 658 individuals who presented to hospital for deliberate self-poisoning showed that referral for specialist follow-up may have halved the risk of repetition (adjusted hazard ratio for 6-month repetition: 0.49).[106] These studies also included all ages and those with a history of self-harm; it is unclear whether these results might be extended to youth making their first-ever hospital presentation for self-harm (see Section 2.4.3). Understanding the effect of follow-up on self-harm repetition will not only have important implications for clinical care, but also for policy and service planning by contributing to the development of indicators for the pediatric mental health presentations. The need to develop performance measures in pediatric emergency care, in general and for specific conditions, has been documented.[107,108]

2.4 Research Issues for Studying Self-harm

2.4.1 Outcomes of Interest

Intervention and observational studies carried out among those who present to hospital for self-harm have more often examined repeat self-harm as the outcome of interest rather than suicide.[109] This tendency has been due to both substantive and methodological reasons. Self-harm repetition is a risk factor for suicide: a prospective study of 11,583 individuals who presented to hospital for self-harm

between 1978 and 1997 found that those who repeated at least once during follow-up had about double the risk of suicide as those who presented only once.[110] Self-harm itself is also an outcome that is distressing (to the individual) and costly (to health services) which should be prevented.[10] However, repeat self-harm is also easier to study than suicide; despite the elevated risk of suicide in this population, it is still a rare outcome and thus requires a large sample for a statistically powered study.[64,111] Self-reported symptoms, behaviours and emotions have also been reported as study outcomes[109] and ones which may be equally important.[10]

2.4.2 Data Sources

There are two main sources of information for studying self-harm: survey and health services data. Survey data have provided prevalence estimates of self-harm, as well as an understanding of the potential risk factors. For example, the US Youth Risk Behaviour Survey (YRBS)[112-114] provides regular data on self-reported suicide attempts among high school students and major school-based surveys of self-harm have also been carried out in seven countries (Australia, Belgium, England, Hungary, Ireland, the Netherlands and Norway) for the Child & Adolescent Self-harm in Europe (CASE) Study[15] as well as in Scotland,[37] and Finland.[115] Survey data have also shown that many self-harming adolescents will not present to hospital and thus never be captured in health services data. Analysis of YRBS data found that 8.4% of high school students reported making a suicide attempt in the previous year, yet only 2.3% (less than one third of these) reported receiving medical attention for an attempt.[112] Similarly, the CASE study found that 5.4% of students reported self-harm in the previous year, but of them, only about one in eight (12.2%) reported presenting to hospital.[116] This latter study also suggested that those who present to hospital represent a more suicidal subset of youth who self-harm; the intent to die was the strongest predictor of health service use following self-harm (in both boys and girls).

Although surveys provide better estimates of the frequency of self-harm in the community, they have rarely been large enough to examine health service use or self-harm repetition in detail. As such, health service data are also often used to study and report on self-harm. Acknowledging the priority need for mental health indicators,[117] in 2011 Statistics Canada and the Canadian Institute for Health Information published their first *Health Indicators* report on self-harm, using pan-Canadian inpatient admission data to describe hospitalizations for self-harm.[46] However, linkage of emergency department and inpatient records has shown that less than half of those who present to hospital for self-harm were admitted and admission was associated with individual- and system-level factors,

such as self-harm method and hospital resources.[118,119] As such, emergency department presentations provide more representative information and are a prominent data source for self-harm research and reporting, describing self-harm across time and jurisdictions. For example, recognizing the value of emergency department data, a specialized self-harm monitoring system has been running in Oxford, England for 30+ years.[120] Subsequently, addressing the need for multicenter self-harm monitoring, as expressed in England's national suicide prevention strategy,[121] five more hospitals from another two cities (Manchester and Leeds) have joined this effort.[122] Emergency department data have also been used for this purpose internationally, including in the United States[48] as well as in multi-national self-harm research projects.[4]

2.4.3 Inception Cohorts

Early recognition, diagnosis and intervention in mental health problems, especially in children and youth, are key components of a comprehensive mental health system.[123] However, despite the potential benefits of early intervention in self-harm[59] (and the associated mental disorders),[124] few epidemiologic studies have captured self-harm populations early in their clinical course. There are examples of descriptive studies,[18,125,126] case-control studies,[127] cohort studies[6,27,128,129] and trials of interventions[70,75] all restricted to youth, but few have explicitly identified a population from their first-ever presentation. There is also evidence of differences between those making their first-ever self-harm presentation and those with a history of self-harm. For example, among those presenting to the emergency department, individuals with no previous self-harm presentations were less likely to repeat, both in all-age[130] and youth[6] samples. As well, factors associated with repetition among those making their first-ever presentation appeared to differ from those with a history of self-harm.[131] These influences may contribute to a differential effect for interventions aimed at preventing self-harm repetition; although trials of these interventions have generally proven inconclusive thus far, subgroup analyses in some have shown effects vary according to the individual's history of self-harm.[132-134]

Two inception cohorts of youth have been reported upon. Stewart et al,[135] assembled a sample of 224 7-19 year-olds who presented for suicidality (ideation, planning or attempts) to a pediatric emergency department in Ottawa, Canada over a one-year period (1997-98). Hawton et al[136] assembled a cohort of 710 under-15 year-olds who presented for self-harm to an emergency department in Oxford, UK from 1978-2003 and identified each child's index episode as the first during the study period. Although Hawton et al's study was not explicitly described as an inception

cohort, given that self-harm is very rare before the age of 12,[18,137] the multiple years of data collection and the age range of the cohort, it is reasonable to describe the index episodes as such.

Both these studies provided comprehensive descriptions of clinical and demographic characteristics of youth making their first-ever suicidality and self-harm presentations. However, they were also limited in certain respects. First, the samples were based on presentations to a single hospital, thus unable to capture information on any repetition or previous episodes that took place outside of the study hospital, possibly biasing any repetition estimates.[110] Second, there was likely insufficient heterogeneity in the study samples to ascertain regional/residential effects. Third, as with most other studies of self-harm repetition, the repetition outcome was treated as binary, dividing the study population into repeaters and non-repeaters and ignoring multiple self-harm repetition (see Section 2.4.4). Fourth, neither study could link individuals to their health service records for contacts that took place outside the study hospital. As such, they could not fully describe health services received prior to or following the presentation, including whether mental health services were received in primary care or from mental health specialists.

2.4.4 Statistical Analysis of Self-harm Repetition

Self-harm repetition increases the risk of suicide and is an outcome of interest in observational and intervention research.[10] However, few such studies have accounted for the number of repeat presentations. More often, they track a cohort over a period of time for any subsequent presentations, sometimes only counting those repeat presentations from the same study hospital. Individuals are then described using the dichotomy of repeaters vs. non-repeaters and analyzed using logistic regression or survival analysis.[6,50,106,129,130,138] Accordingly, most previous studies have not addressed group differences in the probability of multiple recurrences. This approach may obscure important clinical and cost differences; for example, a trial of an intervention aimed at reducing deliberate self-poisoning repetition found that, after 2-years, while there was no effect on the proportion of repeaters (21.2% in intervention group vs. 22.8% in control group), when considering the *number* of repeat presentations, the intervention halved the rate of repetition (rate ratio = 0.49).[139] Repeat self-harm presentations, as an outcome, are not well suited for typical count models (Poisson or negative binomial regression) because of "excess zeros" (e.g., the 84% of the sample that will not repeat within 1 year). Excess zeros is a source of overdispersion, where the observed variance exceeds that expected under the models' distributional assumptions.[140] To date, three alternative statistical methods have been used to analyze multiple self-harm repetition. Haw et al,[141] using monitoring data

from an Oxford, UK hospital, analyzed repeat self-harm presentations with multinomial logistic regression to determine factors associated with infrequent (one to three repeat events) or frequent (four or more repeat events) repetition. Others[142,143] have used multiple event survival analysis. Hurdle models have also been suggested as an appropriate and useful statistical model for analyzing self-harm repetition[144] (see Appendix B for further discussion on the utility of hurdle models for studying repeat self-harm).

2.5 Canadian Context: Gaps and Opportunities

Although suicide is a leading cause of death in young Canadians, and self-harm is a major risk factor for it, there are very few Canadian studies of self-harm in youth.[145] The Statistics Canada Canadian Community Health Survey 1.2: Mental Health and Well-Being (CCHS 1.2) provided nationally representative data about suicide attempts, but was not specific to youth.[45] And although there have been some Canadian studies of self-harm using health services data,[118,119,146-152] few were restricted to youth[135,149] or stratified by age group.[118]

Following the framework of the "Population Health Approach", to which establishing, measuring and analyzing population health status (and inequities) is key,[153] Canadian research on both the prevalence and correlates of self-harm is needed in order for action to address this public health issue. For example, unlike many other countries (including Australia, Denmark, England, Estonia, Finland, Germany, Greenland, Japan, Ireland, Northern Ireland, the Netherlands, New Zealand, Norway, Scotland, Sri Lanka, Sweden, the United States and Wales), Canada has yet to implement a national suicide prevention strategy.[154] Similarly, unlike the UK, Australia and New Zealand, Canada does not have nationally-endorsed clinical guidelines in the area of self-harm. Also, unlike the UK, Canada does not have a dedicated self-harm monitoring system (but very recently began reporting national data on inpatient admissions for self-harm).[46]

New, current Canadian data describing self-harm and its' demographic patterns would highlight this public health issue and in turn help to provide the impetus to develop and implement policies and resources. To this end, the Province of Ontario has advantages, both nationally and internationally, in its ability to conduct population-based studies of self-harm. Existing health services databases can be used, at low cost relative to specialized self-harm monitoring systems (such as those set up in England,[122] Ireland,[50] and across Europe[6]), to establish large cohorts with the ability to address important research questions. Unique aspects of the data include:

- Population coverage: With a 2006 census estimate of over 12 million, Ontario is Canada's largest provincial population. All acute and primary medical care is universally insured, so there is near complete coverage of the population in administrative data. Self-harm studies will accrue a large, population-based sample with enough heterogeneity to ascertain regional/residential effects.

- Emergency department coverage: All facilities in Ontario are mandated to submit emergency department abstracts to the National Ambulatory Care Reporting System (NACRS) and complete data for all emergency department presentations are available from 2002/03. Accordingly, self-harm repetition studies using Ontario NACRS data will identify repeat presentation(s) to any Ontario hospital, whether that is to the same hospital or another.

- Individual-level linkage: Ontario's administrative data cover health services including inpatient admissions, emergency department presentations, and physician visits. Each of these data contain an anonymous identifier, so that these records can be linked to an individual over time. As such, unlike most previous self-harm studies, patterns of health services received prior to or following the presentation can be well-described and analyzed in relation to further self-harm events.

2.6 Summary

Self-harm is a major risk factor for suicide, which is the second leading cause of mortality in 15-24 year-olds (both worldwide and in Canada). Self-harm among youth is also a public health issue in its own right: it is common (roughly one in 20 high school students report an episode of self-harm in the previous year) and the frequency peaks in the late teens. Self-harm in youth is associated with health and psychosocial problems for the individual and those who care for them.

Although there is some evidence of promising suicide prevention strategies – namely, educating physicians about detecting and treating depression and restricting access to lethal means – much more suicide and self-harm prevention research is needed. Prevention discourse has also included some "high risk" approaches, such as improving care for those who present to hospital for self-harm (a population in which suicide risk is elevated and mental disorder is common). Both methodological and substantive considerations have meant intervention studies in this population have typically focused on repeat self-harm as the outcome of interest. Although results of such studies have not provided compelling evidence, in part because of methodological weaknesses in the studies themselves, clinical guidelines identify the importance of follow-up after a hospital presentation for

self-harm. In fact, a 2011 report commissioned by the US Suicide Prevention Resource Center in collaboration with SAMHSA described continuity of care as "an underutilized suicide prevention strategy". Yet, it is unclear who is receiving this follow-up and from which providers, as well as the effect it may have on repeat self-harm presentations. This is particularly true for youth making their first-ever presentation for self-harm. Understanding the effect of mental health follow-up on repeat self-harm would not only have implications for clinical care, but also for policy and planning by contributing to the development of quality indicators for mental health and pediatric emergency care.

There are two major data sources for studying self-harm: survey and health service data. Survey data are vital for estimating prevalence and correlates of self-harm (since most who self harm will not present to hospital). However, such surveys require large samples to study health service use related to self-harm. Health service data, and in particular those describing emergency department presentations, are also a prominent source of information for self-harm research and reporting. These data also appear to capture the more suicidal subset of those who self-harm.

There are relatively few Canadian studies of self-harm, even those providing descriptive data, identifying patterns and correlates of self-harm in youth. This may explain, in part, why self-harm has received less attention for public health action as it has in other countries. For example, Canada does not have a national suicide prevention strategy, nationally-endorsed clinical guidelines for self-harm, or a self-harm monitoring system, all of which have been implemented in England. New Canadian data are needed to highlight this important public health issue. To this end, Ontario has excellent existing research data and infrastructure to study emergency department presentations for self-harm. The current study was designed to not only address important substantive gaps in the literature but also to exploit the strengths of existing data in addressing these gaps.

3. Methods

3.1 Research Design

This retrospective cohort was assembled from a population-based sample of 12-17 year-olds presenting to emergency departments in the Province of Ontario, Canada.

3.2 Sampling Procedures

3.2.1 Data Sources

This study made use of existing Ontario heath services administrative data, accessed through the Institute for Clinical Evaluative Sciences (ICES). Health services data and complementary data sources (described in Tables 1 and 2) were used to provide descriptive information on youth emergency department presentations for self-harm, and then to create an inception cohort of those making their first-ever self-harm presentation. New and existing definitions and methods were used to define the target population and assess outcomes.

3.2.2 Subject Selection

Subjects were selected by identifying all 2,454,957 emergency department presentations by 12-17 year-olds over the seven-year period between April 1, 2002 and March 31, 2009. Presentations were defined from National Ambulatory Care Reporting System (NACRS) records using registration date and age information, and where the records indicated the encounter took place in the emergency department or urgent care centre of an Ontario hospital. Records identified as duplicates and those without valid Ontario health insurance numbers were ineligible. From this population, three datasets were created as depicted in Figure 2 and described below:

1) All emergency department presentations: this dataset included all emergency department presentations (as specified above) excluding deaths on arrival or in the emergency department (n=406); scheduled visits[b] (n=14,443); and those where the individual left without being seen (n=169). The "All emergency department presentations" sample consisted of 2,439,939 emergency department presentations by 910,756 individuals.

---

[b] In some (often rural) facilities, clinics or day surgeries are unavailable so the emergency department is used for prescheduled appointments.[155] As the scheduled visit indicator was not available for every NACRS record, scheduled visits were identified either with this indicator or as records where the CTAS category value is missing. CTAS category is mandatory for emergency departments, but every emergency department presentation identified with the scheduled visit indicator was missing CTAS (compared to 0.04% of those not flagged with the indicator), missing CTAS data was deemed to be a good proxy for the scheduled visit indicator.

2) All self-harm presentations: this dataset was a subset of the previous "All emergency department presentations" dataset. More specifically, emergency department presentations identified as being for self-harm were selected, i.e., those where the main problem (that which was deemed by the provider at the end of the visit to be the clinically significant reason for the individual's visit, and which required evaluation and/or treatment or management) or other problem(s) (those which coexist at the time of the individual's visit and which influenced the client's need for treatment or care, excluding those that were previously treated and no longer existed) indicated self-harm. Two alternative definitions of self-harm were used to accommodate potential under-identified cases of self-harm:[150]

- SH1: any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84).

- SH2: as above, as well as any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).[c]

The "All self-harm presentations" sample consisted of 16,835 presentations by 12,907 individuals under SH1 and 22,589 presentations by 17,557 individuals under SH2.

3) Inception self-harm: this dataset included only individual's first-ever emergency department presentations for self-harm, created as a subset of the previous "All self-harm presentations" dataset by excluding individuals who met one or more of the following criteria:

a) Individual's 12th birthday was prior to April 1, 2002: this exclusion criterion was applied to ensure that, as closely as possible, cohort member's emergency department use from the age of 12 years was ascertained. Since hospital presentations for self-harm are very rare before the age of 12 years,[18,137] each cohort member's first self-harm presentation could be described as their "first-ever", thereby creating an inception cohort.

b) Less than one year of follow-up data (after the index event): this criterion was met when the individual died within one year of their index event (these individuals were described separately, see Appendix D, note: those who died on arrival or in the emergency department at the time of their index event were excluded in earlier "All emergency

---

[c] The "intentional self-harm" and "undetermined" codes represent a subset of "external cause of morbidity and mortality" ICD codes. External cause codes specify the nature of an injury or poisoning (typically as accidental, assault, self-harm or undetermined) and are mandatory when a record lists an ICD diagnosis code of "Injury, poisoning and certain other consequences of external causes" (ICD-10: S00-T98).[155]

department presentations" data steps) or the index event was on or after April 1, 2007. As such, given the province-wide coverage of the data, loss to follow-up was considered negligible and each cohort member had one year of follow-up data.

c) History of self-harm (prior to the index event): this was ascertained as either as an emergency department presentation (NACRS record) or an inpatient admission (Discharge Abstract Database [DAD] record) that indicated self-inflicted (ICD-9: E950-9 or ICD-10: X60-84, as applicable) or undetermined injury or poisoning (ICD-9: E980-9 or ICD-10: Y10-34, as applicable).[d]

The "Inception self-harm" dataset consisted of 3,497 individuals under SH1 and 4,932 individuals under SH2.

3.3 Measures

3.3.1 Variable Definitions

The following section lists and describes the variables defined for each dataset. The roles of the variables in the analyses (i.e., as exposure, outcome or covariate) differ according to objective and are outlined in Table 3.

Variables were defined according to information available from each of the datasets (as listed in Figure 3). Sex, age, community size, neighbourhood income quintile, Canadian Triage and Acuity Scale (CTAS) category, disposition, alcohol involvement and hospital type variables were defined for all emergency department presentations and these variables were contained in each of the three datasets. Variables for self-harm method and coding of intent were defined for the "All self-harm presentations" dataset. The additional variables defined specifically for the "Inception self-harm" cohort were 1-year health service use history, inpatient psychiatry, 30-day mental health follow-up and 1-year repeat self-harm presentation(s), as depicted in Figure 4.

Individual-level demographic

---

[d] Data on inpatient admissions to general hospitals *in Ontario* were available for every cohort member from birth. However, Ontario introduced NACRS emergency department data in 2001/02. As such, those cohort members who had their index event in 2002/03 could have as little as 1-year look back data (and those who had their index event in 2007/08 had from 6 to 7 years). However, due to the sampling method, very few [SH1: 33 (0.9%)/SH2 64 (1.3%)] individuals entered the cohort in 2002/03, and so there was minimal concern about inadequate look back data. Further, given self-harm presentations are rare before age 12, at least one year of look back data was considered adequate.

- Sex: listed on NACRS record as girl (female), boy (male) or other (transsexual or hermaphrodite).

- Age: listed on NACRS record in integer years and categorized as 12-15 or 16-17 years (i.e., child or adolescent, as defined by the Ontario Health Insurance Plan [OHIP]).[156]

- Community size: using the individual's residential postal code and the Statistics Canada Postal Code Conversion File (PCCF),[157] individuals were assigned to their dissemination area: a small, relatively stable geographic unit composed of one or more blocks and the smallest standard geographic area for which census data are produced.[158] The population, in 2006, of the community in which the individual resided was then assigned and categorized as: 1,500,000+ (Toronto); 500,000-1,499,999; 100,000-499,999; 10,000-99,999; <10,000 or missing. "Rural" residence was defined according to Statistics Canada's recommended definition of rural and small town, i.e., population <10,000.[159]

- Neighbourhood income quintile: as with community size, postal code information and the PCCF were used to define the income quintile of the area, in 2006, relative to the community in which the individual resided: 5 (highest) to 1 (lowest) or missing.[157] For this measure, mean income per person equivalent (household income, adjusted for household size) was calculated for each dissemination area (described above). Then, dissemination areas were ranked according to this measure by city, town or rural/small town area in which the dissemination area was located. Next, the population of the city, town or rural/small town area was divided into approximate fifths to create community-specific income quintiles.

Individual-level clinical

- CTAS category: listed on the NACRS record, the CTAS category is assigned to patients on arrival to the emergency department (or shortly thereafter) to prioritize their care requirements and also to provide information back to planners about patient care, workload, and resource requirements.[160] Categories, from highest to lowest acuity, are: 1: resuscitation; 2: emergent; 3: urgent; 4: semi-urgent; or 5: non-urgent. CTAS category has been found to have high inter-observer agreement.[161,162]

- Alcohol involvement: using diagnosis codes listed on the NACRS record and categorized as:

- o Yes: record lists any of codes for mental and behavioural disorders due to use of alcohol (ICD-10: F10); finding of alcohol in blood (ICD-10: R78.0); toxic effect of alcohol (ICD-10: T51); evidence of alcohol involvement determined by blood alcohol level (ICD-10: Y90); evidence of alcohol involvement determined by level of intoxication (ICD-10: Y91); intentional self-poisoning by and exposure to alcohol (ICD-10: X65); poisoning by and exposure to alcohol, undetermined intent (ICD-10: Y15); or, accidental poisoning by and exposure to alcohol (ICD-10: X45); or,

  - o No.

- Disposition: Using disposition information listed on the NACRS record and linked to inpatient (Discharge Abstract Database [DAD] or Ontario Mental Health Reporting System [OMHRS] records, as applicable), categorized hierarchically as:

  - o Admitted: the NACRS record was matched to a DAD or OMHRS record.

  - o Transferred: the NACRS record was coded as transfer. Note: for the inception cohort, individuals identified as being transferred to another emergency department at the time of their index event were matched to these subsequent records and, using the information on this next record, characterized according to this disposition status.

  - o Left before visit completed: the NACRS record was coded as left without treatment, or against medical advice.

  - o Discharged: the record was not identified as any of the four categories above.

- Method of self-harm: using external cause of injury codes listed on NACRS record and categorized as:[143]

  - o Self-poisoning only: record was coded as intentional self-poisoning (ICD-10: X60-69), and/or poisoning, undetermined intent (ICD-10: Y10-19) under SH2; or,

  - o Self-cutting only: record was coded as intentional self-harm by sharp object (ICD-10: X78), and/or contact with sharp object, undetermined intent (ICD-10: Y28) under SH2; or,

  - o Other only: record was coded as intentional self-harm (ICD-10: X70-77; X79-84); or,

o   Multiple: more than one of the above methods listed.

Specific methods of self-poisoning were also described as medicinal (ICD-10: X60-64/Y10-14) or non-medicinal (ICD-10: X65-69/Y15-19), and, using external cause of injury and diagnostic codes, categorized as: non-opioid analgesics, antipyretics and antirheumatics (ICD-10: T39 or X60/Y10); antiepileptic, sedative-hypnotic, antiparkinsonsim and psychotropic drugs (ICD-10: T42, T43 or X61/Y11); other single agent; and, multiple agents. Also, where included, diagnosis codes were used to describe the frequency of the most common self-poisoning agents in youth: 4-Aminophenol derivatives (including acetaminophen/paracetamol) (ICD-10: T39.1), and antidepressants (excluding tricyclic, tetracylic or monoamine-oxidase-inhibitor antidepressants) (ICD-10: T43.2).[118]

As well as the categories above, method of self-harm was described as:

o   Includes self-cutting: record was coded, alone or in combination, as intentional self-harm by sharp object (ICD-10: X78), and/or contact with sharp object, undetermined intent (ICD-10: Y28) under SH2; or,

o   No self-cutting.

▪   Coding of intent: applicable only under SH2, using external cause of injury codes listed on the NACRS record and categorized hierarchically as:

o   Self-harm: record was coded with intentional self-harm (ICD-10: X60-84); or,

o   Undetermined.

Individual-level health service use

▪   1-year health service use history: individuals were linked to their health service records in the 1-year prior to their index event to ascertain:

o   Inpatient admissions: using DAD and OMHRS data, each individual's inpatient admission history was categorized hierarchically as: includes mental health (one or more OMHRS admissions or DAD admissions with a most responsible diagnosis indicating mental/behavioural disorder [ICD-9: 290-319 or ICD-10: F00-99, as

applicable] or the most responsible physician was a psychiatrist);[118,119] other only (admission(s) did not meet previous definition); or, none.

- o Emergency department presentations: using NACRS data, each individual's emergency department usage history was categorized hierarchically as: includes mental health (one or more presentations with a most responsible diagnosis indicating mental/behavioural disorder [ICD-9: 290-319 or ICD-10: F00-99, as applicable]); other only (presentation(s) did not meet previous definition); or, none. (See Section 3.2.2 for note on adequacy of look back data).

- o In hospital mental health service use: a composite of the two variables above (inpatient admissions and emergency department presentations) was also created to describe each individual's mental health service use in hospital in the previous year. Categories were defined hierarchically as: includes inpatient admission(s); emergency department presentation(s) only; or, none.

- o Ambulatory mental health service use (with a physician): using OHIP, the physician services each individual received were categorized hierarchically as: includes psychiatrist (one or more OHIP records where the physician specialty was psychiatry); other specialty only (one or more OHIP records where the physician specialty was not psychiatry, but the diagnosis code was mental (see Appendix E));[163,164] or, none.

- ▪ Inpatient psychiatry: individuals admitted to hospital in relation to their index event (as per disposition variable above) were linked to their CIHI, OMHRS and OHIP records to ascertain their psychiatry contact during the admission period:

  - o Yes: those admitted at their index event and where the NACRS record from the index event could be linked to one or more of : 1) an OMHRS admission record; 2) a DAD record where the most responsible service was psychiatry or child psychiatry; or, 3) one or more OHIP records during the inpatient admission period where the physician specialty was a psychiatry.

  - o No: those admitted at their index event, but who did not meet criteria for previous category; or,

- o Not admitted (not applicable).

- ▪ 30-day mental health follow-up:[41,91,92,95] the ambulatory mental health services received *from a physician* within 30 days of the individual's index event discharge date (i.e., as of emergency department or inpatient discharge date, as applicable) were defined using OHIP data and categorized hierarchically according to physician specialty (as described for "ambulatory mental health contacts" variable above):

  - o Psychiatrist; or,

  - o Other specialty only; or,

  - o None.

- ▪ 1-year repeat self-harm presentation(s): any subsequent emergency department presentation for self-harm (as previously defined), within 1 year of the index event, was counted as a repetition. A variable of the count of such repetitions was created for each inception cohort member. Follow-up began either from the date of emergency department discharge or inpatient discharge, as applicable. An alternate version of this variable was also created specifically for objective 4. Here, repeat presentations within 30 days of the index event were not included in the count (as this was the period of interest for defining the exposure).

Hospital-level

- ▪ Hospital type: the institution at which the individual presented was categorized as: teaching (belonging to the Council of Academic Hospitals of Ontario, including specialty pediatric hospitals); small (generally admit fewer than 3,500 weighted cases, have a referral population of fewer than 20,000 people and are the only hospital in their community); or, community (acute care hospital that does not fit previous definitions).[165] Nearly all teaching and pediatric hospitals are Schedule 1 psychiatric facilities, as designated under Ontario's mental health act.[166] Schedule 1 hospitals are required to deliver specific mental health services (i.e., inpatient, outpatient, day care, emergency, consultative and educational).[167]

Those records with missing data for any of the above variables were described as such.

3.4 Statistical Analysis

3.4.1 Analytic Methods

All analyses were carried out with SAS, version 9.1.[168] Descriptive statistics for each of the three datasets ("all emergency department presentations", "all self-harm presentations" and "inception self-harm") were cross-tabulated as frequencies and proportions.

Objective 1 – Emergency department presentations for self-harm

First, incidence rates were calculated, overall and according to individual-level demographic characteristics. The numerators were the number of self-harm presentations (i.e., from the "All self-harm presentations" dataset), where multiple events by the same person were all included.[e] The denominators were the amount of person years, calculated by summing the annual population estimates (using census for age and sex specific estimates or the Registered Persons Database [RPDB] for community size and neighbourhood income quintile specific estimates). The rates were expressed per 100,000 person years, with 95% confidence intervals calculated to account for clustering from multiple events per person.[171]

Second, self-harm as a proportion of all emergency department presentations was calculated, overall and according to individual-level demographic and clinical characteristics. The numerators were the number of self-harm presentations (i.e., from the "All self-harm presentations" dataset) and the denominators were the number of emergency department presentations by the eligible population (i.e., from the "All emergency department presentations" dataset).

Objective 2 – Mental health follow-up after first-ever emergency department presentation for self-harm

Cross-tabulations of exposure variables (individual-level demographic and clinical characteristics) with outcome (30-day mental health follow-up) were created for the "Inception self-harm" cohort. Logistic regression analyses were also carried out with two separate outcomes and models:

---

[e] Incidence rates can be calculated either with or without recurrent events in the same person.[169] Cummings, Koepsell and Mueller have described this possibility of multiple events per person as a situation of "multiplicity" and a methodological challenge for injury research; with multiple events per person, the assumption of statistically independent events may be incorrect (thus requiring analyses to account for the clustering)[170] and individuals continue to contribute person-time to the denominator even after an event (as they remain at risk for a recurrent event).[169]

1) 30-day mental health follow-up with a psychiatrist (vs. follow-up with other specialty only or none)

2) 30-day mental health follow-up with a psychiatrist or other specialty (vs. none). This second outcome was to ascertain whether any differences in receiving follow-up from a psychiatrist (i.e., statistically significant associations with the first outcome) were explained by seeking care from another physician specialty (i.e., associations no longer statistically significant with the second outcome).

These two bivariate models included random effects for the hospital at which the index presentation took place (i.e., to account for hospital-level differences in management of self-harm). Associations were expressed with odds ratios and 95% confidence intervals. Note, hierarchical linear modeling (HLM) was considered for this analysis, but given that only individual-level characteristics were being assessed, a random effects model was considered appropriate.[172] Hospital-level effects, and HLM, are discussed later as an area for further research (see Section 6.3.4).

Objectives 3&4 – Repetition and association between mental health follow-up after first-ever emergency department presentation for self-harm and repeat self-harm presentation(s)

Hurdle models[173] (see Section 2.4.4) were used to study factors associated with repeat self-harm presentation(s) and the association between 30-day mental health follow-and such repetition in the "Inception self-harm" cohort. The hurdle models combined a binary (logit) model with a zero-truncated count (negative binomial) model. The first part of the model tested factors associated with any repetition (repeaters vs. non-repeaters) and the second part tested factors associated with the number of repeat presentations (only among repeaters). Associations were expressed with odds ratios and incidence rate ratios, with 95% confidence intervals. Note, random effects models were considered for this analysis (to account for hospital-level clustering), but the number of "repeaters" per institution was low (among institutions with repeaters, median number was SH1: 2 / SH2: 3).

3.4.2 Modeling Strategy

Objectives 1 to 3 were descriptive (and in some cases exploratory) analyses. That is to say, the results provided a description of child and adolescent emergency department presentations for self-harm and mental health follow-up and repetition among those making their first-ever emergency department presentation for self-harm, but did not test specific causal hypotheses.

Objective 4, however, did evaluate a pre-defined relationship of interest. Accordingly, given the observational data, multivariable analysis was used to attempt to account for baseline differences in the exposure groups. That is, prior to initiating the study, it was acknowledged that there may be differences between the exposure groups beyond the health services they receive within 30-days of a first-ever emergency department presentation for self-harm. For example, confounding[f] by indication[175] or confounding by severity[176] may bias results; individuals at greater risk of repeat self-harm presentations may also be more likely to be referred to specialist clinicians.[64] Hence, in unadjusted analysis, it would have appeared that follow-up increased repeat self-harm presentation(s). Conversely, when Kapur et al found a protective effect for referral to specialist follow-up, they noted bias may have been in the opposite direction; that is, more difficult individuals (presumably also more likely to repeat) were referred less often.[106] Bias in this direction seems less likely in the current inception cohort.

Covariates were selected for the model based on a strategy described by Vittinghoff[177] and summarized here. First, the goal of the analysis was defined: to evaluate the association between the exposure of interest (mental health follow-up) and an outcome (repeat self-harm presentation(s)). As such, the rationale for a multivariable model was to obtain the best estimate of the association of interest while minimizing bias due to confounding and also maximizing precision. Second, a diagram of the proposed relationships was created in order to clarify and describe the hypothesized interrelationships between the exposure of interest, covariates and outcome (see Figure 1). The covariates were chosen based on evidence from previous studies that they may act as confounders. That is, they may be associated with both the outcome and the exposure (evidence is summarized in Appendix A), but given the temporal relationship between the exposure and covariates (i.e., the covariates always preceded mental health follow-up), they were not mediators of the association between the exposure and the outcome. The diagram was further interpreted in context with the results obtained from objectives 2 and 3. However, this is not to state that covariates were chosen based on bivariate screening (or the final model was changed). Such a method of selecting covariates has been criticized for inappropriately excluding important variables, for example, when the association between that variable and the outcome is confounded by another variable.[178] Finally, the multivariable model was created. Given the large sample size and for face validity, no covariates were eliminated (including on statistical grounds). However, the standard errors of the effect

---

[f] A confounder, as defined in Szklo and Nieto,[174] can distort the association between an exposure and outcome and meets all of the following criteria: 1) is causally associated with the outcome; 2) is (causally or non-causally) associated with the exposure; and 3) is not an intermediate variable on the causal pathway between the exposure and outcome.

estimates for the exposure were compared between unadjusted and adjusted models in order to provide some assurance of precision (i.e., variable selection or elimination was unnecessary).

3.4.3 Sample Size and Power

The sample size was fixed. That is, it consisted of the entire eligible population of Ontario. Prior to initiating the study, previous year's data were used to estimate the sample size and statistical power for objective 4. These calculations were reviewed and approved at the thesis protocol presentation. For example, testing the association between mental health follow-up and repetition, with a logistic regression (sample n=2,000, exposure prevalence=50%, α=0.05, baseline repetition=10%, covariate R^2=0.30 and two-sided tests) power=0.99 to detect an odds ratio of 2 and power=0.69 to detect an odds ratio of 1.5. With a Poisson regression, testing the association between mental health follow-up and number of repeat presentations, (sample n=400, exposure prevalence=50%, α=0.05, baseline repetition=1.5, covariate R^2=0.30 and two-sided tests) power=1.00 to detect a rate ratio of 2 and power=0.99 to detect a rate ratio of 1.5. Final sample sizes exceeded those estimated in the study protocol because an additional year of data was made available.

3.5 Ethical and Privacy Reviews

The St. Michael's Hospital (SMH) Research Ethics Board (REB) approved this research. As the research constituted student work, the principal investigator was listed as the student's supervisor at SMH (Dr. Anne Rhodes) and the student was listed as a co-principal investigator. A University of Toronto REB administrative review was also completed. Finally, an Institute for Clinical Evaluative Sciences (ICES) Privacy Impact Assessment was also carried out to ensure the research met with ICES standards as well as provided the legally-required documentation under Ontario's Personal Health Information Protection Act (PHIPA).

Table 1: Health Services Administrative Data Used to Describe and Analyze Emergency Department Presentations by 12-17 Year-olds in the Province of Ontario Between April 1, 2002 and March 31, 2009

Data Source	Description	International Classification of Disease (ICD) Coding	Data Collection Agency	Data Validity
Discharge Abstract Database (DAD)	Records represent inpatient hospitalizations. All hospitals in Ontario are required to submit demographic and clinical information about all hospital admissions and discharges, including transfers and deaths.	From 2002/03, ICD-10-CA (an enhanced version of ICD-10 developed by the Canadian Institute for Health Information [CIHI]) Prior to 2002/03, ICD-9-CM.	CIHI	A reabstraction study of 14,500 charts, carried out from 2002/03 to 2003/04 in 18 Ontario hospital sites, found overall median (and interquartile ranges) for the top 50 most responsible diagnoses were: kappa 0.81 (0.70 to 0.87), sensitivity 0.82 (0.71 to 0.89), and positive predictive value 0.82 (0.74 to 0.89). The values (with 95% confidence intervals) for depressive episode were 0.80 (0.74 to 0.87), 0.84 (0.74 to 0.92) and 0.77 (0.67 to 0.86, respectively.[179]
National Ambulatory Care Reporting System (NACRS)	Records represent visits to hospital and community based ambulatory care, including emergency departments. As of April 1, 2002 all hospitals in Ontario have been submitting demographic and clinical information about emergency department presentations.	From 2002/03, ICD-10-CA Prior to 2002/03, ICD-9-CM.	CIHI	A reabstraction study of 7,500 charts, carried out in 2004/05 in 15 Ontario emergency departments found very high agreement for demographic data but under-reporting of problems (e.g., patients who presented with multiple conditions or problems where only one problem was reported to the NACRS). Agreement for coding of the main problem was 68.8%.[180]
Ontario Health Insurance Program (OHIP)	Records represent physicians' services insured by the Ontario Ministry of Health and Long-Term Care (MOHLTC). These services include: physician consults or assessments in	Based on 3-digit ICD-9 codes, with variants	MOHLTC	A reabstraction study of 952 (adult) charts, carried out between 1999 and 2000 in 5 academic family practice clinics in Toronto, Ontario found administrative measures of mental health have excellent specificity and adequate sensitivity for

	private offices, acute care, and long-term care facilities; technical and professional components of diagnostic and therapeutic procedures; surgical procedures; and laboratory services. These data only capture information for those physicians who work on a fee-for-service basis and not those reimbursed by Alternate Funding Plans or salary.			studying mental health service use in primary care.[164] No similar data validity studies of pediatric populations could be located.
Ontario Mental Health Reporting System (OMHRS)	Records represent all inpatient hospitalizations (to adult mental health beds) as of October 1, 2005. This includes beds in General, Provincial Psychiatric, and Specialty Psychiatric facilities.	n/a	CIHI	No data validity studies located.

Table 2: Complementary Data Used to Describe and Analyze Emergency Department Presentations by 12-17 Year-olds in the Province of Ontario Between April 1, 2002 and March 31, 2009

Data Source	Description	Data Collection Agency
Institute for Clinical Evaluative Sciences (ICES) Physician Database (IPDB)	Records provide information about physician demographics, specialty training and certification and practice location. This information is validated against the Ontario Physician Human Resource Data Centre (OPHRDC) database, which verifies this information through periodic telephone interviews with all physicians practicing in Ontario.	ICES, using data from the OHIP Corporate Provider Database (CPDB), OPHRDC database and OHIP physician billings
Census	Data provide Ontario population estimates, overall and by age and sex, collected in the 2001[181] and 2006[182] censuses, with intercensal estimates available for non-census years.	Statistics Canada
Registered Persons Database	Data are used to provide Ontario population estimates from an historical population-based register of unique health numbers issued to each person eligible for Ontario health services. Among youth, the difference between census and RPDB population estimates is <5%.[183]	MOHLTC

Table 3: Roles of Measures Used in Each of the Four Study Objectives

Outcome	Exposure	Covariates
Objective 1 – Emergency department presentations for self-harm		
Incidence rate of hospital presentation for self-harm	Individual-level demographic: sex; age; community size; and, neighbourhood income quintile	n/a
Self-harm as a proportion of all emergency department presentations	Individual-level demographic: sex; age; community size; and, neighbourhood income quintile Individual-level clinical: Canadian Triage and Acuity Scale (CTAS); alcohol involvement; and disposition	n/a
Objective 2 – Mental health follow-up after first-ever emergency department presentation for self-harm		
30-day mental health follow-up	Individual-level demographic: sex; age; community size; and, neighbourhood income quintile Individual-level clinical: CTAS; alcohol involvement; method of self-harm; and, coding of intent Individual-level health service use: mental health service use history (in-hospital and ambulatory); and, inpatient psychiatry	n/a
Objective 3 – Repetition after first-ever emergency department presentation for self-harm		
1-year repeat self-harm presentation(s)	Individual-level demographic: sex; age; community size; and, neighbourhood income quintile Individual-level clinical: CTAS; alcohol involvement; method of self-harm; and, coding of intent Individual-level health service use: mental health service use history (in-hospital and ambulatory); and, inpatient psychiatry	n/a
Objective 4 – Association between mental health follow-up after first-ever emergency department presentation for self-harm and repeat self-harm presentation(s)		
1-year repeat self-harm presentation(s), excluding repetition within first 30 days	Individual-level health service use: 30-day mental health follow-up	Individual-level demographic: sex; age; community size; and, neighbourhood income quintile Individual-level clinical: CTAS; alcohol involvement; method of self-harm; and, coding of intent Individual-level health service use: mental health service use history (in-hospital and ambulatory); and, inpatient psychiatry

Figure 1: Diagram of Proposed Relationships (for Objective 4)
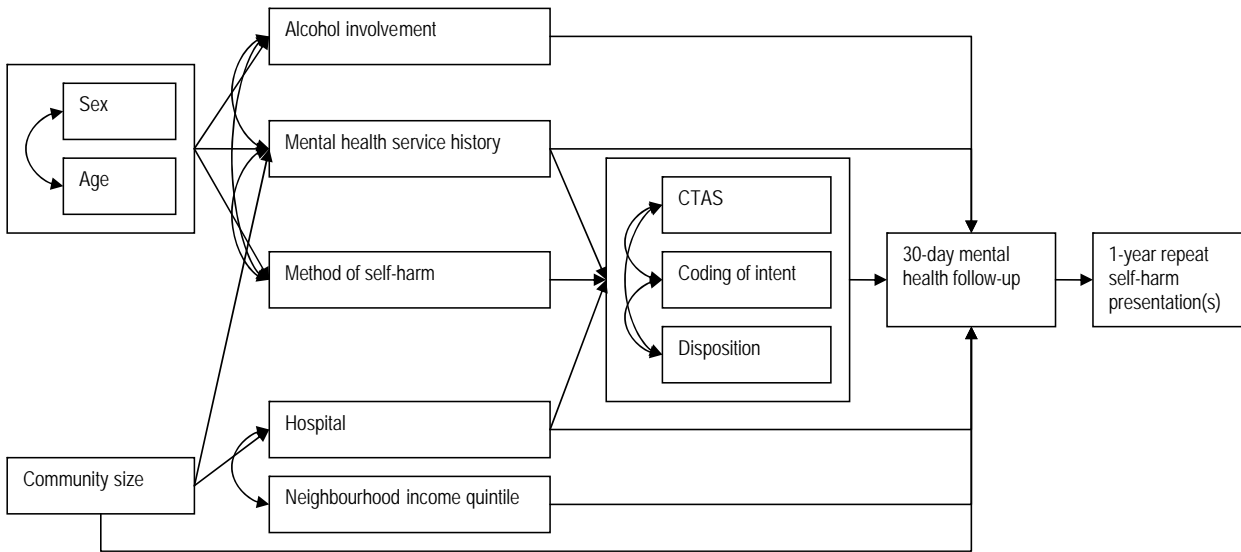
CTAS: Canadian Triage and Acuity Scale
Note: variables presented as potential antecedents of follow-up may also be associated with repetition (see Table 3).

Figure 2: Flow of Data in Creating Each of the Three Study Datasets

```
┌─────────────────────────────────────────────────────────┐
│  All emergency department presentations by 12-17 year-olds│
│       in Ontario between April 1, 2002 and March 31, 2009 │
│  n = 2,454,957 presentations by 911,765 individuals       │
└─────────────────────────────────────────────────────────┘
```

All emergency department presentations 2,439,939 presentations by 910,756 individuals	Excluded (presentations): ▪ Deaths, on arrival or in ED (n=406) ▪ Scheduled visits (n=14,443) ▪ Left without being seen (n=169)

All self-harm presentations SH1: n=16,835 presentations by 12,907 individuals SH2: n=22,589 presentations by 17,557 individuals	Excluded (presentations): ▪ Non-self-harm (SH1 n=2,423,104; SH2 n= 2,417,350)

Inception self-harm SH1: n=3,497 individuals SH2: n=4,932 individuals	Excluded (individuals): ▪ 12th birthday prior to April 1, 2002 (SH1 n=7,822; SH2 n= 10,563) ▪ Less than 1 year of follow-up* (SH1 n=1,441; SH2 n=1,979) ▪ History of self-harm* (SH1 n=147; SH2 n=83) * relative to index event

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Figure 3: Variables Defined for the Three Study Datasets

All emergency department presentations **All self-harm presentations** **Inception self-harm**	*Individual-level demographic:* - sex - age - community size - neighbourhood income quintile *Individual-level clinical:* - Canadian Triage and Acuity Scale - alcohol involvement - disposition *Hospital-level:* - hospital type
	All of the above, plus *Individual-level clinical:* - method of self-harm - coding of intent
	All of the above, plus *Individual-level health service use:* - 1-year health service use history - inpatient psychiatry - 30-day mental health follow-up - 1-year repeat self-harm presentation(s)

D a t a s e t   V a r i a b l e s

Figure 4: Timeline Depicting Individual-level Health Service Use Variables Defined for the Inception Self-harm Cohort

Index event

1-year repeat self-harm presentation(s)

Objective 3

Objective 4

time

1-year health service use history
- Inpatient admissions
- emergency department presentations
- ambulatory mental health contacts (with a physician)

Inpatient psychiatry

30-day mental health follow-up
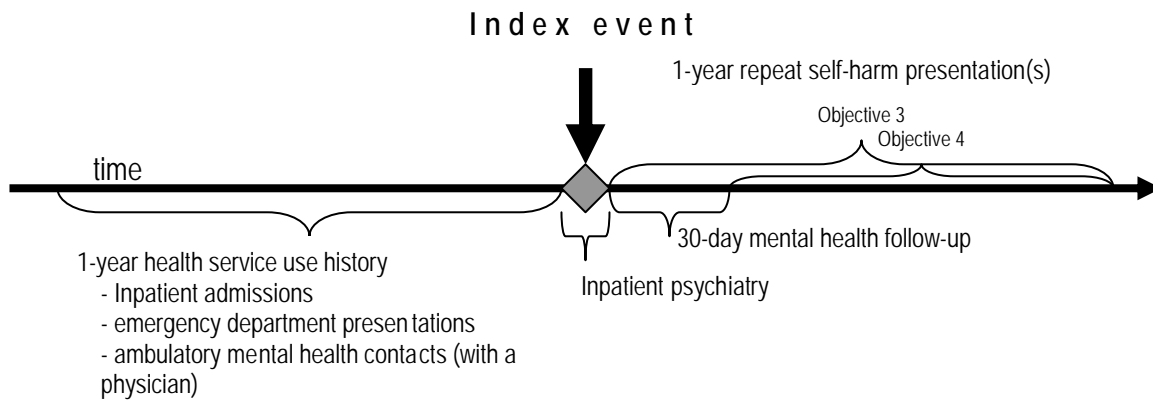
4. Results

4.1 Sample Characteristics

4.1.1 All Emergency Department Presentations

Table 4 presents the characteristics of all emergency department presentations by 12-17 year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009, excluding those that ended in death, scheduled visits and those where the individual left without being seen. Boys accounted for slightly over half (51.6%) of emergency department presentations in this age group and the frequency of emergency department presentations increased by year of age. Those living in communities with populations of less than 10,000 made up the largest proportion of emergency department presentations (26.4%) followed closely by those living in areas with populations of 100,000-499,999 and Toronto (the only city with a population greater than 1.5 million), representing 25.2% and 23.8% of the sample respectively. The frequency of emergency department presentations appeared evenly distributed according to neighbourhood income quintile.

About two thirds (65.3%) of emergency department presentations were triaged as low acuity (semi- or non-urgent) and a small proportion was triaged as resuscitation or emergent (0.2% and 5.4% respectively). Most presentations (99.0%) were not identified as involving alcohol. Most emergency department presentations ended in discharge (90.6%), but 3.9% resulted in inpatient admission, 0.9% in transfer and 4.6% left without treatment or against medical advice. The majority of presentations took place in community hospitals (71.4%), then small (15.1%) and teaching (13.5%) hospitals.

4.1.2 All Self-harm Presentations

Table 5 presents the demographic characteristics of self-harm presentations by 12-17 year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009. Both self-harm definitions (SH1 and SH2) showed girls outnumbered boys about three to one, although boys make up a slightly higher proportion under SH2 (27.9% vs. 23.4% under SH1). Under both definitions, 12-14 year-olds together represented about a quarter of self-harm presentations, whereas 15, 16 and 17 year-olds made up about a quarter of the self-harm presentations each. The number of self-harm presentations was unequally distributed according to community size and neighbourhood income quintile under either definition.

Table 6 shows the clinical characteristics of self-harm presentations by 12-17 year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009. Self-poisoning only was the most common method category, accounting for about two thirds of the sample under either definition. Nearly all self-poisonings involved agents that were medicinal: 10,383 (93.4%) under SH1 and 13,754 (91.1%) under SH2. Of those identified as self-poisoning only, the distribution of the agent categories were as follows: non-opioid analgesics, antipyretics and antirheumatics (SH1: 4,193 [37.7%]/SH2: 5,104 [33.8%]); antiepileptic, sedative-hypnotic, antiparkinsonsim and psychotropic drugs (SH1: 2,459 [22.1%]/SH2: 3,269 [21.7%]); other (SH1: 2,617 [23.6%]/SH2: 4,451 [29.5%]); and, multiple (SH1: 1,844 [16.6%]/SH2: 2,278 [15.1%]). Records with (more-detailed) diagnosis codes (SH1: 10,682/SH2: 14,421) confirmed the most common self-poisoning agents, alone or in combination, were: 4-Aminophenol derivatives (including acetaminophen/paracetamol) (SH1: 3,518 [32.9%]/SH2:4,225 [29.3%]) and antidepressants (excluding tricyclic, tetracylic or monoamine-oxidase-inhibitor antidepressants) (SH1: 1,582 [14.8%]/SH2: 1,865 [12.9%]). The next most common method of self-harm was self-cutting only, which accounted for about a quarter of presentations under (under either definition).

Table 6 also shows the majority of self-harm presentations were triaged as high acuity (resuscitation, emergent or urgent) (SH1: 83.5%/SH2: 80.5%). Fewer than one in 20 presentations were identified as involving alcohol (SH1: 3.8%/SH2: 4.7%). Just under two-thirds were discharged from the emergency department, and one third was admitted under SH1 and slightly less (29.0%) under SH2. Under either definition, about 4% were transferred and 2% left the emergency department without treatment or against medical advice. Most (SH1: 69.8%/SH2: 70.8%) self-harm presentations took place in community hospitals.

4.1.3 Inception Self-harm

The demographic characteristics of the inception cohort, at the index event, are presented in Table 7. Similar to self-harm presentations overall (see Table 5), both definitions show girls outnumbered boys about three to one, although boys make up a slightly higher proportion under SH2 (28.6% vs. 23.2% under SH1). The data on age represent an artifact of the sampling scheme and should not be interpreted as the age at which youth first present to the emergency department for self-harm. The number of self-harm presentations was unequally distributed according to geographic variables (community size and neighbourhood income quintile) under either definition, but the distribution did not differ substantially between SH1 and SH2.

Table 8 presents the clinical characteristics of the inception cohort at the index episode, which reflect similar findings to those for self-harm presentations overall (see Table 6). Self-poisoning only was the most common index presentation, accounting for just under two thirds of the sample under either definition. Nearly all self-poisonings involved agents that were medicinal: 2,092 (93.8%) under SH1 and 2,899 (90.0%) under SH2. Of those identified as self-poisoning only, the agent categories were as follows: non-opioid analgesics, antipyretics and antirheumatics (SH1: 876 [39.3%]/SH2: 1,090 [33.8%]); antiepileptic, sedative-hypnotic, antiparkinsonsim and psychotropic drugs (SH1: 424 [19.0%]/SH2: 592 [18.4%]); other (SH1: 534 [24.0%]/SH2: 1,040 [32.3%]); and, multiple (SH1: 396 [17.8%]/500 [15.5%]). The majority of index presentations were triaged as high acuity (resuscitation, emergent or urgent) (SH1: 82.4%/SH2: 79.5%). About one in 20 index presentations were identified as involving alcohol (SH1: 3.8%/5.1%). One third (32.9%) were admitted under SH1 and slightly less (27.7%) under SH2. Of those that were admitted, about three quarters (SH1: 77.6%/SH2:74.1%) received inpatient psychiatry services. Nearly three-quarters of index presentations (SH1: 72.6%/SH2: 72.7%) took place in community hospitals.

Table 9 provides information on the health service patterns for the inception cohort in the year prior to the index event. About one in eight (SH1: 14.0%/SH2: 12.3%) had an inpatient admission. Of those that had been admitted, about two-thirds (SH1: 69.4%/SH2: 65.6%) had had at least one psychiatric stay and the most common primary diagnoses were: mood (affective) disorders; neurotic, stress-related and somatoform disorders; and, behavioural and emotional disorders with onset usually occurring in childhood and adolescence. Under both SH1 and SH2, about half had visited the emergency department in the year before their first-ever self-harm presentation. Of those that had presented to the emergency department in the previous year, just over a third (SH1: 37.2%/SH2: 34.3%) had a mental health presentation during this time. Similar to inpatient admissions, of all the psychiatric presentations in this group, the most common primary diagnoses were: mood (affective) disorders; neurotic, stress-related and somatoform disorders; and, behavioural and emotional disorders with onset usually occurring in childhood and adolescence, as well as mental and behavioural disorders due to psychoactive substance use. About half of those presenting to hospital for self-harm for the first time had had ambulatory mental health contact with a physician within the previous year (SH1: 50.4%/SH2: 46.3%). Of those individuals who had made such contacts, less than half had had contact with a psychiatrist. Overall, about half (SH1: 46.0%/SH2: 50.2%) of those presenting to hospital for self-harm for the first time had no mental health service contact (hospital or ambulatory only) in the previous year. Of those that had been in contact with mental health

services, more than half (SH1: 60.3%/SH2: 58.4%) had been either admitted to hospital as an inpatient, presented to the emergency department or been seen by a psychiatrist.

4.2 Substantive Objectives

4.2.1 Objective 1

Incidence rates, using population denominators

The overall incidence rate, with 95% confidence interval (CI), of emergency department presentations for self-harm by 12-17 year-olds was 239.0 (95% CI: 233.1, 244.9) per 100,000 person years under SH1 and 320.7 (95% CI: 314.0, 327.4) per 100,000 person years under SH2. SH2 increased the incidence rate estimate by about a third (34.2%). The sex-specific incidence rate estimates under SH1 were 375.7 (95% CI: 364.4,387.0) per 100,000 person years for girls and 109.2 (95% CI: 105.1,113.2) per 100,000 person years for boys. The corresponding rates under SH2 were 474.5 (95% CI: 461.8,487.3) per 100,00 person years for girls and 174.6 (95% CI: 169.5,179.7)) per 100,000 person years for boys, which represented proportional increases of 26.3% and 60.0% respectively.

Figure 5 depicts the incidence rate for emergency department presentations for self-harm by 12-17 year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009. The SH1 and SH2 data confirm emergency department presentations for self-harm were more common in girls at every age, but increased with age in both boys and girls.

Figure 6 shows the incidence rate for self-harm presentations by community size. These data show that, under both definitions, 12-17 year-olds living in Toronto (the only Ontario city with a population greater than 1.5 million) had a substantially lower incidence rate than the rest of the province. Those living in communities with populations of 100,000-499,999 and 500,000-1,499,999 residents had very similar incidence rates. The highest rates were seen among those living in communities with populations of less than 10,000 and 10,000-99,999 residents, where rates were also very similar.

Figure 7 presents the incidence rate for self-harm presentations by neighbourhood income quintile. Both definitions data show an inverse relationship between neighbourhood income quintile and self-harm presentations; that is, 12-17 year-olds living in the lowest income neighbourhoods had the highest rates and vice versa.

Self-harm as a proportion of all emergency department presentations

Table 10 shows self-harm made up a small proportion (SH1: 0.7% and SH2: 0.9%) of emergency department presentations by 12-17 year-olds in the in the Province of Ontario between April 1, 2002 and March 31, 2009. The higher frequency of self-harm among girls, with increasing age and in lower income neighbourhoods previously shown (see Figures 5 and 7) was similarly reflected here; the proportion of total emergency department presentations related to self-harm was higher in girls than in boys, increased with age and showed an inverse relationship with neighbourhood income quintile. In contrast, self-harm made up the smallest proportion of emergency department presentations in the lowest population communities, where self-harm presentation rates were highest (see Figure 6).

Data from the clinical variables showed self-harm accounted for a disproportionate number of high acuity presentations; that is, although self-harm represented just less than one in 100 emergency department presentations overall, it made up about one in 16 (SH1: 5.2%/SH2: 7.3%%) presentations triaged as resuscitation and about one in 18 (SH1: 4.7%/SH2: 6.1%) presentations triaged as emergent. Similarly, self-harm represented about one in 16 (5.8%/SH2: 6.8%) presentations admitted through the emergency department. Also, self-harm accounted for a disproportionate number of presentations identified as involving alcohol (SH1: 2.7%/SH2: 4.5%, vs. less than 1.0% of those that did not involve alcohol).

4.2.2 Objective 2

Mental health follow-up after first-ever emergency department presentation for self-harm

Tables 11 and 12 describe the physician contacts made by 12-17 year-olds within 30 days after their first-ever emergency department presentation for self-harm. Just under one-quarter (SH1: 23.6%/SH2: 19.4%) of 12-17 year-olds who presented to the emergency department for self-harm for the first time received ambulatory mental health follow-up within 30 days from a psychiatrist. About one in five (SH1: 19.2%/SH2: 17.9%) were seen by another physician specialty for mental health reasons during this time. Over half (SH1: 57.2%/SH2: 62.7%) did not have any mental health contact with a physician within 30 days of their first-ever hospital presentation for self-harm.

Tables 13 and 14 provide results of the regression models testing factors associated with receiving mental health follow-up from a physician within 30-days of a first-ever emergency department presentation for self-harm. Factors positively associated with mental health follow-up, whether that

was with a psychiatrist or with any physician specialty, were community size (population of 100,000 or more), CTAS category (high acuity), inpatient psychiatry services, mental health service history (ambulatory and in hospital service use within the previous year) and coding of intent (self-harm). Conversely, method of self-harm (including self-cutting) and alcohol involvement were both negatively associated with mental health follow-up, although these effects were statistically significant only under SH2. Girls were more likely than boys to receive any mental health follow-up within 30 days, but the difference was not statistically significant for follow-up from a psychiatrist (under SH1). Age was not associated with mental health follow-up, under either self-harm definition. The effect of neighbourhood income quintile on mental health follow-up was less clear; some estimates were statistically significant for one outcome but not the other, and only under one self-harm definition (e.g., lowest income quintile was negatively associated with any mental health follow-up, but not mental health follow-up from a psychiatrist, and only under SH1) and there was no clear gradient.

4.2.3 Objective 3
Repetition after first-ever emergency department presentation for self-harm

Table 15 provides the frequency of repeat self-harm presentations within 1-year of the index episode. Both SH1 and SH2 show that among 12-17 year-olds, within one year of their first-ever hospital presentation for self-harm, just over 12% repeated. Furthermore, of those that did repeat, about a quarter (SH1: 23.0%/SH2: 24.8%) repeated more than once.

Tables 17 and 18 show the proportions repeating within the year (according to study variables) and bivariate hurdle model results. Factors positively associated with both the odds of repetition and the number of repeat presentations were sex (girls) and method of self-harm (including self-cutting). Younger age was also positively associated with repetition, but the association was not statistically significant for number of repeat events under SH1. Coding of intent (self-harm) was positively associated with the odds of repetition but not number of repeat events. Lower neighbourhood income quintile was positively associated with the number of repeat events but not the odds of repetition. The parameter estimates suggest alcohol involvement was associated with both a reduced odds of repetition and fewer repeat events, but none of the effect estimates were statistically significant. The estimates for community size, CTAS category and inpatient psychiatry differed according to self-harm definition. Under SH1, it appeared that those living in Toronto were less likely to repeat and had fewer repeat events, but these associations were not statistically significant under SH2. Similarly, under SH1, highest acuity CTAS categories (resuscitation/emergent) were less likely to

repeat and had fewer events, but only the second parameter estimate remained statistically significant under SH2. The effect of inpatient psychiatry was not statistically significant under SH1, but it was positively associated with the odds of repetition under SH2. Mental health service history (ambulatory and in hospital service use within the previous year) was positively associated with the odds of repetition (under both definitions), but under SH2, ambulatory mental health service use that included a psychiatrist and in hospital mental health service use that included inpatient admission(s) were both positively associated with the number of repeat presentations.

4.2.4 Objective 4

Association between mental health follow-up after first-ever emergency department presentation for self-harm and repeat self-harm presentation(s)

Table 19 provides the results of the analysis of the association between mental health follow-up, from a physician, within 30-days of a first-ever emergency department presentation for self-harm and repeat self-harm presentations within 1-year. For SH1, the unadjusted model shows that, compared to those who received no follow-up, those who received such follow-up from a psychiatrist were more likely to repeat but there was no statistically significant difference in the number of repeat events. Conversely, those who received follow-up from another specialty were not more likely to repeat, but when they did, repeated more often. Covariate-adjusted analysis attenuated the strength of the associations seen in the crude analysis and only the association between follow-up from a psychiatrist and odds of repetition remained statistically significant. For SH2, in unadjusted analysis, both follow-up from a psychiatrist and follow-up from another physician specialty were positively associated with the odds of repetition and the number of repeat events. In adjusted analysis, these associations were attenuated such that, as seen in the SH1 analysis, only the association between follow-up from a psychiatrist and odds of repetition remained statistically significant.

Table 4: Demographic, Clinical and Hospital Characteristics of Emergency Department Presentations by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

Variable	All Emergency Department Presentations (n=2,439,939)	
	n	%
Sex		
Girls	1,182,124	48.5%
Boys	1,257,754	51.6%
Other	61	0.0%
Age (years)		
12	337,156	13.8%
13	356,049	14.6%
14	376,844	15.4%
15	412,856	16.9%
16	452,038	18.5%
17	504,996	20.7%
Community size (population)		
1,500,000+	580,328	23.8%
500,000-1,499,999	242,574	9.9%
100,000-499,999	615,267	25.2%
10,000-99,999	356,408	14.6%
<10,000	644,648	26.4%
missing	714	0.0%
Neighbourhood income quintile		
1 (lowest)	500,402	20.5%
2	484,453	19.9%
3	483,630	19.8%
4	490,686	20.1%
5 (highest)	471,990	19.3%
missing	8,778	0.4%
Canadian Triage and Acuity Scale		
Resuscitation	5,952	0.2%
Emergent	131,124	5.4%
Urgent	711,301	29.1%
Semi-urgent	1,243,842	51.0%
Non-urgent	347,720	14.3%
Alcohol involvement		
Yes	23,414	1.0%
No	2,416,525	99.0%
Disposition		
Admitted	96,087	3.9%
Discharged	2,210,378	90.6%
Transferred	21,943	0.9%
Left before visit completed	111,531	4.6%
Hospital type		
Teaching (includes pediatric)	328,604	13.5%
Community	1,742,115	71.4%
Small	369,220	15.1%

Table 5: Demographic Characteristics of Emergency Department Presentations for Self-harm by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

Variable	SH1 (n=16,835)		SH2 (n=22,589)	
	n	%	n	%
Sex				
Girls	12,892	76.6%	16,282	72.1%
Boys	3,943	23.4%	6,307	27.9%
Age (years)				
12	446	2.7%	727	3.2%
13	1,222	7.3%	1,692	7.5%
14	2,695	16.0%	3,639	16.1%
15	3,819	22.7%	4,994	22.1%
16	4,303	25.6%	5,687	25.2%
17	4,350	25.8%	5,850	25.9%
Community size (population)				
1,500,000+	4,042	24.0%	5,685	25.2%
500,000-1,499,999	2,595	15.4%	3,269	14.5%
100,000-499,999	5,047	30.0%	6,491	28.7%
10,000-99,999	2,069	12.3%	2,951	13.1%
<10,000	3,069	18.2%	4,179	18.5%
missing	13	0.1%	13	0.1%
Neighbourhood income quintile				
1 (lowest)	3,875	23.0%	5163	22.8%
2	3,519	20.9%	4755	21.1%
3	3,317	19.7%	4431	19.6%
4	3,078	18.3%	4121	18.2%
5 (highest)	2,936	17.4%	3981	17.6%
missing	110	0.7%	138	0.6%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 6: Clinical and Hospital Characteristics of Emergency Department Presentations for Self-harm by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

Variable	SH1 (n=16,835)		SH2 (n=22,589)	
	n	%	n	%
Method of self-harm				
Poisoning only	11,113	66.0%	15,102	66.9%
Self-cutting only	4,204	25.0%	5,856	25.9%
Other only	1,336	7.9%	1,325	5.9%
Multiple	182	1.1%	306	1.4%
Canadian Triage and Acuity Scale				
Resuscitation	310	1.8%	437	1.9%
Emergent	6190	36.8%	7,929	35.1%
Urgent	7553	44.9%	9,822	43.5%
Semi-urgent	2416	14.4%	3,737	16.5%
Non-urgent	366	2.2%	664	2.9%
Alcohol involvement				
Yes	634	3.8%	1,056	4.7%
No	16,201	96.2%	21,533	95.3%
Disposition				
Admitted	5,599	33.3%	6,537	28.9%
Discharged	10,234	60.8%	14,689	65.0%
Transferred	705	4.2%	822	3.6%
Left before visit completed	297	1.8%	541	2.4%
Hospital type				
Teaching (includes pediatric)	3,669	21.8%	4,739	21.0%
Community	11,743	69.8%	15,992	70.8%
Small	1,423	8.5%	1,858	8.2%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 7: Demographic Characteristics of the Index Episode in an Inception Cohort of Emergency Department Presentations for Self-harm by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2008

Variable	SH1 (n = 3,497)		SH2 (n = 4,932)	
	n	%	n	%
Sex				
Girls	2,686	76.8%	3,524	71.5%
Boys	811	23.2%	1,408	28.6%
Age (years)				
12	311	8.9%	517	10.5%
13	640	18.3%	883	17.9%
14	906	25.9%	1,284	26.0%
15	874	25.0%	1,193	24.2%
16	568	16.2%	782	15.9%
17	198	5.7%	273	5.5%
Community size (population)				
1,500,000+	834	23.9%	1,227	24.9%
500,000-1,499,999	492	14.1%	645	13.1%
100,000-499,999	1,045	29.9%	1,384	28.1%
10,000-99,999	491	14.0%	719	14.6%
<10,000	635	18.2%	957	19.4%
Neighbourhood income quintile				
1 (lowest)	791	22.6%	1,137	23.1%
2	732	20.9%	1,036	21.0%
3	699	20.0%	968	19.6%
4	662	18.9%	885	17.9%
5 (highest)	586	16.8%	868	17.6%
missing	27	0.8%	38	0.8%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 8: Clinical Characteristics of the Index Episode in an Inception Cohort of Emergency Department Presentations for Self-harm by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2008

Variable	SH1 (n = 3,497)		SH2 (n = 4,932)	
	n	%	n	%
Method of self-harm				
Poisoning only	2,230	63.8%	3,222	65.3%
Self-cutting only	878	25.1%	1,288	26.1%
Other only	352	10.1%	351	7.1%
Multiple	37	1.1%	71	1.4%
Canadian Triage and Acuity Scale				
Resuscitation	54	1.5%	86	1.7%
Emergent	1,370	39.2%	1,840	37.3%
Urgent	1,458	41.7%	1,998	40.5%
Semi-urgent	542	15.5%	877	17.8%
Non-urgent	73	2.1%	131	2.7%
Alcohol involvement				
Yes	131	3.8%	249	5.1%
No	3,366	96.2%	4,683	94.9%
Inpatient psychiatry				
Yes	890	25.5%	1,012	20.5%
No	257	7.4%	353	7.2%
Not admitted (not applicable)	2,350	67.2%	3,567	72.3%
Hospital type				
Teaching (includes pediatric)	656	18.7%	935	19.0%
Community	2,539	72.6%	3,584	72.7%
Small	302	8.6%	413	8.4%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 9: 1-year Health Service Use History (Prior to the Index Episode) in an Inception Cohort of Emergency Department Presentations for Self-harm by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2008

Variable	SH1 (n = 3,497)		SH2 (n = 4,932)	
	n	%	n	%
Inpatient admissions				
Includes psychiatric	338	9.7%	399	8.1%
Non-psychiatric only	149	4.3%	209	4.2%
None	3,010	86.1%	4,324	87.7%
Emergency department presentations				
Includes psychiatric	677	19.4%	850	17.2%
Non-psychiatric only	1,144	32.7%	1,628	33.0%
None	1,676	47.9%	2,454	49.8%
Ambulatory mental health service use (with a physician)				
Includes psychiatrist	773	22.1%	960	19.5%
Other specialty only	988	28.3%	1,321	26.8%
None	1,736	49.6%	2,651	53.8%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Figure 5: Incidence Rate (and 95% Confidence Interval) of Emergency Department Presentations for Self-harm, by Age and Sex, for 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

	12	13	14	15	16	17
▲ Girls (SH2)	77.9	215.7	501.6	659.1	713.2	679.2
■ Girls (SH1)	56.5	172.5	393.5	527.6	564.8	539.1
△ Boys (SH2)	47.0	76.1	129.4	204.8	266.4	322.7
□ Boys (SH1)	20.5	39.0	74.9	134.2	177.7	207.7

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

51

Figure 6: Incidence Rate (and 95% Confidence Interval) of Emergency Department Presentations for Self-harm, by Community Size, for 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

	1,500,000+	500,000-1,499,999	100,000-499,999	10,000-99,999	<10,000
▲ SH2	185.0	351.9	356.7	471.4	439.9
■ SH1	131.6	279.3	277.3	330.5	323.0

Community size (population)

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Figure 7: Incidence Rate (and 95% Confidence Interval) of Emergency Department Presentations for Self-harm, by Neighbourhood Income Quintile, for 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

	1 (lowest)	2	3	4	5 (highest)
▲ SH2	346.3	333.9	306.5	277.5	260.1
■ SH1	259.9	247.1	229.5	207.3	191.8

Neighbourhood income quintile

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 10: Self-harm as a Proportion of all Emergency Department Presentations by 12-17 Year-olds in the Province of Ontario between April 1, 2002 and March 31, 2009

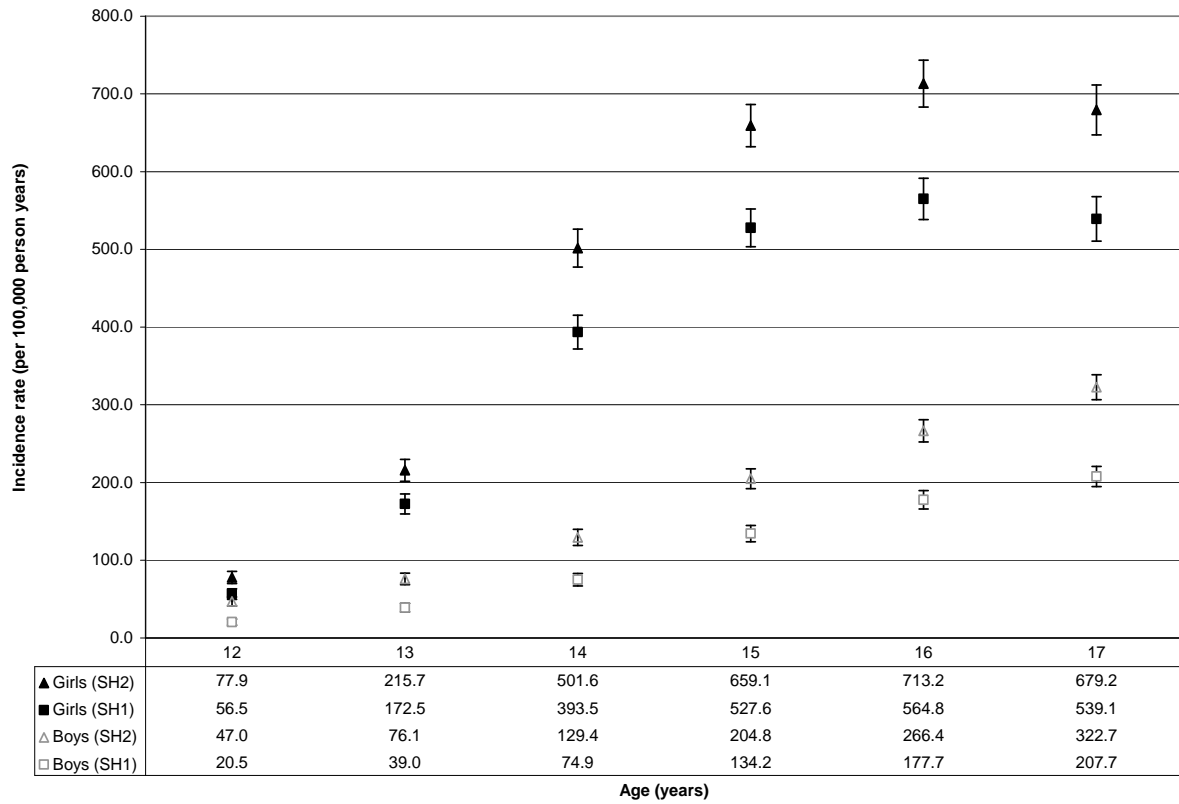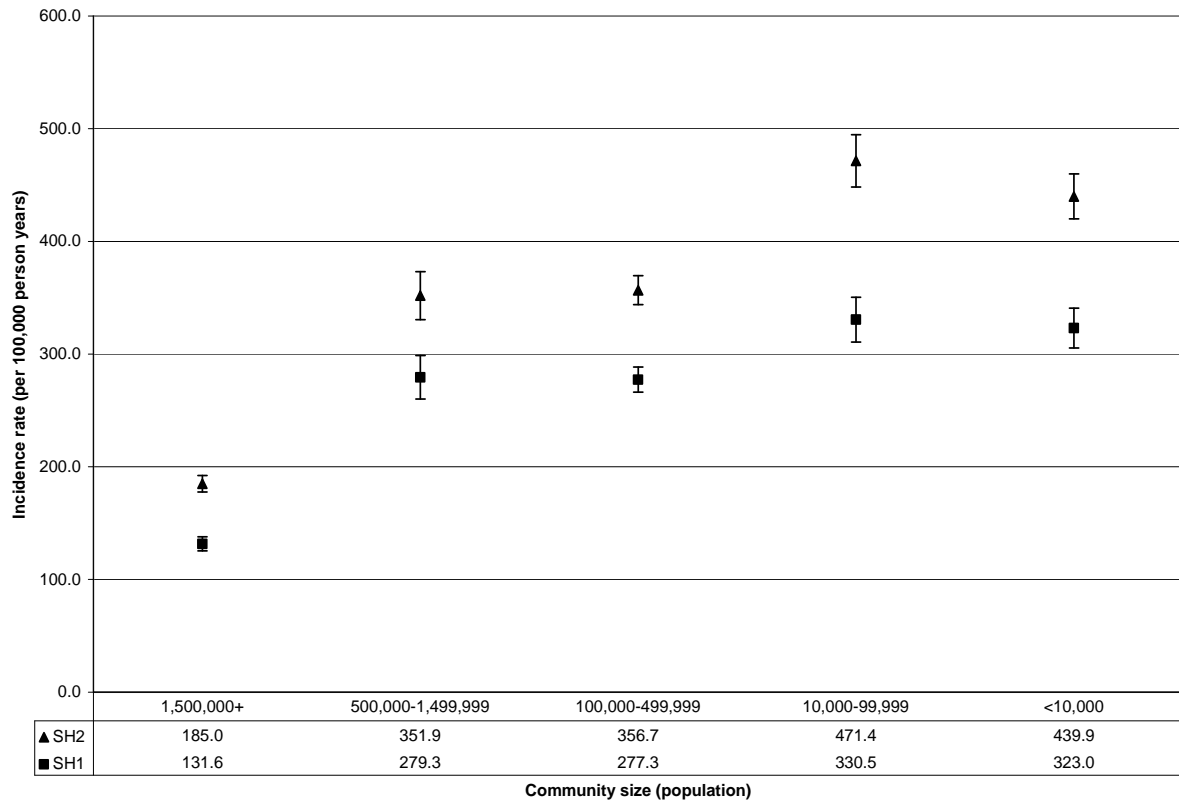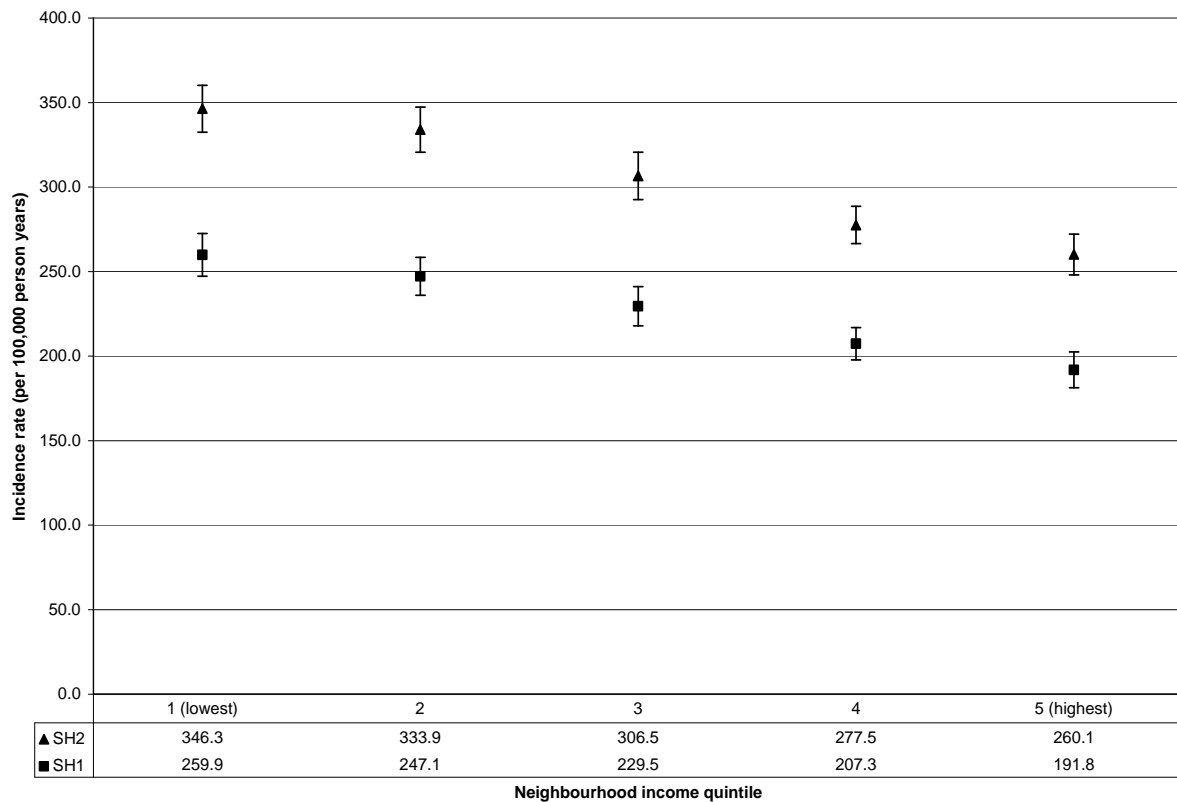| Variable	All Emergency Department Presentations	SH1		SH2	
	n_0	n_1	% (n_1/n_0)	n_2	% (n_2/n_0)
Overall	2,439,939	16,835	0.7%	22,589	0.9%
Sex					
Girls	1,182,124	12,892	1.1%	16,282	1.4%
Boys	1,257,754	3,943	0.3%	6,307	0.5%
Age (years)					
12	337,156	446	0.1%	727	0.2%
13	356,049	1,222	0.3%	1,692	0.5%
14	376,844	2,695	0.7%	3,639	1.0%
15	412,856	3,819	0.9%	4,994	1.2%
16	452,038	4,303	1.0%	5,687	1.3%
17	504,996	4,350	0.9%	5,850	1.2%
Community size (population)					
1,500,000+	580,328	4,042	0.7%	5,685	1.0%
500,000-1,499,999	242,574	2,595	1.1%	3,269	1.4%
100,000-499,999	615,267	5,047	0.8%	6,491	1.1%
10,000-99,999	356,408	2,069	0.6%	2,951	0.8%
<10,000	644,648	3,069	0.5%	4,179	0.7%
missing	714	13	1.8%	13	1.8%
Neighbourhood income quintile					
1 (lowest)	500,402	3,875	0.8%	5163	1.0%
2	484,453	3,519	0.7%	4755	1.0%
3	483,630	3,317	0.7%	4431	0.9%
4	490,686	3,078	0.6%	4121	0.8%
5 (highest)	471,990	2,936	0.6%	3981	0.8%
missing	8,778	110	1.3%	138	1.6%
Canadian Triage and Acuity Scale					
Resuscitation	5,952	310	5.2%	437	7.3%
Emergent	131,124	6,190	4.7%	7,929	6.1%
Urgent	711,301	7,553	1.1%	9,822	1.4%
Semi-urgent	1,243,842	2,416	0.2%	3,737	0.3%
Non-urgent	347,720	366	0.1%	664	0.2%
Alcohol involvement					
Yes	23,414	634	2.7%	1,056	4.5%
No	2,416,525	16,201	0.7%	21,533	0.9%
Disposition					
Admitted	96,087	5,599	5.8%	6,537	6.8%
Discharged	2,210,378	10,234	0.5%	14,689	0.7%
Transferred	21,943	705	3.2%	822	3.7%
Left before visit completed	111,531	297	0.3%	541	0.5%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 11: Mental Health Contact with a Physician within 30-days the Index episode in an Inception Cohort of Emergency Department Presentations for Self-harm, by Individual Characteristics (Self-harm Definition 1 [SH1])

Variable	30-day mental health follow-up (highest level of care)					
	Psychiatrist		Other MD		None	
	n	%	n	%	n	%
Overall	826	23.6%	671	19.2%	2,000	57.2%
Sex						
Girls	667	24.8%	532	19.8%	1,487	55.4%
Boys	159	19.6%	139	17.1%	513	63.3%
Age (years)						
12-15	657	24.1%	528	19.3%	1,546	56.6%
16-17	169	22.1%	143	18.7%	454	59.3%
Community size (population)						
1,500,000+	326	39.1%	106	12.7%	402	48.2%
500,000-1,499,999	129	26.2%	122	24.8%	241	49.0%
100,000-499,999	223	21.3%	229	21.9%	593	56.8%
10,000-99,999	65	13.2%	98	20.0%	328	66.8%
<10,000	83	13.1%	116	18.3%	436	68.7%
Neighbourhood income quintile						
1 (lowest)	144	18.2%	146	18.5%	501	63.3%
2	186	25.4%	138	18.9%	408	55.7%
3	160	22.9%	125	17.9%	414	59.2%
4	187	28.3%	123	18.6%	352	53.2%
5 (highest)	147	25.1%	137	23.4%	302	51.5%
Missing n = 27						
Method of self-harm						
Includes self-cutting	189	20.1%	188	20.6%	537	58.8%
No self-cutting	637	24.7%	483	18.7%	1,463	56.6%
Canadian Triage and Acuity Scale						
Resuscitation/Emergent	402	28.2%	286	20.1%	736	51.7%
Urgent	351	24.1%	284	19.5%	823	56.5%
Semi-/Non-urgent	73	11.9%	101	16.4%	441	71.7%
Alcohol involvement						
Yes	21	16.0%	24	18.3%	86	65.7%
No	805	23.9%	647	19.2%	1,914	56.9%
Inpatient psychiatry						
Yes	294	33.0%	175	19.7%	421	47.3%
No	36	14.0%	73	28.4%	148	57.6%
Not admitted (not applicable)	496	21.1%	423	18.0%	1,431	60.9%
Ambulatory mental health service use (with a physician), previous year						
Includes psychiatrist	373	48.2%	114	14.8%	286	37.0%
Other specialty only	202	20.5%	269	27.2%	517	52.3%
None	251	14.5%	288	16.6%	1,197	69.0%
In hospital mental health service use, previous year						
Includes inpatient admission(s)	132	39.1%	62	18.3%	144	42.6%
Emergency department presentation(s) only	135	32.3%	71	17.0%	212	50.7%
None	559	20.4%	538	19.6%	1,644	60.0%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84).

Table 12: Mental Health Contact with a Physician within 30-days the Index episode in an Inception Cohort of Emergency Department Presentations for Self-harm, by Individual Characteristics (Self-harm Definition 2 [SH2])

Variable	30-day mental health follow-up (highest level of care)					
	Psychiatrist		Other specialty		None	
	n	%	n	%	n	%
Overall	957	19.4%	882	17.9%	3,093	62.7%
Sex						
Girls	760	21.6%	675	19.2%	2,089	59.3%
Boys	197	13.4%	207	14.7%	1,004	71.3%
Age (years)						
12-15	754	19.4%	691	17.8%	2,432	62.7%
16-17	203	19.2%	191	18.1%	661	62.7%
Community size (population)						
1,500,000+	376	30.6%	146	11.9%	705	57.4%
500,000-1,499,999	149	23.1%	155	24.0%	341	52.9%
100,000-499,999	256	18.5%	281	20.3%	847	61.2%
10,000-99,999	74	10.3%	137	19.1%	508	70.7%
<10,000	102	10.7%	163	17.0%	692	72.3%
Neighbourhood income quintile						
1 (lowest)	180	15.8%	195	17.2%	762	67.0%
2	220	21.2%	187	18.1%	629	60.7%
3	181	18.7%	168	17.4%	619	64.0%
4	202	22.8%	153	17.3%	530	59.9%
5 (highest)	171	19.7%	176	20.3%	521	60.0%
Missing n = 27						
Method of self-harm						
Includes self-cutting	205	15.4%	658	18.3%	2,189	60.8%
No self-cutting	752	20.9%	224	16.8%	904	67.8%
Canadian Triage and Acuity Scale						
Resuscitation/Emergent	459	23.8%	384	19.9%	1083	56.2%
Urgent	412	20.6%	379	19.0%	1207	60.4%
Semi-/Non-urgent	86	8.5%	119	11.8%	803	79.7%
Alcohol involvement						
Yes	28	11.2%	45	18.1%	176	70.7%
No	929	19.8%	837	17.9%	2,917	62.3%
Inpatient psychiatry						
Yes	326	32.2%	202	20.0%	484	47.8%
No	39	11.0%	98	27.8%	216	61.2%
Not admitted (not applicable)	592	16.6%	582	16.3%	2,393	67.1%
Ambulatory mental health service use (with a physician), previous year						
Includes psychiatrist	436	45.4%	142	14.8%	382	39.8%
Other specialty only	239	18.1%	366	27.7%	716	54.2%
None	282	10.6%	374	14.1%	1,995	75.3%
In hospital mental health service use, previous year						
Includes inpatient admission(s)	146	36.6%	75	18.8%	178	44.6%
Emergency department presentation(s) only	160	29.1%	101	18.4%	288	52.5%
None	651	16.3%	706	17.7%	2,627	65.9%
Coding of intent						
Self-harm	824	23.6%	670	19.2%	1,998	57.2%
Undetermined	133	9.2%	212	14.7%	1,095	76.0%

Self-harm definition 2 (SH2): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84), poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 13: Odds of Mental Health Contact with a Physician within 30-days the Index Episode in an Inception Cohort of Emergency Department Presentations for Self-harm, by Individual Characteristics (Self-harm Definition 1 [SH1])

Variable	30-day mental health follow-up (highest level of care)			
	Model 1: Psychiatrist vs. (other specialty or none)		Model 2: (Psychiatrist or other specialty) vs. none	
	OR	95% CI	OR	95% CI
Sex				
Girls	1.21	(0.99,1.50)	1.27	(1.07,1.51)*
Boys	1.00		1.00	
Age (years)				
12-15	1.13	(0.92,1.39)	1.11	(0.94,1.32)
16-17	1.00		1.00	
Community size (population)				
1,500,000+	3.15	(2.13,4.67)*	2.03	(1.50,2.74)*
500,000-1,499,999	1.47	(0.93,2.35)	1.65	(1.16,2.37)*
100,000-499,999	1.50	(1.06,2.12)*	1.60	(1.23,2.09)*
10,000-99,999	1.02	(0.67,1.55)	1.13	(0.84,1.54)
<10,000	1.00		1.00	
Neighbourhood income quintile				
1 (lowest)	0.78	(0.59,1.03)	0.69	(0.55,0.87)*
2	1.06	(0.81,1.39)	0.85	(0.67,1.07)
3	0.95	(0.72,1.25)	0.73	(0.58,0.92)*
4	1.22	(0.93.1.60)	0.94	(0.74,1.18)
5 (highest)	1.00		1.00	
Missing n = 27				
Method of self-harm				
Includes self-cutting	0.82	(0.67,1.00)	0.94	(0.80,1.11)
No self-cutting	1.00		1.00	
Canadian Triage and Acuity Scale				
Resuscitation/Emergent	2.21	(1.63,3.00)*	2.00	(1.59,2.52)*
Urgent	1.82	(1.34,2.46)*	1.73	(1.38,2.16)*
Semi-/Non-urgent	1.00		1.00	
Alcohol involvement				
Yes	0.65	(0.39,1.08)	0.72	(0.49,1.06)
No	1.00		1.00	
Inpatient psychiatry				
Yes	1.91	(1.58,2.32)*	1.79	(1.52,2.12)*
No	0.77	(0.52,1.14)	1.29	(0.97,1.72)
Not admitted (not applicable)	1.00			
Ambulatory mental health service use (with a physician), previous year				
Includes psychiatrist	5.06	(4.11,6.24)*	3.54	(2.94,4.27)*
Other specialty only	1.54	(1.24,1.92)*	2.00	(1.69,2.37)*
None	1.00		1.00	
In hospital mental health service use, previous year				
Includes inpatient admission(s)	2.72	(2.09,3.53)*	2.11	(1.65,2.69)*
Emergency department presentation(s) only	2.25	(1.76,2.89)*	1.56	(1.26,1.94)*
None	1.00		1.00	

CI: Confidence interval; OR: Odds ratio; *: 95% confidence interval does not include 1.

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84).

Table 14: Odds of Mental Health Contact with a Physician within 30-days the Index Episode in an Inception Cohort of Emergency Department Presentations for Self-harm, by Individual Characteristics (Self-harm Definition 2 [SH2])

Variable	30-day mental health follow-up (highest level of care)			
	Model 1: Psychiatrist vs. (other specialty or none)		Model 2: (Psychiatrist or other specialty) vs. none	
	OR	95% CI	OR	95% CI
Sex				
Girls	1.56	(1.30,1.87)*	1.57	(1.37,1.81)*
Boys	1.00		1.00	
Age (years)				
12-15	1.06	(0.88,1.27)	1.02	(0.88,1.18)
16-17	1.00		1.00	
Community size (population)				
1,500,000+	2.29	(1.57,3.32)*	1.50	(1.14,1.98)*
500,000-1,499,999	1.56	(1.01,2.40)*	1.58	(1.13,2.19)*
100,000-499,999	1.52	(1.10,2.10)*	1.58	(1.24,2.01)*
10,000-99,999	0.96	(0.66,1.41)	1.14	(0.88,1.50)
<10,000	1.00		1.00	
Neighbourhood income quintile				
1 (lowest)	0.91	(0.71,1.17)	0.84	(0.69,1.02)
2	1.15	(0.91,1.47)	1.00	(0.82,1.21)
3	1.02	(0.79,1.31)	0.87	(0.71,1.06)
4	1.28	(1.01,1.64)*	1.03	(0.85,1.26)
5 (highest)	1.00		1.00	
Missing n = 27				
Method of self-harm				
Includes self-cutting	0.79	(0.66,0.94)*	0.82	(0.71,0.95)*
No self-cutting	1.00		1.00	
Canadian Triage and Acuity Scale				
Resuscitation/Emergent	2.51	(1.91,3.29)*	2.60	(2.13,3.17)*
Urgent	2.09	(1.60.2.74)*	2.22	(1.83,2.70)*
Semi-/Non-urgent	1.00		1.00	
Alcohol involvement				
Yes	0.44	(0.29,0.67)*	0.66	(0.49,0.88)*
No	1.00		1.00	
Inpatient psychiatry				
Yes	2.43	(2.04,2.90)*	2.26	(1.94,2.63)*
No	0.75	(0.52,1.09)	1.44	(1.13,1.84)*
Not admitted (not applicable)	1.00		1.00	
Ambulatory mental health service use (with a physician), previous year				
Includes psychiatrist	6.33	(5.24,7.65)*	4.24	(3.60,5.00)*
Other specialty only	1.88	(1.55,2.29)*	2.50	(2.16,2.89)*
None	1.00		1.00	
In hospital mental health service use, previous year				
Includes inpatient admission(s)	3.07	(2.41,3.90)*	2.42	(1.94,3.01)*
Emergency department presentation(s) only	2.42	(1.94,3.02)*	1.82	(1.51,2.21)*
None	1.00		1.00	
Coding of intent				
Self-harm	3.20	(2.59,3.94)*	2.38	(2.05,2.77)*
Undetermined	1.00		1.00	

CI: Confidence interval; OR: Odds ratio; *: 95% confidence interval does not include 1.

Self-harm definition 2 (SH2): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84), poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 15: Repeat Self-harm Presentations within 1-year in an Inception Cohort of Emergency Department Presentations for Self-harm

Number of repeat self-harm presentations	SH1 (n=3,497)		SH2 (n=4,932)	
	n	%	n	%
0	3,057	87.4%	4,331	87.8%
1	339	9.7%	452	9.2%
2	65	1.9%	94	1.9%
3	17	0.5%	30	0.6%
4	8	0.2%	11	0.2%
5 or more	11	0.3%	14	0.3%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 16: Repeat Self-harm Presentations within 1-year in an Inception Cohort of Emergency Department Presentations for Self-harm, Excluding Repeat Presentations within First 30 Days

Number of repeat self-harm presentations	SH1 (n=3,497)		SH2 (n=4,932)	
	n	%	n	%
0	3,151	90.1%	4,477	90.8%
1	267	7.6%	339	6.9%
2	50	1.4%	75	1.5%
3	15	0.4%	23	0.5%
4 or more	14	0.4%	18	0.4%

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 17: Associations between Individual Characteristics and Repeat Self-harm Presentations within 1-year in an Inception Cohort of Emergency Department Presentations for Self-harm (Self-harm Definition 1 [SH1])

Variable	Individuals			Repetition (yes vs. no)		Number of repetitions (among repeaters)	
	Total	Repeaters		OR	95% CI	IRR	95% CI
	n	n	%				
Sex							
Girls	2,686	374	13.9%	1.83	(1.39,2.40)*	2.51	(1.24,5.06)*
Boys	811	66	8.1%	1.00		1.00	
Age (years)							
12-15	2,731	374	13.7%	1.68	(1.28,2.22)*	1.72	(0.90,3.27)
16-17	766	66	8.6%	1.00		1.00	
Community size (population)							
1,500,000+	834	83	10.0%	0.72	(0.53,1.00)*	0.44	(0.21,0.93)*
500,000-1,499,999	492	78	15.9%	1.24	(0.89,1.73)	1.38	(0.71,2.71)
100,000-499,999	1,045	134	12.8%	0.97	(0.72,1.29)	1.07	(0.59,1.97)
10,000-99,999	491	61	12.4%	0.93	(0.65,1.32)	0.84	(0.40,1.79)
<10,000	635	84	13.2%	1.00		1.00	
Neighbourhood income quintile							
1 (lowest)	791	105	13.3%	1.04	(0.76,1.43)	3.48	(1.66,7.30)*
2	732	88	12.0%	0.93	(0.67,1.29)	2.29	(1.05,4.99)*
3	699	82	11.7%	0.91	(0.65,1.27)	2.41	(1.10,5.28)*
4	662	87	13.1%	1.03	(0.74,1.44)	1.47	(0.66,3.30)
5 (highest)	586	75	12.8%	1.00		1.00	
Missing n=27							
Method of self-harm							
Includes self-cutting	914	163	17.8%	1.81	(1.46,2.23)*	2.12	(1.37,3.26)*
No self-cutting	2,583	277	10.7%	1.00		1.00	
Canadian Triage and Acuity Scale							
Resuscitation/Emergent	1,424	150	10.5%	0.69	(0.52,0.91)*	0.53	(0.30,0.96)*
Urgent	1,458	200	13.7%	0.93	(0.71,1.21)	0.78	(0.46,1.34)
Semi-/Non-urgent	615	90	14.6%	1.00		1.00	
Alcohol involvement							
Yes	131	14	10.7%	0.83	(0.47,1.45)	0.31	(0.06,1.56)
No	3,366	426	12.7%	1.00		1.00	
Inpatient psychiatry							
Yes	890	124	13.9%	1.15	(0.92,1.44)	1.35	(0.85,2.15)
No	257	26	10.1%	0.80	(0.52,1.22)	0.77	(0.29,2.01)
Not admitted (not applicable)	2,350	290	12.3%	1.00		1.00	
Ambulatory mental health service use (with a physician), previous year							
Includes psychiatrist	773	139	18.0%	2.54	(1.97,3.27)*	1.22	(0.73,2.07)
Other specialty only	988	163	16.5%	2.29	(1.80,2.91)*	0.88	(0.52,1.48)
None	1,736	138	8.0%	1.00		1.00	
In hospital mental health service use, previous year							
Includes inpatient admission(s)	338	96	28.4%	3.54	(2.71,4.63)*	1.04	(0.61,1.77)
Emergency department presentation(s) only	418	68	16.3%	1.74	(1.30,2.31)*	1.53	(0.86,2.71)
None	2,741	276	10.1%	1.00		1.00	

CI: confidence interval; IRR: incidence rate ratio; OR: Odds ratio; *: 95% confidence interval does not include 1.

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84).

Table 18: Associations between Individual Characteristics and Repeat Self-harm Presentations within 1-year in an Inception Cohort of Emergency Department Presentations for Self-harm (Self-harm Definition 2 [SH2])

Variable	Individuals Total n	Repeaters n	Repeaters %	Repetition (yes vs. no) OR	Repetition (yes vs. no) 95% CI	Number of repetitions (among repeaters) IRR	Number of repetitions (among repeaters) 95% CI
Sex							
Girls	3,524	502	14.2%	2.20	(1.75,2.75)*	2.84	(1.59,5.06)*
Boys	1,408	99	7.0%	1.00		1.00	
Age (years)							
12-15	3,877	503	13.0%	1.46	(1.16,1.83)*	1.86	(1.10,3.16)*
16-17	1,055	98	9.3%	1.00		1.00	
Community size (population)							
1,500,000+	1,227	125	10.2%	0.90	(0.69,1.18)	0.71	(0.39,1.29)
500,000-1,499,999	645	111	17.2%	1.65	(1.24,2.20)*	1.18	(0.66,2.11)
100,000-499,999	1,384	173	12.5%	1.13	(0.88,1.47)	1.07	(0.63,1.82)
10,000-99,999	719	85	11.8%	1.07	(0.79,1.44)	0.97	(0.52,1.83)
<10,000	957	107	11.2%	1.00		1.00	
Neighbourhood income quintile							
1 (lowest)	1,137	138	12.1%	1.11	(0.84,1.47)	2.70	1.46,5.01)*
2	1,036	132	12.7%	1.17	(0.89,1.55)	1.60	(0.84,3.02)
3	968	119	12.3%	1.13	(0.85,1.50)	1.75	(0.92,3.35)
4	885	110	12.4%	1.14	(0.85,1.53)	1.75	(0.91,3.38)
5 (highest)	868	96	11.1%	1.00		1.00	
Missing n=38							
Method of self-harm							
Includes self-cutting	1,333	193	14.5%	1.32	(1.10,1.59)*	2.15	(1.48,3.12)*
No self-cutting	3,599	408	11.3%	1.00		1.00	
Canadian Triage and Acuity Scale							
Resuscitation/Emergent	1,926	227	11.8%	1.04	(0.82,1.32)	0.51	(0.31,0.84)*
Urgent	1,998	259	13.0%	1.16	(0.92,1.46)	0.79	(0.49,1.26)
Semi-/Non-urgent	1,008	115	11.4%	1.00		1.00	
Alcohol involvement							
Yes	249	22	8.8%	0.69	(0.44,1.07)	0.31	(0.06,1.56)
No	4,683	579	12.4%	1.00		1.00	
Inpatient psychiatry							
Yes	1,012	165	16.3%	1.58	(1.30,1.93)*	1.35	(0.91,2.01)
No	353	45	12.7%	1.19	(0.85,1.65)	0.54	(0.25,1.19)
Not admitted (not applicable)	3,567	391	11.0%	1.00		1.00	
Ambulatory mental health service use (with a physician), previous year							
Includes psychiatrist	960	184	19.2%	2.79	(2.25,3.45)*	1.91	(1.23,2.97)*
Other specialty only	1,321	209	15.8%	2.21	(1.80,2.71)*	1.14	(0.73,1.78)
None	2,651	208	7.9%	1.00		1.00	
In hospital mental health service use, previous year							
Includes inpatient admission(s)	399	117	29.3%	3.84	(3.02,4.88)*	1.62	(1.03,2.54)*
Emergency department presentation(s) only	549	96	17.5%	1.96	(1.54,2.51)*	1.57	(0.97,2.55)
None	3,984	388	9.7%	1.00		1.00	
Coding of intent							
Self-harm	3,492	493	14.1%	2.03	(1.63,2.52)*	1.30	(0.81,2.10)
Undetermined	1,440	108	7.5%	1.00		1.00	

CI: confidence interval; IRR: incidence rate ratio; OR: Odds ratio; *: 95% confidence interval does not include 1.

Self-harm definition 2 (SH2): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84), poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

Table 19: Multivariable Analysis of the Association between 30-day Mental Health Follow-up from a Physician and Repeat Self-harm Presentation(s) within 1-year in an Inception Cohort of Emergency Department Presentations for Self-harm

30-day mental health follow-up (highest level of care)	Individuals			Unadjusted Hurdle Model				Adjusted[1] Hurdle Model			
				Repetition (yes vs. no)		Number of repetitions (among repeaters)		Repetition (yes vs. no)		Number of repetitions (among repeaters)	
	Total	Repeaters		OR	95% CI	IRR	95% CI	OR	95% CI	IRR	95% CI
	n	n	%								
Excluding repeat events within 30 days											
SH1											
Psychiatrist	826	114	13.8%	1.80	(1.40,2.33)*	1.24	(0.71,2.16)	1.54	(1.16,2.06)*	0.94	(0.47,1.88)
Other specialty	671	69	10.3%	1.29	(0.96,1.74)	2.17	(1.17,4.00)*	1.07	(0.78,1.45)	1.64	(0.82,3.27)
None	2,000	163	8.2%	1.00		1.00		1.00		1.00	
Total	3,497	346	9.9%								
SH2											
Psychiatrist	957	139	14.5%	2.15	(1.71,2.69)*	1.67	(1.04,2.67)*	1.37	(1.06,1.77)*	1.27	(0.70,2.31)
Other specialty	882	89	10.1%	1.42	(1.10,1.83)*	1.94	(1.14,3.32)*	1.04	(0.79,1.36)	1.58	(0.87,2.86)
None	3,093	227	7.3%	1.00		1.00		1.00		1.00	
Total	4,932	455	9.2%								

1: adjusted for sex, age, community size, neighbourhood income quintile, method of self-harm, Canadian Triage and Acuity Scale, alcohol involvement, inpatient psychiatry, mental health service history (ambulatory and in hospital service use within the previous year) and coding of intent (SH2 only)

CI: confidence interval; IRR: incidence rate ratio; OR: Odds ratio; *: 95% confidence interval does not include 1.

Self-harm definition 1 (SH1): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84). Self-harm definition 2 (SH2): as with SH1, as well as records that list any codes for poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

5. Discussion

5.1 Key results

5.1.1 Objective 1

Emergency department presentations for self-harm

The descriptive data presented here show the incidence of emergency department presentations for self-harm among Ontario youth is quite consistent with that in other countries. For example, the conservative self-harm definition (SH1) showed the incidence rate among 15-17 year-olds was 353.7 per 100,000 person years. Strikingly similar figures have been reported for the 15-19 year-old age group in Ireland (approximately 350 per 100,000 person years)[184] and the United States (approximately 340 per 100,000 person years).[49,185] However, data from Oxford, England showed the incidence rate was about double these estimates, roughly 700 per 100,000 person years.[186] This dramatically higher rate may reflect differences in ascertainment as those data were collected at a single hospital, for a dedicated self-harm monitoring system.

As hypothesized, these data also showed similar demographic patterns as have been previously reported for emergency department presentations for self-harm. That is, presentations were more common in girls, increased with age and were inversely related to an area-level socioeconomic measure (neighborhood income quintile). These findings were also reflected when describing self-harm as a proportion of all emergency department presentations; self-harm made up a larger proportion of emergency department use among girls, as age increased, and among those living in lower income neighborhoods. Potential explanations that have been raised for the consistent age and sex patterns involve the timing of puberty, mediated by depressive symptoms, alcohol use and sexual activity.[187] The neighborhood socioeconomic effects, similarly reported in data from youth in England, have been thought to involve exposure to violence, family factors, housing, nutrition, smoking and substance abuse.[188] The relationship with community size (population) was less straightforward. The incidence rate of emergency department presentations for self-harm was highest in low population areas (and vice versa) but self-harm also made up a smaller proportion of overall emergency department use in these low population areas. This may reflect the finding that those living in Ontario's rural areas have substantially higher emergency department use than the rest of the province.[189] In fact, although youth living in rural areas had higher rates of emergency

department presentations for self-harm, the presentations were of lower CTAS (data not shown). This pattern has also been documented for Ontario emergency department use overall.[190]

These results also confirmed self-harm represented a small but complicated proportion of emergency department presentations in youth;[191] self-harm accounted for about 1% of presentations by 12-17 year-olds overall, but roughly one in 20 presentations triaged as highest acuity (resuscitation or emergent), involving alcohol or admitted through the emergency department.

5.1.2 Objective 2

Mental health follow-up after first-ever emergency department presentation for self-harm

Less than half of 12-17 year-olds making their first-ever emergency department presentation for self-harm had mental health contact with a physician within 30-days. Physician supply no doubt contributes, but research has also shown clinician referrals and individual adherence to be factors. European and New Zealand data showed about two-thirds of youth who presented to the emergency department for self-harm were recommended for follow-up[7,41,192] and non-adherence is an acknowledged problem in this population.[193] In fact, suicidal adolescents appear to keep fewer appointments and drop out of treatment faster than their non-suicidal counterparts.[194] In their study of youth who had presented to the emergency department for suicide attempts, Sprito et al found that after three months just less than half (48%) were still receiving psychiatric treatment whereas the remainder never attended, or attended only one or two appointments.[195] Qualitative research has shown some youth who self-harm describe difficulty engaging with health services, partly because of a sense of mismatch of their needs with the services offered;[196,197] similar to adults,[198] youth who self-harm discuss not only psychiatric illness and alcohol as factors in self-harm, but also the importance of life events. A study of French adolescents admitted to hospital for a suicide attempt found the most common reason for poor adherence with follow-up, reported by about half (53%), was fear of talking about painful things.[199]

Certain demographic and clinical factors were associated with follow-up. As hypothesized, factors negatively associated with follow-up were living in rural areas (and areas with populations of less than 100,000), triage as lowest acuity (semi- or non-urgent), discharge directly from the emergency department, no history of mental health service use in the previous year and diagnostic coding of undetermined. There was also evidence that boys, individuals who presented with self-cutting, and those identified with alcohol involvement were less likely to receive follow-up.

It must also be noted that in this cohort, although making their first-ever emergency department presentations for self-harm, many had been in contact with mental health services in the previous year. Nearly one in 10 had been admitted to hospital for a psychiatric stay and about one in five had a psychiatric presentation to the emergency department. Hence, it would appear that for many, self-harm was not the event that precipitated contact with mental health services. In fact, history of mental health service use may have been understated because, consistent with most previous research, these psychiatric inpatient admissions and emergency department presentations were defined with a subset of ICD codes (i.e., indicating mental or behavioral disorder [ICD-10: F00-99]) and it is unclear if and how sub-threshold disorder (which may predict suicidality)[200] or mental health complaints without formal diagnoses were captured.

5.1.3 Objective 3

Repetition after first-ever emergency department presentation for self-harm

Within one year of a first-ever emergency department presentation for self-harm, just over 12% of 12-17 year-olds repeated and of those that did, about a quarter repeated more than once. The proportion repeating was higher than previous studies that have reported the figure specifically for those making their first-ever self-harm presentation (estimates have been about 7-10%).[6,50,130]

Bivariate analyses showed certain demographic and clinical factors were associated with repetition. As hypothesized, those who presented with self-cutting were more likely to repeat and repeated more often. Contrary to hypotheses, girls and 12-15 year-olds were also more likely to repeat and repeated more often. Conversely, there was also some evidence that those living in Toronto and those triaged highest acuity (resuscitation or emergent) were less likely to repeat and repeated less often. Mental health service history and coding of self-harm predicted repetition, but not the number of repeat events. Hurdle models also revealed that, although there was no association with repetition, of those who did repeat, individuals living in lower income neighbourhoods repeated more often.

5.1.4 Objective 4

Association between mental health follow-up after first-ever emergency department presentation for self-harm and repeat self-harm presentation(s)

This analysis did not show that a measure of mental health follow-up had a protective association with repeat self-harm presentation(s). In fact, even in adjusted analyses, follow-up with a psychiatrist was positively associated with odds of repetition.

Should these effects be true, possible explanations relate to the exposure, the outcome and the potential effect of other factors, including:

a. No association may reflect lack of effective interventions for self-harm

This analysis was investigating a very broad approach – essentially, as described by Evans,[201] the "pragmatic solution… to screen those presenting following self-harm for major psychiatric illness and treat this group with appropriate evidence-based interventions" (p. 46). Yet, there is no single proven uniformly delivered intervention for reducing self-harm repetition. New research is needed in the area of self-harm and with it, new approaches to studying this population. Recent advances have included applying novel designs,[134] including actively suicidal and self-harming youth and reporting on suicidality and self-harm outcomes,[202] and involving service users to design interventions.[203] Interventions specific to youth that differentiate suicidal from non-suicidal behavior and address the importance of contextual factors may be most promising.[204]

Further, the exposure variable was an indicator (yes/no) of mental health service use within 30-days. Although it was chosen as a measure of quality (reflecting continuity of care) that was consistent with previous research and broader indicator development work (see Section 2.3) it may have been an inadequate measure for this population. That is, because one mental health contact in 30 days does not necessarily represent appropriate and/or ongoing clinical care. In this regard, non-adherence has been well-documented in this population (see Section 6.1.2) and there are likely great variations in the type and extent of care offered in follow-up.

b. Positive association may reflect positive engagement with health system

As will also be discussed in section 6.2.2, recent discourse has highlighted the utility of repeat self-harm presentations as a study outcome. More specifically, although repetition is typically treated as a negative outcome (see Section 2.4.1), it may also represent positive engagement with services in a population that is often reluctant to come in to contact with health services.[205] In fact, it may be that in the course of the emergency department presentation or mental health follow-up, young people were encouraged to return to the emergency department at times of crisis. This may be particularly relevant to studying certain populations, such as those living in rural areas with fewer specialist pediatric mental health services[103,104] or emergency department alternatives (e.g., walk-in clinics).

c. Positive association may reflect effects of other factors linked to mental health follow-up

Given that a large proportion of this cohort likely had a diagnosable mental disorder, most often depression,[206,207] some (and especially those who received mental health follow-up) will have been taking antidepressants. As such, a comment must be made on the recent controversy regarding a possible heightened suicidality risk among youth taking selective serotonin reuptake inhibitors (SSRIs) and the prospect that any increase in self-harm presentations may be linked to these medications. Although the possible link between SSRIs and suicidality is still unresolved, observational data have shown that regulatory warnings (including in Canada and the United States, mid-2004) were associated with decreased prescriptions and increased suicide rates among youth in the United States and the Netherlands[208] with similar evidence from Canada.[209] With regard to self-harm, a UK study showed that although prescriptions decreased, emergency department presentations for self-harm among youth did not change after the regulatory warning there.[210] Similarly, Manitoba data showed no effect on inpatient admission for self-harm among youth.[209]

Should the associations observed in objective 4 be untrue effects, possible explanations relate to bias from residual confounding and/or misclassification:

a. Residual confounding

    Although multivariable analyses were used to adjust for confounding, it is possible that residual confounding was present, either because of confounders measured with error or unmeasured confounders. Confounding by indication[175] or confounding by severity[176] were of particular concern in this analysis. In the current context, the former refers specifically to scenarios whereby a "disease" is an indication for the intervention (follow-up) and meets the three criteria for confounding (see Section 3.4.2 for the list of criteria). The latter, confounding by severity, is a special form of confounding by indication, whereby the prognosis or severity of a disease manifestation acts as the confounder. In this case, controlling for the disease would not exclude the possibility of residual confounding.[176] For example, as will be discussed in Section 6.2.1, it was likely that those who were suicidal were more likely to be referred for and receive follow-up as well as more likely to make a repeat self-harm presentation.[211] However, adjusting for a binary measure of suicidality would not necessarily fully account for the spectrum of severity with which these youth likely presented.

    Residual confounding may have accounted for the results; these data were somewhat limited in detailed diagnostic, clinical or health services information (see Section 6.2.1) with which to adjust the analyses. As discussed in Section 6.2.1, future studies may require new measures,

possibly through primary data collection, developing and validating measures from administrative data and/or new data linkages.

b. Misclassification of exposure variable

The utility of administrative data for defining mental health services delivered in primary care settings has been studied to some extent in adults,[164] but has not yet been tested specifically in this pediatric population. Some physician contact within 30-days of the self-harm presentation may have been misclassified. Non-differential misclassification would bias the association towards the null, however, differential misclassification could bias associations either toward or away from the null.[212]

5.2 Limitations

5.2.1 Drawbacks of Administrative Data

Although administrative data are a vital source of information for health policy and planning and offer numerous advantages for studying self-harm (see Section 2.4.2), inherent limitations must also be acknowledged. (Some of these limitations were introduced, in the previous section, and are addressed in a more systematic way for the entire dissertation, in this section.)

Imperfect ascertainment of self-harm

Of those who present to the emergency department, the self-inflicted nature of their injury or poisoning may go undetected or unrecorded.[213] For example, because of stigma, the individual may be hesitant to disclose and/or the clinician may be reluctant to document self-harm. While an attempt was made to account for some of the probable under-ascertainment of self-harm by including presentations coded as "undetermined" (some of which have been found to likely represent self-harm)[150] it is still unclear which definition of self-harm is most accurate. The potential effects of imperfect ascertainment of self-harm are as follows:

- Objective 1: Such phenomena would lead to underestimates of the frequency of emergency department presentations for self-harm: incidence rates would be underestimated as would the estimates of self-harm as a proportion of all emergency department use. Further, it is possible that this under-ascertainment may be differential, for example, with regard to sex differences, because boys may be less likely to disclose their intent than girls.[214]

- Objective 2: Differential ascertainment could also lead to measurement-related selection bias. For example, if those who were most acutely suicidal were more likely to be coded as self-harm.

Presumably these individuals would also be more likely to get follow up and, as such, the results would have overestimated the proportion of youth who receive mental health follow-up after their first-ever emergency department presentation for self-harm.

- Objective 3: Measurement-related selection bias, as described above, would also have overestimated the proportion of youth who made repeat self-harm presentation(s), as suicidality has been associated with self-harm repetition.[211]

- Objective 4: Measurement-related selection bias, as described above, could also have distorted the measure of the association between follow-up and repetition.[212]

Misclassification of variables

The quality of these data for certain measures may be questionable. About 25% of self-harm presentations were identified as having a mental health (primary or other) diagnosis (data not shown). However, other studies of similar populations have reported this figure to be between 50 and 75%.[41,129,185] Similarly, these data showed less than 5% of emergency department presentations for self-harm recorded alcohol involvement. In contrast, data from a specialized self-harm monitoring system in Oxford, England showed about 18% of self-harm presentations by 15-24 year-olds involved alcohol[27] and similar data from New Zealand and Finland found this figure was 29%[192] and upwards of 50%[41] respectively. These differences may suggest disparities between settings in mental health diagnoses and/or alcohol involvement, but a more likely explanation may be clinical ascertainment differences and/or NACRS data quality. With respect to the latter, under-reporting of problems has been documented for NACRS (individuals who presented with multiple conditions or problems often have only one diagnosis recorded on the NACRS record).[180] The potential effects of misclassification of variables are as follows:

- Objective 1: The estimates for diagnoses other than the self-harm injury or poisoning (i.e., mental health diagnoses and alcohol involvement) may be understated.

- Objective 2: Measurement error may be present; for example, assuming non-differential misclassification, associations between alcohol involvement and mental health follow-up would be biased towards the null (differential misclassification could bias associations either toward or away from the null).[212]

- Objective 3: Measurement error, as described above, would similarly bias the association between alcohol involvement and repetition.

- Objective 4: The opportunity for residual confounding remained; misclassification of one or more covariates may have biased the measure of the association between follow-up and repetition, by imperfectly controlling for the covariate(s) in question.[215]

For both issues described above (imperfect ascertainment of self-harm and misclassification of variables), future studies may require primary data collection, or studies to develop and validate data algorithms (similar to those defining diabetes[216] and asthma[217] using administrative data). However, such validation studies were not feasible with these retrospective administrative data.

Variables not captured in current datasets

Some important variables were outside the scope of the current datasets. For example, it was impossible to disaggregate self-harm by suicidal intent. Hawton et al, who are responsible for a 30+ year ongoing project monitoring self-harm presentations in a hospital in England have described the core and desirable variables that could be included in such monitoring systems, including suicidal intent.[120] Unfortunately, such information is not included in the current NACRS data and ICD does not distinguish suicidal and non-suicidal acts. The potential effects of variables not captured in current datasets (and pertaining specifically to the example provided above) are as follows:

- Objective 1: The data could not establish what proportion of self-harm presentations represented suicide attempts versus non-suicidal self-injury.

- Objective 2: Suicidality is likely seen as an important indication of need for mental health services, and although a positive association between suicidality and mental health follow-up likely existed, these data could not test such a hypothesis.

- Objective 3: Suicidality has been found to be associated with repetition,[211] but it is still unclear whether this finding extends to the number of repeat presentations.

- Objective 4: The opportunity for residual confounding remained;[g] there was no measure of severity included in these data, nor were there data on some other important factors (potential confounders), including suicidality. As described above, suicidality likely predicted both mental health follow-up and repeat self-harm presentations and could have, therefore, acted as an unmeasured confounder.

---

[g] Note, other methods have also been advocated for outcomes research, such as propensity score methods or instrumental variable analysis.[218] In practice, propensity score methods may not have affected results; they cannot account for unmeasured confounding[219] and propensity scores based on administrative data may not balance characteristics contained in more detailed clinical data.[220] In fact, a review of observational studies that used propensity score methods found little difference in strength or statistical significance of effect estimates when comparing these results to those of traditional multivariable models.[221] Similarly, instrumental variable analysis requires, among other assumptions, an "instrument" that is a good predictor of treatment and is unrelated to unmeasured confounders.[218]

Researchers are increasingly acknowledging that, although highly associated,[222] attempted suicide and non-suicidal self-injury differ on various factors, including intent and epidemiology[223] and future research should endeavor to distinguish them as such.[213,224,225] A system which also incorporates a third category, that where the suicidal intent is undetermined,[11,12,226] may also be most useful given difficulties in assessing suicidal intent.[227,228] Understanding the different forms of self-harm may have important implications for future revisions to the ICD.[224]

Mental health services not captured in current linked datasets

These data did not capture all relevant information on mental health and addiction services. For example, there was no comprehensive information about mental health services provided in the emergency department prior to discharge, including psychiatric consultation or crisis team assessment.[107] Further, available data sources do not include information on contact with non-physician providers (such as psychologists, nurses and social workers) who are seen exclusively by about one-quarter of Canadians who use mental health services[229] (although it is unclear whether this finding extends specifically to youth). The potential effects of mental health services not captured in current linked datasets are as follows:

- Objective 1: Not applicable.

- Objective 2: Mental health follow-up overall was no doubt higher than what was reported in the current data, which provided only information on physician providers.

- Objective 3: Not applicable.

- Objective 4: The opportunity for residual confounding remained. However, the impact on the measure of the association between follow-up and repetition is difficult to predict as it is unclear both to what extent other services were accessed and what effect they may have on repetition.

Further study is needed to establish the mental health services used by Canadian youth, and, in particular, how often and which non-physician providers are accessed. New data linkages, such as with those capturing drug and alcohol treatment services[230] and community mental health services[231] may represent opportunities to address important research and policy issues.

5.2.2 Repeat Self-harm Presentations as the Outcome

The outcome in the relationship of interest (Objective 4) was repeat emergency department presentation(s) for self-harm within 1-year of the index event. Although similar measures have typically been the outcome of interest in observational and intervention studies on self-harm, several

limitations must also be acknowledged. First, other important outcomes (i.e., mortality [all cause and suicide] and self-reported symptoms, behaviours and emotions [see Section 2.4.1]) were not addressed. Unfortunately, mortality could not be studied because, at the time this work was carried out, ICES data did capture accurate date or cause of death information (unless the death occurred in-hospital). Similarly, no self-reported information was available. Second, only repeat self-harm presentations within 1-year after the index event were assessed. Although risk extends beyond 1-year, the majority of those who repeat will do so within that time; Owens et al's review found about 16% will return to the emergency department for self-harm within 1-year and this figure rises to about 20-25% in the subsequent few years.[19] Third, all repetition may not be a negative outcome (see Section 6.1.4). Some clinicians and researchers have argued that, in some, repeat self-harm presentations may reflect positive engagement with health services in a hard-to-reach population (e.g., the individual has recognized to ask for help and thus a positive outcome).[205]

5.3 Implications

5.3.1 For Policy and Practice

Self-harm: a public health issue

The descriptive data presented here portray a clinical population quite similar to those of other countries. The data also showed that self-harm accounts for a relatively small proportion of emergency department use among 12-17 year-olds, but a disproportionate number of emergency department presentations that are highest acuity (i.e., triaged resuscitation or emergent), involve alcohol and result in inpatient admission. No previous Canadian study has provided such data on self-harm in youth. These results should focus attention, both of the public and of policy-makers, on this important public health issue.

Strategies to improve mental health follow-up after emergency department presentation for self-harm

These results also suggested youth receive suboptimal follow-up after their first-ever emergency department presentation for self-harm and strategies to improve follow-up are warranted. Such strategies might include those advocated in clinical guidelines, such as arranging follow-up prior to discharge,[85] involving primary care practitioners[84] and parents[85] in ongoing care, and written information on discharge (e.g., key contacts and details about follow-up arrangements).[82,86] The data also showed patterns of health service use among youth following their first-ever emergency

department presentation for self-harm that suggested specific approaches may be needed in certain populations. In particular:

a. Boys have already been shown to be identified with self-harm less often than girls,[118] independent of method of injury/poisoning, acuity or admission.[150] Rhodes et al suggested this difference may reflect male propensity for impulsivity, emotional inexpressiveness, substance misuse and differential patterns of care.[232-234] These factors may also explain differences in mental health follow-up, but taken in context with the higher suicide risk among males, highlight a need for better assessment and management for boys who present to the emergency department for self-harm.

b. Youth living in rural areas have already been shown to access (and have access to) fewer specialist mental health services. Not surprisingly, this finding extends to those making their first-ever emergency department presentation for self-harm. Those living in rural areas and small communities (population less than 100,000) were less likely than those living in more populated areas to receive follow-up from a psychiatrist, and the effect still held when considering mental health follow-up from other physician specialties. These differences reinforce the importance of programs such as pediatric telepsychiatry,[235,236] which can serve youth in areas where specialist access is problematic.

c. Individuals who use self-cutting as a method of self-harm have been shown to be less likely to receive a psychosocial assessment or be admitted, despite their risk of negative outcomes.[143] The results presented here corroborate this finding as it appears these individuals may also be less likely to receive mental health follow-up. They also support the suggestion that the protective effect for psychosocial assessments would be mediated through increased referrals for psychiatric follow-up.[89]

d. Those discharged directly from the emergency department receive mental health follow-up less often than those who receive inpatient psychiatric services. This may mean the most severe (those admitted to hospital) are appropriately receiving the most follow-up. Yet, even among those who were admitted, there was some evidence that those who did not receive inpatient psychiatric services were less likely to receive follow-up; this finding is supported by previous research that showed more psychiatric contact while admitted improved adherence to follow-up.[199] Quality inpatient care may help establish a therapeutic alliance and improve adherence to follow-up (partly through minimizing negative beliefs about

psychiatry).[135] For those discharged directly from the emergency department, brief interventions may represent similar opportunities. For example, Rotheram-Borus et al's intervention for girls who had attempted suicide included a videotaped orientation (covering the dangers of ignoring suicide attempts and the potential benefits of treatment) and a structured family therapy session in the emergency department.[72]

e. Those with no previous contact with mental health services (ambulatory and in hospital) were least likely to receive follow-up. These associations may be explained by severity; that is, those with a history of mental health service use may represent a more severely affected subset who would, therefore, be more likely to be referred for follow-up. The relationship with ambulatory mental health service use further suggests those with a history of such contact(s) may have already overcome barriers in gaining access prior to their self-harm presentation.[97] Olfson et al, using American data on adult Medicaid recipients, also found a strong association between history of mental health service use and follow-up.[93] They went on to state that some of this "follow-up" likely represented ongoing mental health care rather than emergency department-facilitated referrals and added that a coordinated effort is needed to engage people who self-harm who are not currently receiving mental health care. Still, more research is needed to assess whether this relationship between mental health service use history and follow-up reflects the upstream effects of predisposing factors (i.e., socio-cultural characteristics of the individual), enabling factors (i.e., practical realities of obtaining care) or need factors (either perceived or evaluated).[237]

Taken together, the results presented here suggest emergency department initiated strategies to improve mental health follow-up may be needed, but that certain populations may also require broader strategies (e.g., improving availability of specialists or addressing family and individual attitudes regarding mental health and mental health services).

Mental health follow-up as a prevention strategy

These data were unable to demonstrate that follow-up mental health care could reduce repeat emergency department presentations for self-harm. Potential explanations for this finding are discussed in Section 6.1.4, but the ultimate impact of this and other "high risk" approaches must also be contextualized. In particular because, as described by Rose as the "prevention paradox",[61] the majority of suicides arise from those who will never present to the emergency department for self-harm. (In fact, an analysis from the UK showed that if an intervention could reduce suicide rates by

75

25% among those who present to hospital for self-harm it would only reduce suicide rates by about 6%.)[238] Still, this is an at-risk population in which other important health outcomes, including repeat self-harm, might be prevented.

Taken together, the need for action, the gaps in evidence and the limitations to the high-risk strategy underscore the importance of an integrated prevention approach, with multiple strategies. Many countries (including Australia, Denmark, England, Estonia, Finland, Germany, Greenland, Japan, Ireland, Northern Ireland, the Netherlands, New Zealand, Norway, Scotland, Sri Lanka, Sweden, the United States and Wales)[154] have formally addressed this need for an integrated approach with national suicide prevention strategies. For example, Ireland's national strategy for action on suicide prevention includes universal strategies (to promote positive mental health and well-being and bring about positive attitude change towards mental health, problem solving and coping in the general population) as well as indicated approaches (including, but not limited to, developing and resourcing effective health services for people who present with self-harm).[239] Although a national suicide prevention strategy has been developed and advocated for by the Canadian Association for Suicide Prevention,[240] one has yet to be adopted and implemented. However, there has been very recent progress in this regard; on October 4th, 2011, the House of Commons passed a motion in support of establishing and funding a national suicide prevention strategy.[241]

5.3.2 For Research and Monitoring

On a practical note, this work demonstrated the potential of existing administrative data for self-harm research and monitoring. Relative to establishing a specialized self-harm monitoring system, the advantages of these data include low cost and complete coverage over time and geographic area; the research was conducted relatively easily and inexpensively while also exploiting the opportunities for individual-linkage (see Section 2.5). The need for improved mental health surveillance, including of self-harm, has been identified by both government and stakeholder groups[240,242-244] as well as in international suicide prevention strategies (e.g., in England,[121] Ireland,[239] Scotland,[245] and New Zealand,[246]). Standardized, pan-Canadian information is available on all inpatient admissions to general hospitals, and this data was recently used by Statistics Canada and CIHI for the first Health Indicators report on self-harm in Canada.[46] However, emergency department data offer more representative information (see Section 2.4.2).[146] Unfortunately, Canada does not currently maintain a national emergency department data system.[247] However, NACRS, from which the current data were drawn, is mandated for all Ontario emergency departments, and

some facilities in British Columbia, the Yukon, Prince Edward Island and Nova Scotia also submit this data.[155] NACRS continues to expand and Alberta, Manitoba and Saskatchewan have also recently begun submitting emergency department data and plans are underway in British Columbia, Saskatchewan and Nova Scotia to expand their data collection.[248] This study, which made efficient use of these existing data, highlighted the current capabilities as well as opportunities for expansion.

Going forward, this study has also demonstrated some useful and relevant methods for self-harm research and monitoring. First, to consider whether some injury and poisoning presentations coded as "undetermined" may represent self-harm (as suggested by previous research on inpatient admissions[249,250] and emergency department presentations[150]). The results presented here corroborated this observation. More specifically, the data showed that coding of "undetermined" intent (vs. "self-harm") at an individual's first-ever emergency department presentation for self-injury or -poisoning was negatively associated with the odds of repetition during the subsequent year, but not associated with the number of repeat presentations; in other words, the data suggested that some undetermined presentations represent unintentional injury (hence the difference in odds of repetition), but also self-harm (as the number of repeat presentations did not differ among repeaters). Accordingly, these results reinforce the practice of considering these presentations coded "undetermined" when quantifying emergency department presentations for self-harm. Similar findings in death data (whereby suicides are sometimes coded "undetermined)[251,252] have had important implications for how suicides are studied and reported; for example, "undetermined" deaths are sometimes included in suicide studies[253] and official suicide statistics.[254]

Second, this research demonstrated the use of hurdle models applied to repeat emergency department presentations for self-harm. These analyses yielded new findings that will help to plan future studies, as well as generate hypotheses for future research; for example, hurdle models confirmed that individuals living in lower income areas were not more likely to repeat, however, among those that did repeat, individuals living in lower income areas repeated more often. Others have also acknowledged the need to include multiple events and employed multiple event survival analysis,[143] including in studying the effect of psychosocial assessments on repeat self-harm presentations.[87,89] Although further discourse on the most appropriate analytic strategy is merited, the choice of analytic strategy should ultimately depend on the study design and hypothesis.

5.3.3 Generalisability

A common weakness of any health service data is that they will not necessarily capture the extent and nature of the problem. This study analyzed self-harm presentations to the emergency department and results cannot be generalized to those who do not seek this care, although the latter represent a sizeable number.[112,116] Nevertheless, the results presented here suggested the frequency of child and adolescent emergency department presentations for self-harm is similar to those reported from other Western countries. Also, the clinical population is quite similar; in particular, because findings that emergency department presentations for self-harm were more common in girls, increased with age and most often involved self-poisoning then self-cutting, mirrored those reported from England,[51] Ireland,[50] the United States[48,49,185] as well as the Canadian province of Alberta.[146] However, it is unclear whether the patterns of health service use extend to other populations, and in particular, where health services are not universally insured as they are in Canada. For example, survey data from the United States showed that among 12-17 year-olds who reported a suicide attempt in the previous year, insurance status predicted outpatient mental health service use; compared to those with no insurance, those with Medicare or Medicaid were about twice as likely to access outpatient services (with no effect for other types of insurance).[255]

5.3.4 Areas for Future Research

1. Geographic differences: Community size

Some new results were presented here on demographic patterns in emergency department presentations for self-harm. Namely, that the incidence rate was lowest among youth living in Toronto (Canada's largest city) and highest among those living in lowest population areas. These findings diverge from those reported from Ireland[184] and the United States[256] (see Appendix A). Although higher rates of self-harm have been reported in some ethic groups (e.g., young South Asian and Black women living in England),[257,258] this seems an unlikely explanation given the proportion of Toronto's population made up by visible minorities is about double that for Ontario overall (46.9% vs. 22.8%, respectively).[259] More plausible hypotheses may overlap with the mechanisms proposed to explain higher suicide rates in rural areas.[260,261] For example, differences in service delivery systems, as documented here with mental health follow-up, may be an important factor (e.g., high population areas' better access to potentially-preventive mental health services[103,104]). This may also explain the results suggesting youth living in Toronto were less likely to repeat after their first-ever emergency department presentation for self-harm and also have fewer repeat

presentations. Another potential explanation for the geographic differences may relate to higher incidence of self-harm in Aboriginal people; although information specific to self-harm is lacking, suicide rates are five to seven times higher for First Nations youth than for non-Aboriginal youth.[262] Other research questions with respect to geographic differences by community size may address interaction effects; that is, whether the differences in mental health follow-up apply evenly (e.g., whether the association is seen only in less severe presentations).

2. Hospital-level factors

Differences between hospitals in aspects of self-harm management (including inpatient admissions and referrals for specialist follow-up) have been documented,[7,90,98] yet the hospital characteristics that may explain these differences are largely unknown.[119] Nevertheless, hospital-level characteristics (such as emergency department monitoring systems, written guidelines and staffing) have been reported upon as "quality of care indicators" for self-harm.[263] Despite their untested link with relevant outcomes, many of these hospital-level characteristics were among recommendations contained in nationally-endorsed guidelines[1,82-86] thereby providing some rationale for this use.[264] Still, research is needed to test institution-level effects on outcomes relevant to this population. Such research would require appropriate statistical methodologies to account for the hierarchical structure of the data, such as multilevel models.[172]

3. Performance measures

As previously discussed, a possible explanation for the results in objective 4 (the association between mental health follow-up and repeat self-harm presentation(s)) may be that "30-day mental health follow-up" is an inappropriate measure of continuity of care for this population. For example, this measure does not acknowledge the problems with adherence in this population. Accordingly, further research is needed to refine performance measures for this population. This may include, for example, research testing the association between the number of mental health contacts and repeat self-harm presentation(s). Developing performance measures in pediatric emergency care, in general and for specific conditions, is emerging as an important area of research.[107,108]

4. Mortality outcomes

This study did not assess outcomes other than repeat self-harm presentations (see Section 6.2.2). Future work linking this cohort to mortality outcomes, including suicide, is warranted. Although

suicide is a rare event, these data accrued a relatively large cohort and so would offer opportunities to address important hypotheses in relation to mortality outcomes (including whether mental health service use might be protective of suicide). Expanded data linkages, for example, such that ICES receives vital statistics data directly from the Office of the Registrar General, would be needed.[183]

5. Time trends

This study did not address any temporal trends in emergency department presentations for self-harm. There is some evidence from England that self-harm presentations declined during the 8-year period between 2000 and 2007, mirroring suicide statistics[265] and there may be similar trends in Canada.[46] Also, ecological analyses have also addressed specific research questions related to self-harm. For example, time-series analyses have studied the effects of regulatory warnings[210] and the attack on New York's World Trade Center[266] on self-poisonings.

6. Alcohol involvement

Despite the likely under-recording of alcohol involvement (see Section 6.2.1) these results suggested that individuals whose index self-harm presentation involved alcohol were not only less likely to obtain follow-up, but also less likely to repeat (although these effects were not always statistically significant). Still, similar findings have been reported in other data.[135,192] The nature and effects of alcohol involvement in self-harm appear to warrant further research, but likely require primary data collection rather than routinely-collected administrative data.

7. Inpatient admission

The results presented here for the association between inpatient admission and repeat self-harm presentation(s) differed from those previously published using similar data. That is, an earlier unadjusted analysis (also using a hurdle model) showed that inpatient admission was not associated with the odds of repetition, but it was associated with fewer repeat presentations (among repeaters).[144] However, the current data showed receiving inpatient psychiatric services was associated with an increased odds of repetition (under SH2). These apparently conflicting results may reflect a difference in the study population (the previous study was not an inception cohort), exposure (the previous study did not distinguish inpatient admission according to psychiatric services), or analysis (the previous study used a random effects model for hospital-level clustering). Although admission has not been shown to reduce repeat self-harm,[267] potential benefits from good

inpatient care may include improved assessment and adherence to follow-up[101,199] and so these effects should be delineated in context with each other.

8. Triage score

In unadjusted analyses, CTAS predicted both mental health follow-up as well as repeat self-harm presentation(s). That is, compared to those triaged as highest acuity (emergent or resuscitation), those triaged as lowest acuity (semi- or non-urgent) were less likely to receive mental health follow-up, but more likely to repeat and repeat more often. Although those triaged as highest acuity were also more likely to be admitted to hospital and the inpatient services may have facilitated follow-up,[101,199] after adjustment for admission, the associations between CTAS and mental health follow-up were attenuated but remained statistically significant (data not shown). It also seems plausible that those triaged as highest acuity were most actively suicidal and hence referred for follow-up more often (independent of inpatient admission). This would also explain why those who used self-cutting methods may be less likely to receive follow-up (suicidal intent has been shown to be higher among youth who self-poison compared to those who use self-cutting).[268] As for repetition, the association with CTAS may also be explained by differences in method of self-harm; self-cutting has been reported to be positively associated with repetition[87,130,143] and was more often triaged as lowest-acuity. Taken together, the associations between triage score and method of self-harm with follow-up and repetition should be investigated to determine if targeted approaches are needed.

9. Socioeconomic status

Consistent with most other health conditions, the incidence rate of emergency department presentations for self-harm was inversely related to neighborhood income. Ayton el al, who showed similar findings with data from England, provide a discussion of potential mechanisms to explain this relationship, including family (genetic and environmental) factors, exposure to violence, lifestyle (e.g., substance abuse) and housing.[188] The results presented here confirmed that neighbourhood income was not associated with the odds of repetition,[269] but, using hurdle models, were also able to show that those living in low income neighborhoods repeated more often. Taken together, these findings may have important implications for suicide and self-harm prevention, and as such, the potential mechanisms for this relationship should be investigated further. Such research could consider other area-level measures of socioeconomic status (such as education level, which has been found to predict specialist psychiatry use)[270] and should include individual-level measures.

These findings would have important implications for economic and social policy (e.g., poverty reduction), as well as directing resources for implementing interventions.[184,188]

10. Parental/caregiver involvement

Parental attitudes have been found to be an important predictor of aftercare following adolescents' psychiatric hospitalization.[271] As such, intervention studies conducted among those who present to the emergency department for self-harm have included parents.[72] Involving parents and caregivers has also been highlighted in clinical guidelines for self-harm,[145] for example, obtaining their consent for mental health assessments,[1] collecting collateral information from them,[86] advising them to remove means of self-harm from the home[272,273] or providing them with written information.[274] Some guidelines also address the importance of involving parents and caregivers in obtaining aftercare, such as through assessing their attitudes towards intervention and follow-up[84] or reminding them of appointment times and missed appointment.[85] The effect of parental involvement, on both the receipt and effect of follow-up, merits further attention. Yet, it is also important to acknowledge that self-harm may be related to maltreatment or child protection issues,[83,86] including physical[275] and sexual abuse,[276] and this must also be addressed.

References

Reference List

1. National Collaborating Centre for Mental Health commissioned by the National Institute for Clinical Excellence. Self-harm. The short-term physical and psychological management and secondary prevention of self-harm in primary and secondary care. 2004.

2. Mann JJ, Apter A, Bertolote J, Beautrais A, Currier D, Haas A, et al. Suicide prevention strategies: a systematic review.[see comment]. [Review] [147 refs]. *JAMA.* 2005;294:2064-74.

3. Jacobson CM, Gould M. The Epidemiology and Phenomenology of Non-Suicidal Self-Injurious Behavior Among Adolescents: A Critical Review of the Literature. *Archives of Suicide Research.* 2007;11:129-147.

4. Platt S, Bille-Brahe U, Kerkhof A, Schmidtke A, Bjerke T, Crepet P, et al. Parasiticide in Europe: the WHO/EURO multicentre study on parasuicide. I. Introduction and preliminary analysis for 1989. *Acta Psychiatrica Scandinavica.* 1992;85:97-104.

5. Hjelmeland H, Hawton K, Nordvik H, Bille-Brahe U, De LD, Fekete S, et al. Why people engage in parasuicide: a cross-cultural study of intentions. *Suicide & Life-Threatening Behavior.* 2002;32:380-393.

6. Hulten A, Jiang GX, Wasserman D, Hawton K, Hjelmeland H, De LD, et al. Repetition of attempted suicide among teenagers in Europe: frequency, timing and risk factors. *European Child & Adolescent Psychiatry.* 2001;10:161-9.

7. Hulten A, Wasserman D, Hawton K, Jiang GX, Salander-Renberg E, Schmidtke A, et al. Recommended care for young people (15-19 years) after suicide attempts in certain European countries. *European Child & Adolescent Psychiatry.* 2000;9:100-8.

8. McAuliffe C, Corcoran P, Keeley HS, Arensman E, Bille-Brahe U, De LD, et al. Problem-solving ability and repetition of deliberate self-harm: a multicentre study. *Psychological Medicine.* 2006;36:45-55.

9. DeLeo D., Burgis S, Bertolote J, Kerkhkof A, Bille-Brahe U. Definitions of suicidal behavior: lessons learned from the WHo/EURO multicentre Study. *Crisis.* 2006;27:4-15.

10. Hatcher S, Sharon C, Coggan C. Beyond Randomized Controlled Trials in Attempted Suicide Research. *Suicide and Life-Threatening Behavior.* 2009;39:396-407.

11. Silverman M, Berman AL, Sanddal ND, O'Carroll PW, Joiner TE. Rebuilding the Tower of Babel: A Revised Nomenclature for the Study of Suicide and Suicidal Behaviors. Part 1: Background, Rationale, and Methodology. *Suicide & Life-Threatening Behavior.* 2007;37:248-263.

12. Silverman M, Berman AL, Sanddal ND, O'Carroll PW, Joiner TE. Rebuilding the Tower of Babel: A Revised Nomenclature for the Study of Suicide and Suicidal Behaviors Part 2: Suicide-Related Ideations, Communications, and Behaviors. *Suicide and Life-Threatening Behavior.* 2007;37:264-277.

13. Skegg K. Self-harm. *The Lancet.* 2005;366:1471-1483.

14. Hjelmeland H, Groholt B. A comparative study of young and adult deliberate self-harm patients. *Crisis: The Journal of Crisis Intervention and Suicide Prevention.* 2005;26:64-72.

15. Madge N, Hewitt A, Hawton K, Wilde EJd, Corcoran P, Fekete S, et al. Deliberate self-harm within an international community sample of young people: comparative findings from the Child & Adolescent Self-harm in Europe (CASE) Study. *Journal of Child Psychology and Psychiatry.* 2008;49:667-677.

16. Hawton K, Rodham K, Evans E, Weatherall R. Deliberate self harm in adolescents: self report survey in schools in England. *BMJ.* 2002;325:1207-11.

17. World Health Organisation. ICD–10: International Statistical Classification of Diseases and Related Health Problems. 1992.

18. Vajani M, Annest JL, Crosby AE, Alexander JD, Millet LM. Nonfatal and fatal self-harm injuries among children aged 10-14 years--United States and Oregon, 2001-2003. *Suicide & Life-Threatening Behavior.* 2007;37:493-506.

19. Owens D, Horrocks J, House A. Fatal and non-fatal repetition of self-harm. Systematic review. [Review] [69 refs]. *British Journal of Psychiatry.* 2002;181:193-9.

20. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R. World report on violence and health. World Health Organization 2002Available from: URL: http://whqlibdoc.who.int/publications/2002/9241545615_eng.pdf

21. West BAM, Swahn MHP, McCarty FP. Children at Risk for Suicide Attempt and Attempt-related Injuries: Findings from the 2007 Youth Risk Behavior Survey. *Western Journal of Emergency Medicine.* 2010;11.

22. Martin G, Swannell S, Harrison J, Hazzell P, Taylor A. The Australian National Epidemiological Study of Self-Injury (ANESSI). Brisbane, Australia; 2010.

23. Evans E, Hawton K, Rodham K. Factors associated with suicidal phenomena in adolescents: A systematic review of population-based studies. *Clinical Psychology Review.* 2004;24:957-979.

24. Colman I, Yiannakoulias N, Schopflocher D, Svenson LW, Rosychuk RJ, Rowe BH. Population-based study of medically-treated self-inflicted injuries. *Canadian Journal of Emergency Medicine.* 2004;6:313-320.

25. Bridge JA, Goldstein TR, Brent DA. Adolescent suicide and suicidal behavior. *Journal of Child Psychology and Psychiatry.* 2006;47:372-394.

26. Hawton K, Zahl D, Weatherall R. Suicide following deliberate self-harm: long-term follow-up of patients who presented to a general hospital.[see comment]. *British Journal of Psychiatry.* 2003;182:537-42.

27. Hawton K, Harriss L. Deliberate self-harm in young people: characteristics and subsequent mortality in a 20-year cohort of patients presenting to hospital. *Journal of Clinical Psychiatry.* 2007;68:1574-83.

28. Shaffer D, Gould MS, Fisher P, Trautman P, Moreau D, Kleinman M, et al. Psychiatric Diagnosis in Child and Adolescent Suicide. *Archives of General Psychiatry.* 1996;53:339-348.

29. Brent DA, Baugher M, Bridge JA, Chen T, Chiapetta L. Age- and Sex-Related Risk Factors for Adolescent Suicide. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1999;38:1497-1505.

30. Marttunen MJ, Henriksson MM, Aro HM, Heikkinen ME, Isometsa ET, Lonnqvist JK. Suicide among Female Adolescents: Characteristics and Comparison with Males in the Age Group 13 to 22 Years. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1995;34:1297-1307.

31. Houston K, Hawton K, Shepperd R. Suicide in young people aged 15-24: a psychological autopsy study. *Journal of Affective Disorders.* 2001;63:159-170.

32. Public Health Agency of Canada. Leading Causes of Death and Hospitalization in Canada. http://www phac-aspc gc ca/publicat/lcd-pcd97/table1-eng php 2008

33. Suicide prevention (SUPRE). World Health Organization 2011Available from: URL: http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/

34. Suicides and suicide rate, by sex and by age group. Statistics Canada 2010Available from: URL: http://www40.statcan.ca/l01/cst01/hlth66a-eng.htm

35. Nixon MK, Cloutier P, Jansson SM. Nonsuicidal self-harm in youth: a population-based survey. *Canadian Medical Association Journal.* 2008;178:306-312.

36. Lewis G, Pelosi AJ, Araya R, Dunn G. Measuring psychiatric disorder in the community: a standardized assessment for use by lay interviewers. *Psychological Medicine.* 1992;22:465-486.

37. O'Connor RC, Rasmussen S, Miles J, Hawton K. Self-harm in adolescents: self-report survey in schools in Scotland. *British Journal of Psychiatry.* 2009;194:68-72.

38. Gould MS, King R, Greenwald S, Fisher P, Schwab-Stone M, Kramer R, et al. Psychopathology Associated With Suicidal Ideation and Attempts Among Children and Adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1998;37:915-923.

39. Patton GC, Harris R, Carlin JB, Hibbert ME, Coffey C, Schwartz M, et al. Adolescent suicidal behaviours: a population-based study of risk. *Psychological Medicine.* 1997;27:715-724.

40. Stewart SE, Manion IG, Davidson S, Cloutier P. Suicidal children and adolescents with first emergency room presentations: predictors of six-month outcome. *Journal of the American Academy of Child & Adolescent Psychiatry 40(5):580-7.* 2001.

41. Suominen K, Isometsa E, Martunnen M, Ostamo A, Lonnqvist J. Health care contacts before and after attempted suicide among adolescent and young adult versus older suicide attempters. *Psychological Medicine.* 2004;34:313-21.

42. Asarnow JR, Baraff LJ, Berk M, Grob C, Devich-Navarro M, Suddath R, et al. Pediatric emergency department suicidal patients: Two-site evaluation of suicide ideators, single

attempters, and repeat attempters. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2008;47:958-966.

43. Raphael H, Clarke G, Kumar S. Exploring parents' responses to their child's deliberate self-harm. *Health Education.* 2006;106:9-20.

44. The National Survey on Drug Use and Health (NSDUH) Report. Office of Applied Studies, Substance Abuse and Mental Health Services Administration (SAMHSA) 2009 September 17Available from: URL: http://oas.samhsa.gov/2k9/165/SuicideHTML.pdf

45. Blackmore ER, Munce S, Weller I, Zagorski B, Stansfeld SA, Stewart DE, et al. Psychosocial and clinical correlates of suicidal acts: results from a national population survey. *British Journal of Psychiatry.* 2008;192:279-284.

46. Statistics Canada, Canadian Institute for Health Information. Health Indicators 2011. 2011.

47. Harman JS, Scholle SH, Edlund MJ. Emergency department visits for depression in the United States. *Psychiatric Services.* 2004;55:937-9.

48. Centers for Disease Control and Prevention (CDC). Nonfatal self-inflicted injuries treated in hospital emergency departments--United States, 2000. *MMWR - Morbidity & Mortality Weekly Report.* 2002;51:436-8.

49. Doshi A, Boudreaux ED, Wang N, Pelletier AJ, Camargo CA, Jr. National study of US emergency department visits for attempted suicide and self-inflicted injury, 1997-2001. *Annals of Emergency Medicine.* 2005;46:369-75.

50. Corcoran P, Keeley HS, O'Sullivan M, Perry IJ. The incidence and repetition of attempted suicide in Ireland. *European Journal of Public Health.* 2004;14:19-23.

51. Hawton K, Harriss L. How Often Does Deliberate Self-Harm Occur Relative to Each Suicide? A Study of Variations by Gender and Age. *Suicide & Life-Threatening Behavior.* 2008;38:650-660.

52. Rutz W, vonKnorring L, Walinder J. Frequency of suicide on Gotland after systematic postgraduate education of general practitioners. *Acta Psychiatrica Scandinavica.* 1989;80:151-154.

53. Chapman S, Alpers P, Agho K, Jones M. Australias 1996 gun law reforms: faster falls in firearm deaths, firearm suicides, and a decade without mass shootings. *Injury Prevention.* 2006;12:365-372.

54. Gunnell D, Fernando R, Hewagama M, Priyangika WDD, Konradsen F, Eddleston M. The impact of pesticide regulations on suicide in Sri Lanka. *International Journal of Epidemiology.* 2007;36:1235-1242.

55. Hawton K, Townsend E, Deeks J, Appleby L, Gunnell D, Bennewith O, et al. Effects of legislation restricting pack sizes of paracetamol and salicylate on self poisoning in the United Kingdom: before and after study. *BMJ.* 2001;322:1203.

56. Sinyor M, Levitt AJ. Effect of a barrier at Bloor Street Viaduct on suicide rates in Toronto: natural experiment. *BMJ.* 2010;341.

57. Knox KL, Litts DA, Talcott GW, Feig JC, Caine ED. Risk of suicide and related adverse outcomes after exposure to a suicide prevention programme in the US Air Force: cohort study. *BMJ.* 2003;327:1376.

58. Gould MS, Greenberg T, Velting DM, Shaffer D. Youth suicide risk and preventive interventions: a review of the past 10 years.[see comment]. [Review] [275 refs]. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2003;42:386-405.

59. Portzky G, van HK. Deliberate self-harm in adolescents. [Review] [48 refs]. *Current Opinion in Psychiatry.* 2007;337-342.

60. Fortune S, Sinclair J, Hawton K. Adolescents' views on preventing self-harm. A large community study. *Social Psychiatry & Psychiatric Epidemiology.* 2008;43:96-104.

61. Rose G. The Strategy of Preventive Medicine. Oxford: Oxford University Press; 1992.

62. Campo JV. Youth suicide prevention: does access to care matter? *Current Opinion in Pediatrics.* 2009;21.

63. Beautrais AL. Guest Editorial: Suicide prevention strategies 2006. *Advances in Mental Health.* 2006;5:16-21.

64. Knesper D, American Association of Suicidology &SPRC. Continuity of Care for Suicide Prevention and Research: Suicide attempts and suicide deaths subsequent to discharge from the emergency department or psychiatry inpatient unit. Newton, MA: Education Development Center, Inc.; 2010.

65. Haw C, Hawton K, Houston K, Townsend E. Psychiatric and personality disorders in deliberate self-harm patients. *British Journal of Psychiatry.* 2001;178:48-54.

66. Larkin GL, Beautrais AL, Spirito A, Kirrane BM, Lippmann MJ, Milzman DP. Mental Health and Emergency Medicine: A Research Agenda. *Academic Emergency Medicine.* 2009;16:1110-1119.

67. Da Cruz D, Pearson A, Saini P, Miles C, While D, Swinson N, et al. Emergency department contact prior to suicide in mental health patients. *Emergency Medicine Journal.*

68. Larkin GL, Beautrais AL. Emergency Departments Are Underutilized Sites for Suicide Prevention. *Crisis: The Journal of Crisis Intervention and Suicide Prevention.* 2010;31:1-6.

69. Donaldson D, Spirito A, Esposito-Smythers C. Treatment for adolescents following a suicide attempt: results of a pilot trial. *Journal of the American Academy of Child & Adolescent Psychiatry 44(2):113-20.* 2005.

70. Wood A, Trainor G, Rothwell J, Moore A, Harrington R. Randomized trial of group therapy for repeated deliberate self-harm in adolescents.[see comment]. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2001;40:1246-53.

71. Harrington R, Kerfoot M, Dyer E, Mcniven F, Gill J, Harrington V, et al. Deliberate self-poisoning in adolescence: why does a brief family intervention work in some cases and not others? *Journal of Adolescence.* 2000;23:13-20.

72. Rotheram-Borus MJ, Piacentini J, Cantwell C, Belin TR, Song J. The 18-month impact of an emergency room intervention for adolescent female suicide attempters. *Journal of Consulting & Clinical Psychology.* 2000;68:1081-1093.

73. Carter GL, Clover K, Whyte IM, Dawson AH, D'Este C. Postcards from the EDge project: randomised controlled trial of an intervention using postcards to reduce repetition of hospital treated deliberate self poisoning.[see comment]. *BMJ.* 2005;331:805.

74. Vaiva G, Vaiva G, Ducrocq F, Meyer P, Mathieu D, Philippe A, et al. Effect of telephone contact on further suicide attempts in patients discharged from an emergency department: randomised controlled study.[see comment]. *BMJ.* 2006;332:1241-1245.

75. Cotgrove A., Zirinsky L., Black D., Weston D. Secondary prevention of attempted suicide in adolescence. *Journal of Adolescence.* 1995;18:569-77.

76. Hawton K, Townsend E, Arensman E, Gunnell D, Hazell P, House A, et al. Psychosocial and pharmacological treatments for deliberate self harm. *Cochrane Database of Systematic Reviews.* 1999.

77. Robinson J, Hetrick SE, Martin C. Preventing suicide in young people: systematic review. *Australian and New Zealand Journal of Psychiatry.* 2010;45:3-26.

78. Newton AS, Hamm MP, Bethell J, Rhodes AE, Bryan CJ, Tjosvold L, et al. Pediatric Suicide-Related Presentations: A Systematic Review of Mental Health Care in the Emergency Department. *Annals of Emergency Medicine.* 2010;56:649-659.

79. Burns J, Dudley M, Hazell P., Patton G. Clinical management of deliberate self-harm in young people: the need for evidence-based approaches to reduce repetition. *Australian and New Zealand Journal of Psychiatry.* 2005;39:121-128.

80. Cwik MF, Walkup JT. Can randomized controlled trials be done with suicidal youths? *International Review of Psychiatry.* 2008;20:177-182.

81. Spirito A, Stanton C, Donaldson D, Boergers J. Treatment-as-usual for adolescent suicide attempters: implications for the choice of comparison groups in psychotherapy research. *Journal of Clinical Child & Adolescent Psychology.* 2002;31:41-7.

82. Australasian College for Emergency Medicine & The Royal Australian and New Zealand College of Psychiatrists. Guidelines for the management of deliberate self-harm in young people. 2000.

83. Royal College of Psychiatrists (London). Managing deliberate self-harm in young people. 1998.

84. Shain BN, American Academy of Pediatrics Committee on Adolescence. Suicide and suicide attempts in adolescents. *Pediatrics.* 2007;120:669-76.

85. American Academy of Child and Adolescent Psychiatry. Summary of the practice parameters for the assessment and treatment of children and adolescents with suicidal behavior. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2001;40:495-9.

86. New Zealand Guidelines Group (NZGG) and Ministry of Health. The assessment and management of people at risk of suicide. 2003.

87. Bergen H, Hawton K, Waters K, Cooper J, Kapur N. Psychosocial assessment and repetition of self-harm: The significance of single and multiple repeat episode analyses. *Journal of Affective Disorders.* 2010;127:257-265.

88. Horrocks J, Price S, House A, Owens D. Self-injury attendances in the accident and emergency department: Clinical database study. *British Journal of Psychiatry.* 2003;183:34-39.

89. Kapur N, Murphy E, Cooper J, Bergen H, Hawton K, Simkin S, et al. Psychosocial assessment following self-harm: Results from the Multi-Centre Monitoring of Self-Harm Project. *Journal of Affective Disorders.* 2008;106:285-293.

90. Bennewith O, Gunnell D, Peters T, Hawton K, House A. Variations in the hospital management of self harm in adults in England: observational study.[see comment]. *BMJ.* 2004;328:1108-9.

91. Gunnell D, Bennewith O, Peters TJ, Stocks N, Sharp DJ. Do patients who self-harm consult their general practitioner soon after hospital discharge? A cohort study. *Social Psychiatry & Psychiatric Epidemiology.* 2002;37:599-602.

92. Houston K, Haw C, Townsend E, Hawton K. General practitioner contacts with patients before and after deliberate self harm. *British Journal of General Practice.* 2003;53:365-70.

93. Olfson M, Marcus SC, Bridge JA. Emergency Treatment of Deliberate Self-harm. *Archives of General Psychiatry.* 2012;69:80-88.

94. McEwan K, Goldner E. Accountability & Performance Indicators for Mental Health Services & Supports, A Resource Kit. 2001.

95. Hermann RC, Mattke S, Somekh D, Silfverhielm H, Goldner E, Glover G, et al. Quality indicators for international benchmarking of mental health care. *International Journal for Quality in Health Care.* 2006;18:31-8.

96. Reid R, Haggerty J, McKendry R. Defusing the Confusion: Concepts and Measures of Continuity of Healthcare. 2002.

97. Daniel SS, Goldston DB, Harris AE, Kelley AE, Palmes GK. Review of Literature on Aftercare Services Among Children and Adolescents. *Psychiatric Services.* 2004;55:901-912.

98. Suominen KH, Isometsa ET, Ostamo AI, Lonnqvist JK. Health care contacts before and after attempted suicide. *Social Psychiatry & Psychiatric Epidemiology.* 2002;37:89-94.

99. Beautrais AL, Joyce PR, Mulder RT. Psychiatric contacts among youths aged 13 through 24 years who have made serious suicide attempts. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1998;37:504-11.

100. Piacentini J, Rotheram-Borus MJ, Gillis JR, Graae F, Trautman P, Cantwell C, et al. Demographic predictors of treatment attendance among adolescent suicide attempters. *Journal of Consulting & Clinical Psychology.* 1995;63:469-73.

101. Stewart SE, Manion IG, Davidson S. Emergency management of the adolescent suicide attempter: a review of the literature. [Review] [83 refs]. *Journal of Adolescent Health.* 2002;30:312-25.

102. Dick P., Kavanagh L, Spalding K, McKeever P. Ontario's mosaic of children's treatment services. ICES investigative report. 2005.

103. Steele M, Wolfe W. Child psychiatry practice patterns in Ontario. *Canadian Journal of Psychiatry.* 1999;44:788-792.

104. Blais R, Breton J, Fournier M, St-Georges M, Berthiaume C. Are mental health services for children distributed according to needs? *Canadian Journal of Psychiatry.* 2003;48:176.

105. Dieserud G, Loeb M, Ekeberg O. Suicidal behavior in the municipality of Baerum, Norway: a 12-year prospective study of parasuicide and suicide. *Suicide & Life-Threatening Behavior.* 2000;30:61-73.

106. Kapur N, Cooper J, Hiroeh U, May C, Appleby L, House A. Emergency department management and outcome for self-poisoning: a cohort study. *General Hospital Psychiatry.* 2004;26:36-41.

107. Guttmann A, Razzaq A, Lindsay P, Zagorski B, Anderson GM. Development of measures of the quality of emergency department care for children using a structured panel process. *Pediatrics.* 2006;118:114-123.

108. Alessandrini E, Varadarajan K, Alpern ER, Gorelick MH, Shaw K, Ruddy RM, et al. Emergency Department Quality: An Analysis of Existing Pediatric Measures. *Academic Emergency Medicine.* 2011;18:519-526.

109. Bethell J, Rhodes A. Candidate indicators for the emergency department management of deliberate self-harm (DSH) presentations by young Canadians. 2010.

110. Zahl DL, Hawton K. Repetition of deliberate self-harm and subsequent suicide risk: long-term follow-up study of 11 583 patients. *British Journal of Psychiatry.* 2004;185:70-75.

111. Moller H. Efficacy of different strategies of aftercare for patients who have attempted suicide. *J R Soc Med.* 1989;82:643-647.

112. Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris.W.A., et al. Youth risk behavior surveillance--United States, 2005. *MMWR Surveill Summ.* 2006;55:1-108.

113. Eaton D, Kann L, Kinchen S, Shanklin S, Ross J, Hawkins J, et al. Youth risk behavior surveillance - United States, 2009. *Morbidity and Mortality Weekly Report.* 2010;59:1-142.

114. Eaton D, Kann L, Kinchen S, Shanklin S, Ross J, Hawkins J, et al. Youth risk behavior surveillance--United States, 2007. *Morbidity and Mortality Weekly Report.* 2008;57:1-131.

115. Laukkanen E, Rissanen ML, Honkalampi K, Kylm+ñ J, Tolmunen T, Hintikka J. The prevalence of self-cutting and other self-harm among 13- to 18-year-old Finnish adolescents. *Social Psychiatry and Psychiatric Epidemiology.* 2009;44:23-28.

116. Ystgaard M, Arensman E, Hawton K, Madge N, van Heeringen K, Hewitt A, et al. Deliberate self-harm in adolescents: Comparison between those who receive help following self-harm and those who do not. *Journal of Adolescence*. 2009;32:875-891.

117. Canadian Institute for Health Information. Report from the Third Health Indicators Consensus Conference 2009. Ottawa; 2009.

118. Rhodes AE, Bethell J, Spence J, Links PS, Streiner DL, Jaakkimainen RL. Age-sex differences in medicinal self-poisonings: a population-based study of deliberate intent and medical severity. *Social Psychiatry & Psychiatric Epidemiology*. 2008;43:642-52.

119. Rhodes A, Bethell J, Jaakkimainen RL, Thurlow J, Spence J, Links PS, et al. The impact of rural residence on medically serious medicinal self-poisonings. *General Hospital Psychiatry*. 2008;30:552-560.

120. Hawton K, Bale L, Casey D, Shepherd A, Simkin S, Harriss L. Monitoring deliberate self-harm presentations to general hospitals. *Crisis: Journal of Crisis Intervention & Suicide*. 2006;27:157-63.

121. National suicide prevention strategy for England. http://www dh gov uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4009474 2002

122. Hawton K, Bergen H, Casey D, Simkin S, Palmer B, Cooper J, et al. Self-harm in England: a tale of three cities. *Social Psychiatry & Psychiatric Epidemiology*. 2007;42:513-21.

123. Mental Health Commission of Canada. Toward Recovery & Well-being. A Framework for a Mental Health Strategy for Canada. 2009.

124. Kessler RC, Amminger GP, guilar-Gaxiola S, Alonso J, Lee S, Ustun TB. Age of onset of mental disorders: a review of recent literature. [Review] [50 refs]. *Current Opinion in Psychiatry*. 2007;359-364.

125. Hawton K, Harriss L, Hall S, Simkin S, Bale E, Bond A. Deliberate self-harm in Oxford, 1990-2000: a time of change in patient characteristics. *Psychological Medicine*. 2003;33:987-95.

126. Clarke T., Baker P, Watts C.J., Henderson H., Evans T., Sherr T. Self-harm in younger people: audit of prevalence and provision. *Psychological Health & Medicine*. 2001;6:349-59.

127. Beautrais AL, Joyce PR, Mulder RT. Risk factors for serious suicide attempts among youths aged 13 through 24 years. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1996;35:1174-82.

128. Harrington R, Pickles A, Aglan A, Harrington V, Burroughs H, Kerfoot M. Early adult outcomes of adolescents who deliberately poisoned themselves. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2006;45:337-45.

129. Vajda J, Steinbeck K. Factors associated with repeat suicide attempts among adolescents. *Australian & New Zealand Journal of Psychiatry*. 2000;34:437-45.

130. Kapur N, Cooper J, King-Hele S, Webb R, Lawlor M, Rodway C, et al. The repetition of suicidal behavior: a multicenter cohort study. *Journal of Clinical Psychiatry*. 2006;67:1599-609.

131. Evans J. Interventions to reduce repetition of deliberate self-harm. *International Review of Psychiatry.* 2000;12:44-7.

132. Bennewith O, Stocks N, Gunnell D, Peters TJ, Evans MO, Sharp DJ. General practice based intervention to prevent repeat episodes of deliberate self harm: cluster randomised controlled trial.[see comment]. *BMJ.* 2002;324:1254-7.

133. Evans MO, Morgan HG, Hayward A, Gunnell DJ. Crisis telephone consultation for deliberate self-harm patients: effects on repetition.[see comment]. *British Journal of Psychiatry.* 1999;175:23-7.

134. Hatcher S, Sharon C, Parag V, Collins N. Problem-solving therapy for people who present to hospital with self-harm: Zelen randomised controlled trial. *British Journal of Psychiatry.* 2011.

135. Stewart SE, Manion IG, Davidson S, Cloutier P. Suicidal children and adolescents with first emergency room presentations: predictors of six-month outcome. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2001;40:580-7.

136. Hawton K, Harriss L. Deliberate self-harm by under-15-year-olds: characteristics, trends and outcome. *Journal of Child Psychology & Psychiatry & Allied Disciplines.* 2008;49:441-448.

137. Hawton K, Fagg J, Simkin S, Bale E, Bond A. Deliberate self-harm in adolescents in Oxford, 1985-1995. *Journal of Adolescence.* 2000;23:47-55.

138. Christiansen E, Jensen BF. Risk of repetition of suicide attempt, suicide or all deaths after an episode of attempted suicide: a register-based survival analysis. *Australian & New Zealand Journal of Psychiatry.* 2007;41:257-65.

139. Carter GL, Clover K, Whyte IM, Dawson AH, D'Este C. Postcards from the EDge: 24-month outcomes of a randomised controlled trial for hospital-treated self-poisoning. *British Journal of Psychiatry.* 2007;191:548-553.

140. Hilbe J.M. Negative Binomial Regression. Cambridge University Press; 2007.

141. Haw C, Bergen H, Casey D, Hawton K. Repetition of deliberate self-harm: a study of the characteristics and subsequent deaths in patients presenting to a general hospital according to extent of repetition. *Suicide & Life-Threatening Behavior.* 2007;37:379-96.

142. Reith DM, Whyte IM, Carter GL. Repetition risk for adolescent self-poisoning: a multiple event survival analysis. *Australian and New Zealand Journal of Psychiatry.* 2003;37:212-218.

143. Lilley R, Owens D, Horrocks J, House A, Noble R, Bergen H, et al. Hospital care and repetition following self-harm: multicentre comparison of self-poisoning and self-injury. *British Journal of Psychiatry.* 2008;192:440-445.

144. Bethell J, Rhodes AE, Bondy SJ, Lou WYW, Guttmann A. Repeat self-harm: application of hurdle models. *British Journal of Psychiatry.* 2010;196:243-244.

145. Rhodes A, Bethell J. Indicators for the emergency department management of deliberate self-harm mental health presentations by young Canadians. 2009.

146. Colman I., Yiannakoulias N., Schopflocher D., Svenson L.W., Rosychuk R.J., Rowe B.H. Population-based study of medically treated self-inflicted injuries. *Canadian Journal of Emergency Medicine.* 2004;6:313-320.

147. Colman I, Dryden DM, Thompson AH, Chahal AM, Borden K, Rowe BH, et al. Utilization of the emergency department after self-inflicted injury. *Academic Emergency Medicine.* 2004;11:136-42.

148. Colman I, Newman SC, Schopflocher D, Bland RC, Dyck RJ. A multivariate study of predictors of repeat parasuicide. *Acta Psychiatrica Scandinavica.* 2004;109:306-12.

149. Rosychuk RJ, Yau C, Colman I, Schopflocher D, Rowe BH. Statistical disease cluster surveillance of medically treated self-inflicted injuries in Alberta, Canada. *Chronic Diseases in Canada.* 2006;27:68-76.

150. Bethell J, Rhodes AE. Identifying deliberate self-harm in emergency department data. *Health Reports.* 2009;20:35-42.

151. Myers RP, Li B, Shaheen AA. Emergency department visits for acetaminophen overdose: a Canadian population-based epidemiologic study (1997-2002). *CJEM Canadian Journal of Emergency Medical Care.* 2007;9:267-74.

152. Newman SC, Stuart H. An ecologic study of parasuicide in Edmonton and Calgary. *Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie.* 2005;50:275-80.

153. Health Canada PaPHBSPD. The Population Health Template: Key Elements and Actions That Define A Population Health Approach. 2001.

154. Canadian Association for Suicide Prevention. The CASP National Suicide Prevention Strategy. 2009.

155. National Ambulatory Care Reporting System Manual. Canadian Institute for Health Information 2005

156. Ontario Ministry of Health and Long-Term Care. Schedule of Benefits for Physician Services under the Health Insurance Act. 2008.

157. Statistics Canada. Postal Code Conversion File (PCCF), Reference Guide. http://geodepot statcan ca/Diss2006/Reference/Freepub/92-153-GIE2008001 pdf 2008Available from: URL: http://geodepot.statcan.ca/Diss2006/Reference/Freepub/92-153-GIE2008001.pdf

158. Statistics Canada. Geographic Units: Dissemination Area (DA). http://www12 statcan ca/english/census01/Products/Reference/dict/geo021 htm 2008

159. du Plessis V, Beshiri R, Bollman R. Definitions of rural. Statistics Canada, Rural and Small Town Canada Analysis Bulletin 2001

160. Canadian Triage and Acuity Scale. Canadian Association of Emergency Physicians 2011Available from: URL: http://caep.ca/template.asp?id=B795164082374289BBD9C1C2BF4B8D32

161. Manos D, Petrie DA, Beveridge RC, Walter S, Ducharme J. Inter-observer agreement using the Canadian Emergency Department Triage and Acuity Scale. *Canadian Journal of Emergency Medicine.* 2002;4:16-22.

162. Beveridge R, Ducharme J, Janes L, Beaulieu S, Walter S. Reliability of the Canadian emergency department triage and acuity scale: interrater agreement. *Annals of Emergency Medicine.* 1999;34:155-9.

163. Rhodes A, Bethell J, Schultz SE. Primary Mental Health Care. In: Institute for Clinical Evaluative Sciences, editor. Primary care in Ontario: ICES atlas.Toronto: 2006.

164. Steele LS, Glazier RH, Lin E, Evans M. Using Administrative Data to Measure Ambulatory Mental Health Service Provision in Primary Care. *Medical Care.* 2004;42.

165. Hospital Report Research Collaborative. Hospital Report 2003: Emergency Department Care. 2004.

166. Designated Facilities Under the Mental Health Act. Ontario Ministry of Health and Long Term Care 2011Available from: URL: http://www.health.gov.on.ca/english/public/contact/psych/designated.html#1

167. Lin E, Durbin J, Zaslavska N, Teed M, Veldhuizen S, Daniel I, et al. Hospital Report 2007: Mental Health. Hospital Report Research Collaborative 2008Available from: URL: http://www.hospitalreport.ca/downloads/2007/MH/2007_MH_report.pdf

168. SAS Institute Inc. SAS version 9.1. 2002.

169. Koepsell TD, Weiss NS. Epidemiologic Methods. New York, NY: Oxford University Press, Inc; 2003.

170. Cummings P, Koepsell TD, Mueller BA. Methodological Challenges in Injury Epidemiology and Injury Prevention Research. *Annual Review of Public Health.* 1995;16:381-400.

171. Stukel TA, Glynn RJ, Fisher ES, Sharp SM, Lu-Yao G, Wennberg JE. Standardized rates of recurrent outcomes. *Statistics in Medicine.* 1994;13:1781-1791.

172. Austin PC, Goel V, van Walraven C. An introduction to multilevel regression models. *Canadian Journal of Public Health.* 2001;92:150-154.

173. Mullahy J. Specification and testing of some modified count data models. *Journal of Econometrics.* 1986;33:341-65.

174. Szklo M, Nieto J. Epidemiology: beyond the basics. Sudbury, Mass: Jones and Bartlett; 2004.

175. Psaty BM, Siscovick DS. Minimizing Bias Due to Confounding by Indication in Comparative Effectiveness Research. *JAMA: The Journal of the American Medical Association.* 2010;304:897-898.

176. Salas M, Hofman A, Stricker B. Confounding by indication: an example of variation in the use of epidemiologic terminology. *American Journal of Epidemiology.* 1999;149:981-983.

177. Vittinghoff E, Glidden D, Shiboski S, McCulloch C. Regression methods in biostatistics : linear, logistic, survival, and repeated measures models. New York: Springer; 2005.

178. Sun GW, Shook TL, Kay GL. Inappropriate use of bivariable analysis to screen risk factors for use in multivariable analysis. *Journal of Clinical Epidemiology.* 1996;49:907-916.

179. Juurlink D., Preyra C., Croxford R., Chong A., Austin P., Tu J., et al. Canadian Institute for Health Information Discharge Abstract Database: a validation study. 2006.

180. CIHI Data Quality Study of Ontario Emergency Department Visits for Fiscal Year 2004–2005—Executive Summary. Ottawa; 2008.

181. Statistics Canada. 2001 Census Dictionary. 2001.

182. Statistics Canada. 2006 Census Dictionary. 2006.

183. Iron K, Zagorski B, Sykora K, Manuel D. Living and Dying in Ontario: An Opportunity for Improved Health Information. Toronto: Institute for Clinical Evaluative Sciences; 2008.

184. Corcoran P, Arensman E, Perry IJ. The area-level association between hospital-treated deliberate self-harm, deprivation and social fragmentation in Ireland. *Journal of Epidemiology and Community Health.* 2007;61:1050-1055.

185. Olfson M, Gameroff MJ, Marcus SC, Greenberg T, Shaffer D. Emergency treatment of young people following deliberate self-harm. *Archives of General Psychiatry.* 2005;62:1122-8.

186. Hawton K, Harriss L. The changing gender ratio in occurrence of deliberate self-harm across the lifecycle. *Crisis: The Journal of Crisis Intervention and Suicide Prevention.* 2008;29:4-10.

187. Patton GC, Hemphill SA., Beyers JM, Bond L., Toumbourou JW, McMorris BJ, et al. Pubertal Stage and Deliberate Self-Harm in Adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2007;46:508-514.

188. Ayton A, Rasool H, Cottrell D. Deliberate self-harm in children and adolescents: Association with social deprivation. *European Child & Adolescent Psychiatry.* 2003;12:303-307.

189. Altmayer C, Ardal S, Woodward GL, Schull MJ. Variation in emergency department visits for conditions that may be treated in alternative primary care settings. *Canadian Journal of Emergency Medicine.* 2005;7:252-256.

190. Khan Y, Glazier RH, Moineddin R, Schull MJ. A Population-based Study of the Association Between Socioeconomic Status and Emergency Department Utilization in Ontario, Canada. *Academic Emergency Medicine.* 2011;18:836-843.

191. Deykin EY, Perlow R, McNamarra J. Non-fatal suicidal and life-threatening behavior among 13-to 17-year old adolescents seeking emergency medical care. *American Journal of Public Health.* 1985;75:90-92.

192. Bennett S, Coggan C, Hooper R, Lovell C, Adams P. Presentations by youth to Auckland Emergency Departments following a suicide attempt. *International Journal of Mental Health Nursing.* 2002;11:144-153.

193. Stewart SE, Manion IG, Davidson S. Emergency management of the adolescent suicide attempter: a review of the literature. [Review] [83 refs]. *Journal of Adolescent Health.* 2002;30:312-325.

194. Trautman PD, Stweart N, Morishima A. Are Adolescent Suicide Attempters Noncompliant with Outpatient Care? *Journal of the American Academy of Child & Adolescent Psychiatry.* 1993;32:89-94.

195. Spirito A, Lewander WJ, Levy S, Kurkjian J, Fritz G. Emergency department assessment of adolescent suicide attempters: factors related to short-term follow-up outcome. *Pediatric Emergency Care.* 1994;10:6-12.

196. Sinclair JM, Hawton K. Reducing repeated deliberate self-harm. [Review] [14 refs]. *Practitioner.* 2002;246:164-166.

197. Storey P, Hurry J, Jowitt S, Owens D, House A. Supporting young people who repeatedly self-harm. *The Journal of the Royal Society for the Promotion of Health.* 2005;125:71-75.

198. Hume M, Platt S. Appropriate interventions for the prevention and management of self-harm: a qualitative exploration of service-users' views. *BMC Public Health.* 2007;7.

199. Granboulan V, Roudot-Thoraval F, Lemerle S, Alvin P. Predictive factors of post-discharge follow-up care among adolescent suicide attempters. *Acta Psychiatrica Scandinavica.* 2001;104:31-36.

200. Bethell J, Rhodes A. Depressed mood in the suicidal population. *Canadian Journal of Psychiatry.* 2007;52:744-748.

201. Evans J. Interventions to reduce repetition of deliberate self-harm. *International Review of Psychiatry.* 2000;12:44-47.

202. Goodyer I, Dubicka B, Wilkinson P, Kelvin R, Roberts C, Byford S, et al. Selective serotonin reuptake inhibitors (SSRIs) and routine specialist care with and without cognitive behaviour therapy in adolescents with major depression: randomised controlled trial. *BMJ.* 2007;335:142.

203. Owens C, Farrand P, Darvill R, Emmens T, Hewis E, Aitken P. Involving service users in intervention design: a participatory approach to developing a text-messaging intervention to reduce repetition of self-harm. *Health Expectations.* 2011;14:285-295.

204. David B. Prevention of self harm in adolescents. *BMJ.* 2011;342.

205. Owens C. Interventions for self-harm: are we measuring outcomes in the most appropriate way? *British Journal of Psychiatry.* 2010;197:502-503.

206. Olfson M, Gameroff MJ, Marcus SC, Greenberg T, Shaffer D. Emergency treatment of young people following deliberate self-harm. *Archives of General Psychiatry.* 2005;62:1122-1128.

207. Vajda J, Steinbeck K. Factors associated with repeat suicide attempts among adolescents. *Australian & New Zealand Journal of Psychiatry.* 2000;34:437-445.

208. Gibbons RD, Brown CH, Hur K, Marcus SM, Bhaumik DK, Erkens JA, et al. Early Evidence on the Effects of Regulators' Suicidality Warnings on SSRI Prescriptions and Suicide in Children and Adolescents. *American Journal of Psychiatry.* 2007;164:1356-1363.

209. Katz LY, Kozyrskyj AL, Prior HJ, Enns MW, Cox BJ, Sareen J. Effect of regulatory warnings on antidepressant prescription rates, use of health services and outcomes among children, adolescents and young adults. *Canadian Medical Association Journal.* 2008;178:1005-1011.

210. Bergen H, Hawton K, Murphy E, Cooper J, Kapur N, Stalker C, et al. Trends in prescribing and self-poisoning in relation to UK regulatory authority warnings against use of SSRI antidepressants in under-18-year-olds. *British Journal of Clinical Pharmacology.* 2009;68:618-629.

211. Kapur N, Cooper J, King-Hele S, Webb R, Lawlor M, Rodway C, et al. The repetition of suicidal behavior: a multicenter cohort study. *Journal of Clinical Psychiatry 67(10):1599-609.* 2006.

212. Kleinbaum D, Kupper L, Morgenstern H. Epidemiologic Research. New York,NY: Van Nostrand Reinhold; 1982.

213. Bethell J, Rhodes A. Adolescent depression and emergency department use: The roles of suicidality and deliberate self-harm. *Current Psychiatry Reports.* 2008;10:53-59.

214. Rhodes A, Bethell J, Spence J, Links P, Streiner D, Jaakkimainen L. Age–sex differences in medicinal self-poisonings. *Social Psychiatry and Psychiatric Epidemiology.* 2008;43:642-652.

215. Greenland S. The effect of misclassification in the presence of covariates. *American Journal of Epidemiology.* 1980;112:564-569.

216. Hux JE, Ivis F, Flintoft V, Bica A. Diabetes in Ontario. *Diabetes Care.* 2002;25:512-516.

217. Gershon A, Wang C, Guan J, Vasilevska-Ristovska J, Cicutto L, To T. Identifying patients with physician-diagnosed asthma in health administrative databases. *Canadian Respiratory Journal.* 2009;16:183-188.

218. Normand SL. Some Old and Some New Statistical Tools for Outcomes Research. *Circulation.* 2008;118:872-884.

219. D'Agostino RB. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Statistics in Medicine.* 1998;17:2265-2281.

220. Austin PC, Mamdani MM, Stukel TA, Anderson GM, Tu JV. The use of the propensity score for estimating treatment effects: administrative versus clinical data. *Statistics in Medicine.* 2005;24:1563-1578.

221. Shah BR, Laupacis A, Hux JE, Austin PC. Propensity score methods gave similar results to traditional regression modeling in observational studies: a systematic review. *Journal of Clinical Epidemiology.* 2005;58:550-559.

222. Nock MK. Self-Injury. *Annual Review of Clinical Psychology.* 2010;6:339-363.

223. Muehlenkamp JJ. Self-Injurious Behavior as a Separate Clinical Syndrome. *American Journal of Orthopsychiatry.* 2005;75:324-33.

224. Kutcher S, Szumilas M. Distinguishing Suicide Attempts from Nonsuicidal Self-Harming Behaviors. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2009;48:1039.

225. Nock MK. Distinguishing Suicide Attempts from Nonsuicidal Self-Harming Behaviors. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2009;48:1039-1040.

226. Posner K, Oquendo MA, Gould M, Stanley B, Davies M. Columbia Classification Algorithm of Suicide Assessment (C-CASA): Classification of Suicidal Events in the FDA's Pediatric Suicidal Risk Analysis of Antidepressants. *American Journal of Psychiatry.* 2007;164:1035-1043.

227. Hasley JP, Ghosh B, Huggins J, Bell MR, Adler LE, Shroyer AL. A review of "suicidal intent" within the existing suicide literature. *Suicide and Life-Threatening Behavior.* 2008;38:576-591.

228. Prinstein MJ, Nock MK, SPIRITO ANTH, GRAPENTINE WL. Multimethod Assessment of Suicidality in Adolescent Psychiatric Inpatients: Preliminary Results. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2001;40:1053-1061.

229. Rhodes AE, Bethell J, Bondy SJ. Suicidality, depression, and mental health service use in Canada. *Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie.* 2006;51:35-41.

230. Drug and Alcohol Treatment Information System. Drug and Alcohol Treatment Information System 2011Available from: URL: http://www.datis.ca/

231. Rhodes AE, Barwick M, Vlad C, Antony J, Urajnik D, Bethell J. Child and Youth Mental Health Service Records. The Feasibility of Data Linkage. 2010.

232. Moller-Leimkuhler AM. The gender gap in suicide and premature death or: why are men so vulnerable? *European Archives of Psychiatry and Clinical Neuroscience.* 2003;253:1-8.

233. Nolen-Hoeksema S, Hilt L. Possible contributors to the gender differences in alcohol use and problems. *The Journal of General Psychology.* 2006;133:357-374.

234. Strike C, Rhodes AE, Bergmans Y, LInks P. Fragmented pathways to care: the experiences of suicidal men. *Crisis.* 2011;27:31-38.

235. Greenberg N, Boydell K, Volpe T. Pediatric Telepsychiatry in Ontario: Caregiver and Service Provider Perspectives. *The Journal of Behavioral Health Services and Research.* 2006;33:105-111.

236. Pignatiello A, Teshima J, Boydell KM, Minden D, Volpe T, Braunberger PG. Child and Youth Telepsychiatry in Rural and Remote Primary Care. *Child and adolescent psychiatric clinics of North America.* 2011;20:13-28.

237. Andersen R. Revisiting the behavioral model and access to medical care: does it matter? *Journal of Health and Social Behavior.* 1995;36:1-10.

238. Lewis G, HAWTON K, Jones P. Strategies for preventing suicide. *British Journal of Psychiatry.* 1997;171:351-354.

239. Health Service Executive tNSRGaoHaC. Reach Out. Irish National Strategy for Action on Suicide Prevention. 2005-2014. 2005.

240. Canadian Association for Suicide Prevention (CASP). The CASP Blueprint for a Canadian National Suicide Prevention Strategy. 2004.

241. 41st Parliament, 1st Session. Parliament of Canada 2011Available from: URL: http://www.parl.gc.ca/HousePublications/Publication.aspx?Mode=1&Parl=41&Ses=1&DocId=5155242&Language=E

242. The Standing Senate Committee on Social Affairs SaT. Out of the Shadows at Last, Transforming Mental Health, Mental Illness and Addiction Services in Canada. 2006.

243. Canadian Institute for Health Information. The Health Indicators Project: The Next 5 Years. Report from the Second Consensus Conference on Population Health Indicators. 2005.

244. Canadian Alliance on Mental Illnessand Mental Health. Framework for Action on Mental Illness and Mental Health. 2006.

245. Scottish Executive. Choose Life. A National Strategy and Action Plan to Prevent Suicide in Scotland. http://www scotland gov uk/Resource/Doc/46932/0013932 pdf 2002

246. Associate Ministry of Health. The New Zealand Suicide Prevention Strategy 2006-2016. Wellington: Ministry of Health; 2006.

247. Rowe B, Bond K, Ospina M, Blitz S, Schull M, Sinclair D, et al. Data collection on patients in emergency departments in Canada. *Canadian Journal of Emergency Medicine.* 2006;8:417-424.

248. **National Ambulatory Care Reporting System** . Canadian Institute for Health Information 2011Available from: URL: http://www.cihi.ca/CIHI-ext-portal/internet/en/document/types+of+care/hospital+care/emergency+care/services_nacrs

249. Rhodes AE, Links PS, Streiner DL, Dawe I, Cass D, Janes S. Do hospital E-codes consistently capture suicidal behaviour? *Chronic Diseases in Canada.* 2002;23:139-45.

250. Conner KR, Langley J, Tomaszewski KJ, Conwell Y. Injury hospitalization and risks for subsequent self-injury and suicide: a national study from New Zealand. *American Journal of Public Health.* 2003;93:1128-31.

251. Donaldson AE, Larsen GY, Fullerton-Gleason L, Olson LM. Classifying undetermined poisoning deaths. *Injury Prevention.* 2006;12:338-343.

252. Ohberg A, Lonnqvist J. Suicides hidden among undetermined deaths. *Acta Psychiatrica Scandinavica.* 1998;98:214-218.

253. Biddle L, Brock A, Brookes ST, Gunnell D. Suicide rates in young men in England and Wales in the 21st century: time trend study. *BMJ.* 2008;336:539-542.

254. Suicide rates in the United Kingdom, 2000–2009. Office for National Statistics 2011Available from: URL: http://www.statistics.gov.uk/pdfdir/sui0111.pdf

255. Wu P, Katic BJ, Liu X, Fan B, Fuller CJ. Mental Health Service Use Among Suicidal Adolescents: Findings From a U.S. National Community Survey. *Psychiatric Services.* 2010;61:17-24.

256. Larkin GL, Smith RP, Beautrais AL. Trends in US emergency department visits for suicide attempts, 1992-2001. *Crisis: Journal of Crisis Intervention & Suicide.* 2008;29:73-80.

257. Cooper J, Murphy E, Webb R, Hawton K, Bergen H, Waters K, et al. Ethnic differences in self-harm, rates, characteristics and service provision: three-city cohort study. *British Journal of Psychiatry.* 2010;197:212-218.

258. Cooper J, Husain N, Webb R, Waheed W, Kapur N, Guthrie E, et al. Self-harm in the UK. *Social Psychiatry and Psychiatric Epidemiology.* 2006;41:782-788.

259. Visible minority groups, percentage distribution, for Canada, provinces and territories, and census divisions - 20% sample data. Statistics Canada 2010Available from: URL: http://www12.statcan.ca/census-recensement/2006/dp-pd/hlt/97-562/pages/page.cfm?Lang=E&Geo=CD&Code=35&Table=1&Data=Count&Sex=1&StartRec=1&Sort=2&Display=Page&CSDFilter=5000

260. Judd F, Cooper AM, Fraser C, Davis J. Rural suicide – people or place effects? *Australian and New Zealand Journal of Psychiatry.* 2006;40:208-216.

261. Hirsch J. A review of the literature on rural suicide: risk and protective factors, incidence, and prevention. *Crisis: The Journal of Crisis Intervention and Suicide Prevention.* 2006;27:189-199.

262. Suicide Prevention - First Nations, Inuit and Aboriginal Health. Health Canada 2006Available from: URL: http://www.hc-sc.gc.ca/fniah-spnia/promotion/suicide/index-eng.php

263. Mork E, Mehlum L, Fadum E, Rossow I. Collaboration between general hospitals and community health services in the care of suicide attempters in Norway: a longitudinal study. *Annals of General Psychiatry.* 2010;9:26.

264. Mant J. Process versus outcome indicators in the assessment of quality of health care. *International Journal for Quality in Health Care.* 2001;13:475-480.

265. Bergen H, Hawton K, Waters K, Cooper J, Kapur N. Epidemiology and trends in non-fatal self-harm in three centres in England: 2000-2007. *British Journal of Psychiatry.* 2010;197:493-498.

266. Detsky ME, Sivilotti MLA, Kopp A, Austin PC, Juurlink DN. Deliberate Self-Poisoning in Ontario Following the Terrorist Attacks of September 11, 2001. *JAMA: The Journal of the American Medical Association.* 2005;294:1900-1901.

267. Waterhouse J, Platt S. General hospital admission in the management of parasuicide. A randomised controlled trial. *British Journal of Psychiatry.* 1990;156:236-242.

268. Rodham K, Hawton K, Evans E. Reasons for Deliberate Self-Harm: Comparison of Self-Poisoners and Self-Cutters in a Community Sample of Adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry.* 2004;43:80-7.

269. Johnston A, Cooper J, Webb R, Kapur N. Individual- and area-level predictors of self-harm repetition. *British Journal of Psychiatry.* 2006;189:416-21.

270. Steele LS, Glazier RH, Lin E. Inequity in Mental Health Care Under Canadian Universal Health Coverage. *Psychiatric Services.* 2006;57:317-324.

271. Taylor E, Stansfeld S. Children who poison themselves. II. Prediction of attendance for treatment. *British Journal of Psychiatry.* 1984;145:132-135.

272. McManus B, Kruesi MJ, Dontes A, Defazio C, Piotrowski J, Woodward PJ. Child and adolescent suicide attempts: an opportunity for emergency departments to provide injury prevention education. *American Journal of Emergency Medicine.* 1997;15:357-360.

273. Kruesi MJ, Grossman J, Pennington JM, Woodward PJ, DUDA D, Hirsch JG. Suicide and violence prevention: parent education in the emergency department. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1999;38:250-255.

274. Spirito A, Lewander W. Assessment and Disposition Planning for Adolescent Suicide Attempters Treated in the Emergency Department. *Clinical Pediatric Emergency Medicine.* 2004;5:154-63.

275. Mironova P, Rhodes AE, Bethell JM, Tonmyr L, Boyle MH, Wekerle C, et al. Childhood physical abuse and suicide-related behavior: A systematic review. *Vulnerable Children and Youth Studies: An International Interdisciplinary Journal for Research, Policy and Care.* 2011;6:1-7.

276. Rhodes AE, Boyle MH, Tonmyr L, Wekerle C, Goodman D, Leslie B, et al. Sex Differences in Childhood Sexual Abuse and Suicide-Related Behaviors. *Suicide and Life-Threatening Behavior.* 2011;41:235-54.

277. Menec VH, Sirski M, Attawar D. Does Continuity of Care Matter in a Universally Insured Population? *Health Services Research.* 2005;40:389-400.

278. Hospital Report Research Collaborative. Hospital Report 2005: Emergency Department Care. 2005.

279. McDonald AJ, III, Wang N, Camargo CA, Jr. US Emergency Department Visits for Alcohol-Related Diseases and Injuries Between 1992 and 2000. *Archives of Internal Medicine.* 2004;164:531-537.

280. Hawton K, Harriss L, Hodder, Simkin, Gunnell D. The influence of the economic and social environment on deliberate self-harm and suicide: an ecological and person-based study. *Psychological Medicine.* 2001;31:827-836.

281. Nabalamba A, Millar W. Going to the doctor. *Health Reports.* 2007;18:23-35.

282. Chan B, Austin PC. Patient, Physician, and Community Factors Affecting Referrals to Specialists in Ontario, Canada: A Population-Based, Multi-Level Modelling Approach. *Medical Care.* 2003;41.

283. Veugelers PJ, Yip AM. Socioeconomic disparities in health care use: Does universal coverage reduce inequalities in health? *Journal of Epidemiology and Community Health.* 2003;57:424-428.

284. Pfeffer C, Klerman G, Hurt S, Lesser M, Peskin J, Siefker C. Suicidal Children Grow Up: Demographic and Clinical Risk Factors for Adolescent Suicide Attempts. *Journal of the American Academy of Child & Adolescent Psychiatry.* 1991;30:609-616.

285. Hjelmeland H. Repetition of parasuicide: a predictive study. *Suicide & Life-Threatening Behavior.* 1996;26:395-404.

Appendices

Appendix A: Hypotheses and Supporting Evidence for Each of Four Study Objectives

Table 1: Objective 1 hypotheses and supporting evidence

a) Outcome: incidence rate of emergency department presentations for self-harm

Exposure	Hypothesis	Supporting Evidence (see table c))
Sex	Rate of hospital presentation for self-harm will be higher in girls than in boys	Hawton et al, 2007; Olfson et al, 2005; Colman et al, 2004; Corcoran et al, 2004
Age	In this age range (12-17 year-olds), rates of hospital presentation for self-harm will increase with age	Olfson et al, 2005; Colman et al, 2004; Corcoran et al, 2004
Community size	Exploratory	There is very little study of rural vs. non-rural differences in self-harm.[119] Irish data showed incidence rates in Dublin, other cities and urban districts were higher than the national rate, whereas the rural district rate was lower.(Corcoran et al, 2007) Conversely, US data showed there was no difference in the rate of hospital presentation for self-harm in metropolitan vs. non-metropolitan hospitals.(Doshi et al, 2005)
Neighbourhood income quintile	Rates of hospital presentation for self-harm will inversely related to individual's income quintile (i.e., higher in lower income quintiles)	Strong associations between area deprivation and rate of hospital presentation for self-harm were reported in Ireland (Corcoran et al, 2007) and England (Johnston et al, 2006; Hawton et al, 2001), including in youth (Ayton et al, 2003). Similarly, Canadian (all-age) data on inpatient admissions for self-harm showed rates in the least affluent neighbourhoods were twice as high as the rates in the most affluent neighbourhoods (Statistics Canada and Canadian Institute for Health Information, 2011).

b) Outcome: self-harm as a proportion of all emergency department presentations

Exposure	Hypothesis	Supporting Evidence
Sex	Self-harm will make up a higher proportion of emergency department presentations in girls than in boys	Higher rates of hospital presentation for self-harm in girls (see table 1a above) will be reflected as a higher proportion of emergency department use overall
Age	In this age range (12-17 year-olds), self-harm will make up an increasing proportion of emergency department presentations with increasing age	Higher rates of hospital presentation for self-harm with increasing age (see table 1a above) will be reflected as a higher proportion of emergency department use overall
Community size	Exploratory	Although rural use of emergency departments may be higher overall, given that it is unclear whether self-harm rates are also higher in rural areas (see table a)

		above), it is unclear whether this will translate into a proportional difference.
Neighbourhood income quintile	Exploratory	Higher rates of hospital presentation for self-harm are expected in lower income quintiles (see table 1a above), however, given demographic (including socioeconomic status) differences in emergency department use overall,[190,277] it is unclear whether this will translate into a higher proportion of emergency department use.
Canadian Triage and Acuity Scale	Self-harm will make up a larger proportion of emergency department presentations triaged as higher acuity than those triaged as lower acuity.	Given that about a third of self-harm presentations (all ages) are triaged as resuscitation/emergent,[150] compared to about 5% overall (in 15-19 year-olds),[278] this will translate into a proportional difference.
Alcohol involvement	Self-harm will make up a larger proportion of emergency department presentations that involve alcohol than those that do not.	Given evidence that alcohol is involved in about 20% of self-harm presentations in youth[27] but about 8% of emergency department presentations overall,[279] this will translate into a proportional difference.
Disposition	Self-harm will make up a larger proportion of emergency department presentations that are admitted to hospital that those that are discharged from the emergency department.	Given about a third of self-harm presentations by youth are admitted to hospital, compared to 5% overall (in 15-19 year -olds,[278] this will translated into a proportional difference.

c) Supporting evidence

Author, year	Country	Data Source and Coverage	Year(s)	Age range	Notes
Statistics Canada and the Canadian Institute for Health Information[46]	Canada	Discharge Abstract Database, a national database covering all inpatient admissions to general hospitals.	2009/10	>14 years	Socioeconomic status: neighbourhood income quintile.
Corcoran et al, 2007[184]	Ireland	Irish National Registry of Deliberate Self Harm: self-harm presentations to 38 of Ireland's 40 emergency departments	2002–04	All ages	Area type: Dublin; other cities (Cork, Galway, Limerick and Waterford); urban districts; and rural. Deprivation: Irish National Deprivation Index for Health and Health Services Research, calculated based on data from the 2002 National Census
Hawton et al, 2007[122]	England	All self-harm presentations to	March 2000-	All ages	

		general hospitals in Oxford (one hospital), Manchester (three hospitals) and Leeds (two hospitals)	August 2001		
Johnston et al, 2006[269]	England	Manchester Self-Harm (MASH) monitoring system: all self-harm presentations to three hospitals providing emergency care in the city of Manchester	1997-2002	>15 years	Deprivation: Multiple ecological measures, including Townsend index and Index of Multiple Deprivation (overall measure and six separate domains: income, employment, health, education, housing and access to services)
Doshi et al, 2005[49]	United States	National Hospital Ambulatory Medical Care Survey (NHAMCS): nationally representative data	1997-2001	All ages	Hospital location: metropolitan statistical area vs. nonmetropolitan (standardized geographical divisions defined by the US Bureau of the Census)
Olfson et al, 2005[185]	United States	National Hospital Ambulatory Medical Care Survey (NHAMCS): nationally representative data	1997-2002	<25 years	
Colman et al, 2004[24]	Canada	Ambulatory Care Classification System (ACCS): all emergency department presentations in the province of Alberta	1998/99 - 2000/01	All	
Corcoran et al, 2004[50]	Ireland	All self-harm presentations to hospitals in Southern and Mid-western health boards: covering one quarter of the Irish population	1995-97	All ages	
Ayton et al, 2003[188]	England	All self-harm presentations to the hospital in Hull and East Yorkshire	1996-98	<18 years	Deprivation: Townsend Index
Hawton et al, 2001[280]	England	All self-harm presentations to the main general hospital in Oxford	1985-95	>15 years	Deprivation: Townsend index

Table 2: Objective 2 hypotheses and supporting evidence

a) Outcome: 30-day mental health follow-up

Variable	Hypothesis	Evidence (see table b))
Sex	Exploratory (some evidence of no association, but some evidence that females make be more likely to receive follow-up)	Olfson et al, 2011; Suominen et al, 2004; Hulten et al, 2000
Age	Exploratory	Bennett et al, 2002 found no association between age and follow-up, but the age range and categories were wider than this sample (i.e., 15-19 vs. 20-24 years).
Community size	Exploratory, but hypothesize that individuals living in rural areas will be less likely to receive mental health follow-up.	No previous study (specific to self-harm), but similar evidence from other areas shows that individuals residing in rural areas access specialist services less often,[281] including pediatric mental health and psychiatry use.[102] Referrals may also be highest in cities with medical schools.[282]
Neighbourhood income quintile	Exploratory, but hypothesize that individuals residing in higher neighbourhood income quintile more likely to receive mental health follow-up	No previous study (specific to self-harm), but similar evidence from other areas shows that individuals with lower socioeconomic status access specialist services less often,[283] including from a psychiatrist.[270]
Method of self-harm	Exploratory	European data showed that among 15-19 year-olds making their first ever hospital presentation for self-harm, those that used methods other than self-poisoning were more likely to be recommended aftercare (Hulten et al, 2000). Conversely, an all-age UK study found that those who used self-cutting were less likely to be referred for psychosocial assessment.[89]
Canadian Triage and Acuity Scale	Exploratory, but hypothesize that individuals with index presentations at higher triage categories more likely to receive mental health follow-up	No previous study, but likely that those in higher triage categories are provided with more intense clinical care (including possibly inpatient admission), part of which becomes arranging mental health follow-up.
Alcohol involvement	Exploratory, but hypothesize no association.	One study showed those whose presentations involved alcohol were less likely to be referred for follow-up (Bennett et al, 2002) whereas another showed no difference in health service use within 30-days (Suominen et al, 2004)
Inpatient pyschiatry	Individuals admitted to hospital at index presentation more likely to receive mental health follow-up and the effect will be stronger for those who receive inpatient psychiatry services.	Bennett et al, 2002 found, in adjusted analysis, that those admitted overnight were about twice as likely to be referred for follow-up care. Granboulan et al, 2001 reported that, in adjusted analysis, number of therapy sessions while admitted was positively associated with follow-up.
Mental health service history	Individuals with a history of mental health service use will be more likely to receive mental health follow-up	In an all-ages study of self-poisoning, current psychiatric contact was positively associated with referral for specialist follow-up.[106] A similar study of US Medicaid beneficiaries found the association also held when the outcome was receiving mental health follow-up.[206]
Coding of intent	Exploratory, but hypothesize that individuals with index presentations coded self-harm will be more likely to receive mental health follow-up	No previous study, but records identified as "undetermined" will represent some cases of self-harm not diagnosed as such as well as unintentional injuries. Both situations would be less likely to be referred for follow-up.
Hospital	The clustering of individuals within hospitals should be accounted for in the analysis.	The hospital in which a person presents for self-harm is associated with multiple aspects of management, including being referred for follow-up (Bennett et al, 2002; Hulten et al, 2000).

Note: presentation by girls, that involve self-cutting, triaged as high acuity and admitted to hospital are more likely to be coded self-harm (vs. undetermined) and so the effects of these variables may differ between self-harm definitions.

b) Supporting evidence

Author, year	Country	Sample	n	Age range	Outcome
Olfson et al, 2011[93]	United States	National data on Medicaid beneficiaries	4585	21-64 years	Use of follow-up outpatient mental health care within 30 days
Suominen et al, 2004[41]	Finland	4 general hospitals in Helsinki	188	15-24 years	Health contact within 30 days
Bennett et al, 2002[192]	New Zealand	3 hospital emergency departments	196	15-24 years	Referral for follow-up care
Granboulan et al, 2001[199]	France	7 public general hospitals (inpatient sample)	167	13-18 years	Compliance with follow-up
Hulten et al, 2000[7]	9 European centres	Hospital emergency department within each of 9 regions	1294	15-19 years	Being recommended aftercare

Table 3: Objective 3 hypotheses and supporting evidence

a) Outcome: repeat emergency department presentation(s) for self-harm

Variable	Repetition (yes/no)		Number of repeat events	
	Hypothesis	Evidence (see table b))	Hypothesis	Evidence (see table b))
Sex	No association	Bergen et al, 2010; Reith et al, 2003; Hulten et al, 2001; Stewart et al, 2001; Hjelmeland et al, 1996	Exploratory, although some evidence girls may repeat more.[284]	
Age	Exploratory, but hypothesize that 16-17 year-olds more likely to repeat.	Mixed results from previous studies, either no association (Reith et al 2003) or older ages more likely to repeat (Stewart et al, 2001)	Exploratory	
Community size	Exploratory		Exploratory	
Neighbourhood income quintile	No association	Johnston et al, 2006	Exploratory	
Method of self-harm	Individuals with index presentations involving self-cutting more likely to repeat	Bergen et al, 2010; Lilley et al, 2008; Kapur et al, 2006; Hulten et al, 2001	Individuals with index presentations involving self-cutting repeat more often	Lilley et al, 2008
Canadian Triage and Acuity Scale	Exploratory		Exploratory	
Alcohol involvement	Individuals with index presentations involving alcohol less likely to repeat	Stewart et al, 2001	Exploratory	
Inpatient psychiatry	Exploratory	Previous analysis (Bethell et al, 2010) found no association between admission and repetition, but admission was not stratified according to receipt of inpatient psychiatric services.	Exploratory	Previous analysis (Bethell et al, 2010) found those admitted repeated less often, but admission was not stratified according to receipt of inpatient psychiatric services.
Mental health service history	Individuals with history of mental health contact more likely to repeat	Bergen et al, 2010; Haw et al, 2007; Kapur et al, 2006; Stewart et al, 2001	Exploratory	Some evidence that individuals with history of mental health repeat more often (Haw et al, 2007).
Coding of intent	Since not all those coded undetermined will represent self-harm, individuals with index presentations coded as self-inflicted more likely to repeat	Bethell & Rhodes, 2009	No association between coding of intent and number of repeat presentations.	No previous study, this portion of model is restricted to "repeaters" so those coded as "undetermined" at index presentation likely represented self-harm and therefore will follow similar profile as those coded as "self-harm" at index presentation.

Note: presentation by girls, that involve self-cutting, triaged as high acuity and admitted to hospital are more likely to be coded self-harm (vs. undetermined) and so the effects of these variables may differ between self-harm definitions.

b) Supporting evidence

Author, year	Country	Sample	n	Age range	Outcome	Analysis
Bergen et al, 2010[87]	England	6 emergency departments in 3 cities, self-harm	13,966	All ages	Repeat self-harm presentations within 2 years	Multiple event survival analysis
Bethell et al, 2010[144]	Canada	All emergency departments in Province of Ontario	10,937	12-17 years	Repeat self-harm presentations within 1 year	Hurdle model
Lilley et al, 2008[143]	England	6 emergency departments in 3 cities, self-harm	7,344	All ages	Repeat self-harm presentations	Multiple event survival analysis
Haw et al, 2007[141]	England	1 emergency department, self-harm	4,167	>15 years	Repeat self-harm presentations within 6 years, categorized as no repetition, less frequent repetition (1-3 events), or frequent repetition (4 or more events)	Multinomial logistic regression
Kapur et al, 2006[130]	England	4 emergency department (Manchester and Salford Self-Harm (MASSH) monitoring system)	9,213	>14 years	Repeat self-harm presentation within 1 year	Survival analysis
Johnston et al, 2006[269]	England	3 emergency departments, self-harm (Manchester Self-Harm (MASH) monitoring system)	4,743	>15 years	Repeat self-harm presentation within 6 months	Correlation (proportion repeating with ecological variables, by region)
Reith et al, 2003[142]	Australia	Regional poisoning referral service (from hospitals), self-poisoning	450	10-19 years	Repeat self-poisoning presentations	Multiple event survival analysis
Hulten et al, 2001[6]	9 European centres	Hospital emergency department within each of 9 regions, self-harm	1,294	15-19 years	Repeat self-harm presentation (yes/no)	Survival analysis
Stewart et al, 2001[135]	Canada	1 pediatric emergency department, suicidality (ideation and	548	5-19 years	Return to emergency department within 6 months with documented	Logistic regression

		attempts) inception cohort			suicide attempt (yes/no)	
Vajda & Steinbeck, 2000[129]	Australia	1 hospital emergency department, self-harm	112	13-20 years	Repeat self-harm presentation within 12 months (yes/no)	Logistic regression
Hjelmeland, 1996[285]	Norway	All county healthcare facilities, self-harm	1,220	>14 years	Repeat self-harm presentation within 12 months (yes/no)	Logistic regression

Table 4: Objective 4 hypotheses and supporting evidence

a) Outcome: repeat emergency department presentation(s) for self-harm

Variable	Repetition (yes/no)		Number of repeat events	
	Hypothesis	**Evidence**	**Hypothesis**	**Evidence**
30-day mental health follow-up (unadjusted)	No association or individuals who have mental health follow-up within 30 days of their index episode more likely to repeat.	Kapur et al, 2004 found that, in bivariate analysis, there was no association between referral for specialist follow-up and repetition. However, it is likely that more difficult cases of self-harm (including those more prone to repeat) are more likely to be referred to specialist clinicians.[64]	Exploratory, but hypothesize that before adjusting for other variables, individuals who have mental health follow-up within 30 days of their index episode may repeat more often.	
30-day mental health follow-up (unadjusted)	Individuals who have mental health follow-up within 30 days of their index episode less likely to repeat.	Kapur et al, 2004 found that, after adjusting for demographic and clinical differences, referral for specialist follow-up was associated with half the risk of repetition (hazard ratio (95% confidence interval): 0.49 (0.25 to 0.84))	Exploratory, but hypothesize that after adjusting for other variables, individuals who have mental health follow-up within 30 days of their index episode may repeat less often.	

b) Supporting evidence

Author, year	Country	Sample	n	Age range	Outcome	Analysis
Kapur et al, 2004[106]	UK	4 hospital emergency departments, self-poisoning	658	>16 years	Repeat self-poisoning presentation within 6 months (yes/no)	Survival analysis

Appendix B: Repeat Self-Harm: Application of Hurdle Models (from British Journal of Psychiatry)

Appendix C: Identifying Deliberate Self-Harm in Emergency Department Data (from Health Reports)

Appendix D: Description of Index Events for Inception Cohort Members who Died Within 1-Year of Index Event (Self-harm Definition 2 [SH2])

Variable	SH2* (n=15)	
	n	%
Sex		
Girls	7	46.7%
Boys	8	53.3%
Age (years)		
12-15	7	46.7%
16-17	8	53.3%
Community size		
100,000+	9	60.0%
<99,999	6	40.0%
Neighbourhood income quintile		
1 (lowest) - 3	nr	
4 - 5 (highest)	<6	
Method of self-harm		
Poisoning only	7	46.7%
Self-cutting or other only	8	53.3%
Canadian Triage and Acuity Scale		
Resuscitation or Emergent	nr	
Urgent, semi-urgent or non-urgent	<6	
Disposition		
Admitted	7	46.7%
Discharged, transferred or left before visit completed	8	53.3%

nr: not reportable because of small cell sizes (n<6) and data confidentiality protection.

Self-harm definition 2 (SH2): records that lists any International Classification of Diseases, version 10 (ICD-10) code for intentional self-harm (ICD-10: X60-84), poisoning, undetermined intent (ICD-10: Y10-19) or contact with sharp object, undetermined intent (ICD-10: Y28).

* data not shown for self-harm definition 1 (SH1) because of small cell sizes (n<6) and data confidentiality protection. However, similar patterns observed.

Appendix E: List of Ontario Health Insurance Plan (OHIP) Mental Health Diagnosis Codes
Category: Mental disorders

Sub-category: Psychoses

290   Senile dementia, presenile dementia
291   Alcoholic psychosis, delirium tremens, Korsakov's psychosis
292   Drug psychosis
295   Schizophrenia
296   Manic depressive psychosis, involutional melancholia
297   Paranoid states
298   Other psychoses
299   Childhood psychoses (e.g., autism)

Sub-category: Neuroses and Personality Disorders

300   Anxiety neurosis, hysteria, neurasthenia, obsessive compulsive neurosis, reactive depression
301   Personality disorders (e.g., paranoid personality, schizoid personality, obsessive compulsive personality)
302   Sexual deviations
303   Alcoholism
304   Drug dependence, drug addiction
~~305   Tobacco abuse~~
306   Psychosomatic disturbances
307   Habit spasms, tics, stuttering, tension headaches, anorexia nervosa, sleep disorders, enuresis
309   Adjustment reaction
311   Depressive or other non-psychotic disorders, not elsewhere classified
313   Behaviour disorders of childhood and adolescence
314   Hyperkinetic syndrome of childhood
~~315   Specified delays in development (e.g., dyslexia, dyslalia, motor retardation)~~
~~319   Mental retardation~~

Category: Supplemental classification

Sub-category: Social, Marital and Family Problems

897   Economic problems
898   Marital difficulties
899   Parent-child problems (e.g., child-abuse, battered child, child neglect)
900   Problems with aged parents or in-laws
901   Family disruption, divorce
902   Educational problems
903   Illegitimacy
904   Social maladjustment
905   Occupational problems, unemployment, difficulty at work
906   Legal problems, litigation, imprisonment
909   Other problems of social adjustment