# Using Long Term Risk Factors from the Ontario Mental Health Reporting System (OMHRS) dataset to predict suicide admission and suicide severity among acute psychiatric inpatients in Ontario, Canada

by

Ashley Garner

A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirements for the degree of

Master of Science

in

Public Health and Health Systems

Waterloo, Ontario, Canada, 2021

© Ashley Garner 2021

## Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

# Abstract

The main purpose of this study was to investigate the relationships between multidimensional long term suicide risk factors (LTRF) and short-term suicide related outcomes known as early warning signs (EWS) among a cross-section of psychiatric inpatients in Ontario between 2005 and 2019. This study conducted a secondary data analysis with statistical methodology using the Ontario Mental Health Reporting System (OMHRS) dataset. This study found a diverse range of LTRF from multiple domains related to a person's health and wellbeing to be predictive of EWS. These findings indicate that suicide is a complex phenomenon with multiple interrelated contributing factors, and therefore the whole person should be treated with a multi-disciplinary approach to ameliorate suicide potential, rather than focusing on individual or a particular group of LTRFs.

## Acknowledgements

First of all, I would like to extend my sincere gratitude to my supervisor, Dr John Hirdes, for his unwavering support and for continuing to have faith in my journey. I would also like to express great thanks to Dr Chris Perlman and Dr Gary Cheung for agreeing to be part of this project as well as for your ongoing support and guidance. Deserving of a special mention are Micaela Jantizi, Julie Koreck and also Brian Mills for always being available to help me out, and also to Dr Dave Hammond for the nudge. Finally, thank you to all my dear friends and family back home for keeping me grounded. And of course, to the most important person in my life, my inspiration, Dr Shawadi; without you, none of this would have been possible.

# Table of Contents:

## List of Figures:

## List of Tables:

# Introduction

Suicide is one of the common, deadly, and potentially preventable public health problems of ongoing international concern (Bertolote, Fleischmann, & Leo, 2003; Franklin et al., 2017; White, 2003). Despite advances in medical and psychological science, suicide rates have remained constant, imparting a profound and long-last impact on those left behind. The World Health Organization (WHO) estimates that each year close to 800,00 people die by suicide (WHO, 2019). In 2016 alone, an estimated 793,000 suicide deaths occurred worldwide, representing an annual global age-standardized rate of 10.5 deaths per 100,000 people. Canada records the third highest rate of suicide in the industrialized world where an average of 10 people die by suicide each day across the country, amounting to approximately 11.4 deaths per 100,000 people placing suicide as the 9$^{th}$ leading cause of death nationwide (Statistics Canada, 2019). The scope, severity and consistency of suicide demands better understanding of its causes. Up to this point, decades of research have been dedicated to understanding its causal pathways, how to accurately predict it, and how best to treat and prevent it. Risk factors are a critical component of each of these branches of research (WHO 2012). Numerous different psychological, sociological and biological theorists have grappled with the phenomenological complexity of suicide, which is broadly considered to involve the interaction between genetic, neurobiological, psychological, behavioral and environmental risk/protective factors (O'Connor & Nock, 2014; van Heeringen & Mann, 2014; Turecki & Brent, 2016). Epidemiological research has indicated that risk of suicidal behaviour and suicide varies as a function of sociodemographic characteristics, such as sex, age, living conditions and socioeconomic status (Hawton, 2018; Mościcki, 2001). Psychiatric and physical illness, as predisposing factors, have also been extensively investigated. Indeed, depression, substance use, personality and anxiety disorders are the most commonly associated with suicide risk (Hawton & van Heeringen, 2009), while stroke, epilepsy and chronic pain are the somatic health conditions commonly associated with suicide-related outcomes (Bagary, 2011; Bolton, Gunnell, & Turecki, 2015; Ilgen, Zivin, McCammon et al., 2008; Ilgen, Kleinberg, Ignacio et al., 2013; Maurizio, Paola, Sandra et al., 2012).

Recognition of the diversity of person and societal level risk factors for suicide spans the literature since Durkheim's (1897) examination of the impact of poverty and large-scale economic changes on suicide rates (Piatkowska, 2020). Usually, a broad set of theories gives way to a dominant paradigm that is consolidated and then reformed to reflect developing knowledge. The current theoretical diversity of the suicide research field means that it is still in a pre-paradigmatic phase. For the field to progress to a paradigmatic phase, empirical data must be employed to examine the diverse risk factors purported by each of these theories and test their predictive validity. Few studies in this space have investigated the combined effects of diverse suicide risk factors, instead attempting to explain suicide by focusing on one particular domain of possible risk factors (e.g., psychosocial, psychiatric, or physiological). This approach may be too narrowly focused to estimate the relative

importance of different types of risk factor and their relationships, especially as we understand that risk factors can combine and interact to affect the overall level of suicide risk (Mann, 2002). The rarity of suicide, however, makes it difficult to study, and the multidimensional nature of risk factors creates a methodological challenge meaning that our ability to predict suicide remains poor (Franklin et al., 2017). If we are to enhance our understanding, a model of suicide must consider together a broad array of distal long-term risk factors (LTRF) in order to make reliable assertions regarding their potential to predict acute suicide risk (Hawton & Heeringen, 2009). There is substantial value in better understanding the predictive efficacy of long-term suicide risk factors, particularly modifiable ones, as better insight can provide clues to promising suicide intervention and prevention strategies.

## Long Term Suicide Risk Factors

The etiology of suicide refers to its origins and the causal path that it follows. As we understand it, suicide has a complicated etiology involving multiple protagonists, many of which are long-term in nature acting upon the individual for a lengthy period of time before culminating in acute manifestations of suicidality of described as early warning signs (EWS). This section will discuss a range of prominent LTRFs spanning three broad domains: (1) psychosocial, (2) psychiatric, and (3) physiological.

### Psychosocial factors

Many suicides happen impulsively in moments of crisis with a breakdown in the ability to deal with life stresses. Events, situations or changes where loss and/or readjustment is involved, such as poverty, unemployment, isolation, or interpersonal conflict, might be accompanied by feelings of helplessness, hopelessness, and powerlessness. These reactions to stressors are important to situate within the context of suicide because they are the emotional mechanisms through which many adverse events have an impact on our wellbeing and are widely believed to determine vulnerability to many types of psychopathology (Lupien et al., 2009; van Heeringen, 2012). Exposure to stress can trigger suicidality, and if severe enough, can precipitate suicidal behaviour even without the existence of predisposing characteristics (van Heeringen, 2012).

### Social Connections

It is generally accepted that the presence of a social network is protective against suicide (Joiner, 2002), whereas persons with few or no social connections (e.g., the retired, unemployed, divorced, persons who live alone) are all more vulnerable to suicidality (Heisel, 2006; Kennedy, Metz, & Lowinger, 1996; Rubenowitz, Waern, Wilelmson, & Allbeck, 2001). Studies in older adults have shown that suicides in later life were more likely in people who lived alone and did not participate in community activities (Conwell, Van Orden & Caine, 2011; Dennis, Wakefield, Molloy, Andrews, &

Friedman, 2007), while additional factors such as lack of a confidante, having few close friends and relatives (Bartels et al., 2002; Clarke et al., 2004), and a limited social network, including a perceived lack of social support (Awata et al., 2005; Rowe, Conwell, Schulberg, & Bruce, 2006; Yip et al., 2003) have all been associated with greater suicide risk. Although these studies were predominantly done on older populations, it is conceivable that a similar effect would be experienced by those with similar circumstances in different age groups. Other studies have reported that **married** persons experience lower suicide rates than single, never married individuals, and that divorced, separated and widowed individuals have the highest rates (Durkheim, 1887; Smith, Mercy, & Conn, 1988; Kachur et al, 1995; Kposowa, Breault, & Singh, 1995). One explanation given to account for these observed differences is that marriage provides social and emotional stability, whereas divorce, separation, singlehood and widowhood do not (Hassan, 1995). Accordingly, marriage offers the best protection against suicide because it provides social and community integration, and reduces social isolation (Kposowa et al., 1995; Breault, 1986). Individually, the absence of these protective factors may not be significant, but collectively they represent a major problem in vulnerable populations. The need for purpose, to be valued, to have relations, and to belong to social groups are powerful and extremely pervasive motivations (Baumeister & Leary, 1995). When frustrated, numerous negative effects on health, adjustment, and well-being can emerge. Chronic and repeated exposure to these stressors may result in related pathophysiological and psychopathological changes that may render a person less resilient to further insult, increasing susceptibility to suicide (Lupien et al., 2009; Sapolsky et al., 1986; van Heeringen, 2012; van Heeringen & Mann, 2014).

## Education and Employment

As early as 1897, Emile Durkheim argued that being in an organized labour force was a buffer against suicide because **employment** promotes a person's integration into the society and reduces the risk of suicide. According to Durkheim, job loss and unemployment weakens a person's social integration, deprives one of status and social role and increases social isolation, which elevates the risk of suicide. While later research has tended to produce inconsistent findings on this relationship (Wilson & Walker, 1993; Dooley et al., 1996; Morrel et al., 1998; Boardman et al., 1999), Kposowa (2001) found that unemployed men were a little over twice as likely to die by suicide as their unemployed counterparts, while lower socioeconomic status meant higher suicide risk in this group. Among women, Kposowa (2001) reported that those unemployed had up to three times higher suicide risk than the employed. It has been suggested that persons with lower **education** have fewer intellectual resources at their disposal to navigate life's complexities, thus rendering them more susceptible to detrimental impact of any challenges, adversities, and hardships they may encounter. However, research investigating the link between education and suicide has tended to report mixed findings (Hempstead & Phillips, 2015), with most suggesting higher suicide risk among those with less education (Crosby,

LaVonne, & Stevens, 2013; Lorant et al., 2005), while others report the opposite (Pompili et al., 2011; Vijayakumar et al., 2005). Phillips & Hempstead's (2017) study of differences in US suicide rates by educational attainment found that both men and women with a college degree exhibit the lowest rates of suicide. Other risk factors such as homelessness and unemployment disproportionally affect those with lower education, potentially creating widening socioeconomic disparities in suicide mortality rates. The reverse association between education level and suicide might be explained by well-functioning people who suddenly find themselves in a stressful situation facing the prospect of losing income, employment, or the ability to use their education, they might feel more stigmatized by their social surroundings, or have a greater insight into the course of the mental illness.

## Homelessness

Persons with low education and/or are unemployed are more likely to be homeless, and it is these individuals who represent some of society's most marginalized and unsupported populations. Unsurprisingly, the homeless have greater rates of morbidity than their housed counterparts (Lebrun-Harris, Baggett, Jenkins et al., 2012). Suicide is highly prevalent among homeless persons (Ray 2006), and it is estimated that more than half have experienced suicidal ideation or exhibited behaviours (Coohey, Easton, Kong & Bockenstedt, 2015). In comparison to the general population, suicide rates among homeless groups have been found in some instances to be more than 10 times higher (Patterson & Holden, 2012).

## Immigration

As the process of globalization continues to break down natural boundaries making it possible to travel from one culture to another, migration is a phenomenon with substantial societal implications. Whether voluntary or forced, the stress of the migrating process, the ending of the links with their country of origin, the loss of status and social network, a sense of inadequacy because of language barriers, unemployment, financial problems, or a sense of not belonging, might be accompanied by changes in suicide propensity among migrants compared to those in the host country (Ratkowska & De Leo, 2013). These experiences can provoke a variety of psychopathologies such as depression, anxiety, post-traumatic stress, and addictions, leading to feelings of loneliness and hopelessness (Iliceto, Pompili, & Candilera et al., 2012; Hovey, 2000; Ponizovsky & Ritsner, 1999). Further, rapid changes in the social fabric of the host country might contribute to further isolate people, while decreasing protective factors specific to each culture through the process of homogenization or 'cultural hybridization' (Ratkowska & De Leo, 2013). In the Canadian context, the relationship between immigration and suicide is worth noting. Statistics Canada (2016) reported that 21.9% of the population reported that they were or had ever been a landed immigrant, while more than a million new immigrants

permanently settled in Canada between 2011 and 2016, constituting 3.5% of Canada's total population in 2016.

## Age

Suicide rates tend to increase with age; however, this trend is not uniform as we see considerable cross-cultural variation in suicide rates among different age groups (Shah, 1998). Further, substantial differences in suicide rates exist between men and women across age groups. For example, rates of suicide per 100,000 among males aged 20-79 were between double and triple that of females in the same age categories (Statistics Canada, 2019). In general, the male to female ratio of suicide increases with age, especially in males (van Heeringen & Hawton, 2009), from approximately 3:1 among younger people, to 12:1 among those over 85 years of age (De Leo & Spathonis, 2004). Suicide is the second leading cause of death among adolescents in Canada (Navaneelan, 2012; Statistics Canada, 2018). In 2016, suicide accounted for 19% of deaths among youth aged 10-14, 29% among youth aged 15-19, and 23% among young adults aged 20-24 (Navaneelan, 2012). Adolescence is a period of transition from childhood to adulthood and also, a time of increased vulnerability to mental illness (Varese et al., 2012). Stressful life events, both traumatic and interpersonal, have been shown to contribute to suicide risk in adolescents (Dawes, Mathias, & Richard, 2008), and the number of adversities or negative life events experienced by adolescents appear to have a dose-response relationship with youth suicidal behaviour (Serafini et al., 2015). Older men (i.e., over 84 years) have the highest rate of suicide in Canada across all age groups (Canadian Coalition for Seniors Mental Health, 2006) at a rate of 7.3 times greater than rates of suicide among older women (CDC, 2007).

## Sex & Gender

Because men and women are not homogeneous groups, suicide rates in the general population typically differ by sex. Based on 2016 trends, Statistics Canada (2018) reported that the suicide rates among men are approximately three times higher compared to women; with an average rate of 18.2 male deaths per 100,000 per year over the last 10 years, compared to an average rate of 6.0 female deaths per 100,000 per year over the same time period. While women across the age groups attempt suicide approximately three times more often than men (Ialomiteanu et al., 2016; Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002), they are known to choose less violent and disfiguring methods, such as intentional medication overdose or ingesting a toxic substance (Biermann, Sperling, Bleich, Kornhuber, & Reulbach, 2008; CDC, 2007; Glass & Reed, 1993); whereas men are more likely to use active methods of suicide, i.e., lethal methods such as firearms or hanging (CDC, 2007; Glass & Reed, 1993; Osgood, 1992). The sex differences in methods used may account, in part, for the sex differences observed in the ratio of suicide attempts to fatalities, especially as we understand that men are successful three times more often than women (Resnick, 1980; Farberow and Lilman, 1975).

Although frequently used interchangeably, sex and gender differ in that sex is biologically based and refers to distinct anatomical differences between the reproductive organs of women and men, while gender is defined as either a social construct or a subjective sense of personal identification. Because gender is not divided along binary lines of 'females' and 'male', in some circumstances an individual's assigned sex and gender do not align, meaning that some people do not identify with any gender, while others with multiple genders. For some, this incongruity between their assigned biological sex and their subjective gender identity can be distressing. The DSM 5 defines gender identity disorder (GID) as having deeply rooted feelings of persistent discomfort with one's biological gender and having the desire to be of the opposite gender to the extent that the disturbance causes clinically significant distress or impairment in important areas of functioning (American Psychiatric Association, 2013). Although there are multiple ways a person with GID may self-identify, two common terms are 'transgender' and 'transsexual'. Transgender typically encompasses individuals who self-identify as being or living outside socially constructed gender roles or masculinity and femininity; while transsexual is often used to conceptualize a subset of transgender persons who desire to undergo physical changes to their bodies, such as cross-gender hormone treatments and gender reassignment surgery (Lombardi, 2001). Although this diagnosis is relatively uncommon, persons with GID constitute a sub-population of people who experience numerous disparities in both physical and mental health outcomes (Clements-Nolle, Marx, Guzman, & Katz, 2001). Although there is certainly a paucity of conclusive evidence regarding the association between GID and suicide, some research suggests that persons with GID may be at elevated risk (Kenagy & Bostwick, 2005; McDuffie & Brown, 2010; Mathy, 2002; Xavier, Bobbin, Singer, & Budd, 2005)

## LGBTQ

Societal and cultural aspects undoubtably contribute to observed gender differences suicide rates. This is especially evident when examining minority groups that may suffer from discrimination, such as higher suicide rates observed among those who identify as lesbian, gay, bisexual, transgender, or queer (LGBTQ), likely due at least in part to hostility and/or marginalization of this community (Halady, 2013). According to the Centers for Disease Control and Prevention (CDC), youth who identify as LGBTQ are four times as likely to attempt suicide than their heterosexual peers, and youth who are questioning their sexuality are three times more likely to attempt suicide (CDC, 2011). Though the risk of suicide is higher for youth, the is a significant prevalence of suicidality among LGBTQ adults as well (Paul et al., 2002). The widespread social stigma faced by people who openly identify as, or are perceived to be, LGBTQ (Halady, 2013), which often manifests itself in physical and emotional violence, as well as discrimination by family, friends, community members, and employers, is an important factor contributing to the elevated levels of suicidality within the LGBTQ population. It is important to recognize that the person's orientation is not the root cause of suicide risk, instead suicide

risk may stem from the distress caused by external traumatic life experiences ranging from parental neglect or exclusion, to public discrimination or harassment (Perlman et al., 2011). Fear of violence and discrimination leads to high levels of secrecy regarding LGBT identities and relationships, as well as a general unwillingness to disclose one's LGBT identity.

## Trauma

Trauma is "a horrific event beyond the scope of normal human experience" (Greenwald, 2007) that a substantial proportion (60–90%) of individuals will be exposed to in their lifetime (Kessler et al., 2017; Kilpatrick et al., 2013; Thordardottir et al., 2015). While most adjust to the trauma and adequately recover from the ensuing emotional strain, it remains unexplained why some suffer more than others and experience mental health decline, sometimes to the point of suicide risk. Following a trauma, depending on the type (Kessler et al., 2017; Ozer, Best, Lipsey, & Weiss, 2003), a minority may experience post-traumatic stress disorder (PTSD), which has been linked to suicidality (Ford & Gomez, 2015; Krysinska & Lester, 2010; Panagioti, Gooding, Triantafyllou, & Tarrier, 2015). In a WHO mental health survey of the relationship between traumatic events and suicidal behaviour in 21 countries, Stein et al. (2010) found that violence-related events had the strongest associations with suicidality. Other previous studies have reported suicide risk can be elevated subsequent to exposure to adverse childhood experiences (ACEs) during sensitive periods of psychosocial development (Afifi et al., 2016; Bruffaerts et al., 2010; Afifi, Boman, Fleisher, & Sareena, 2009; Devries et al., 2014; Evans, Hawton, & Rodham, 2005; Miller, Esposito-Smythers, Weismoore, & Renshaw, 2013; Sachs-Ericsson, Stanley, Sheffler, Selby, & Joiner, 2017), for both suicidal ideation (Stansfeld et al., 2017) and suicidal behaviour (Dube et al., 2001; Enns et al., 2006; Ford & Gomez, 2015). In fact, mental illness is widely believed to be grounded in ACEs (Kessler et al., 2017). In a population sample, approximately 78% of those who had attempted suicide had experienced childhood sexual abuse, approximately three quarters had experienced childhood physical abuse, while those who had attempted suicide reported twice as many experiences of childhood emotional abuse than non-attempters (Briere, Madni, & Godbout, 2016). In a large retrospective cohort study, persons who reported having experienced emotional, physical, or sexual abuse in childhood were three to five times more likely to have attempted suicide at some point in their lives (Dube et al., 2001), while another study on ACEs reported that a dose response relationship exists where the accumulation of ACEs increased the odds of both suicidal ideation and behaviour (Thompson, Kingree and Lamis, 2019). Other research in trauma found that non-interpersonal events such as the loss of a loved one can increase the risk of suicidality (Bylund Grenklo et al., 2013; Jakobsen & Christiansen, 2011; Niederkrotenthaler, Floderus, Alexanderson, Rasmussen, & Mittendorfer- Rutz, 2012).

Trauma often precedes the onset of dissociative identity disorder (DID) (Ford & Gomez, 2015), which is characterized by the maintenance of at least two distinct and relatively enduring personality

states, often referred to as ‘alters’ (American Psychiatric Association, 2013). Although the etiology of DID is poorly understood, it is widely believed that the cause is traumagenic, emerging as a direct result of childhood trauma, especially of an abusive nature (Gleaves, 1996; Kluft, 1985; Midgley, 2002; Putnam, 1989; Spiegal, 1984). Different personalities can develop in childhood as a reaction to severe trauma (Sinason, 2002). When people dissociate, they leave their body to escape the pain or trauma. When this defence is not strong enough to protect the person, different personalities or alters emerge as a means to cope and facilitate psychological survival. When the child is experiencing traumatic episodes, the alters take the pain and/or watch, and this allows the child to return to his/her body after the trauma without any awareness of what has occurred (Sinason, 2002). Numerous studies have linked exposure to psychological trauma to DID (Herman,1992; Putnam, Guroff, Barban, & Post, 1986; van der Kolk et al.,1996). Suicide in DID is complicated when different alters are involved. Just because one alter is suicidal, that does not mean the other alter is as well. It is possible that one alter may not even be aware of the suicidal feelings of another, especially when alters are not co-conscious. In some cases, the main person is not suicidal, but one or more alters are making it possible for suicidal feelings and behaviours to occur without the host knowledge or awareness. This dissociative amnesia can make it difficult not only for the person with DID, but also creatures a substantial challenge to assessment and treatment efforts.

## Mental Illness

It is difficult to separate the impact of psychosocial adversity and trauma from that of mental illness. The aforementioned factors are clearly not independent from each other or from mental illness, which can lead to job loss, homelessness, or the breakdown of key relationships. Moreover, mental illness and psychosocial adversity can often combine to increase the overall level of stress on a person (Mann, 2002). Each year it is estimated that 1 in 5 Canadians experience a mental illness. By the time Canadians reach 40, 1 in 2 have, or have had, a mental illness (Smetanin et al., 2011). People with mental illness are more likely to die prematurely from both natural and unnatural causes (Nordentoft et al., 2013), with their average lifespan about 15 to 20 years shorter than that of the general population (Wahlbeck et al, 2011). This excess mortality among persons with mental illness is partly explained by increased risk of suicide (Bostwick & Pankratz 2000; Palmer, Pankratz, & Bostwick, 2005; Nordentoft, Mortensen & Pedersen, 2011), and it is estimated that 90% of individuals who die by suicide have at least one mental health issue (Cavanagh et al., 2003; Hawgood & De Leo, 2008). Suicide risk in relation to mental illness is in large part dependent on the type of illness and therefore varies across categories (Qin & Nordentoft, 2005). Multiple mental disorders demonstrate a strong empirical link with suicide. Among the diagnoses most frequently associated with suicide are mood and anxiety disorders, personality and eating disorders and psychotic disorders.

## Mood Disorders

The association between mood disorders and suicide is well-established (Chioqueta & Stiles 2003; Mann et al., 2005), particularly in depression (Chioqueta & Stiles 2003; Preuss et al., 2002; Yen et al., 2003; Prigerson et al., 2003). Characterized by persistent sadness or low mood, loss of interests or pleasure, and fatigue or low energy, depression is often accompanied by feelings of hopelessness, which is encapsulated by a pervasive lack of perceived efficacy and helplessness giving rise to the belief that one's future will be exclusively bleak (Cornette, Abramson, & Bardone, 2000). Hopelessness is widely believed to be the key mechanism binding the relationship between depression and suicide as it leads one to believe that suicide is a viable, maybe even the only, available strategy to deal with perceivably insoluble problems and a desolate future (Beck et al., 1985). Bertolote et al. (2003) estimated that 53.7% of those who died by suicide are diagnosed with depression, with higher levels of depressive symptoms associated with greater likelihood of suicidal and non-suicidal self-injury (Klassen et al., 2017; Liu et al., 2017). Lonnquest (2000) found a diagnosis of depression ranging from 29% to 88% in a review of psychological autopsy studies, while persons with depression are 60% to 70% more likely than the general population to die by suicide (Khan, 2002). The rates of suicide are also elevated for persons with **bipolar disorder** (Chioqueta & Stiles 2003), who are at uniquely high risk of dying by suicide due to a symptomatic proclivity for erratic and risky behaviour when in the midst of a manic episode that substantially elevates the risk of harm, either intentionally or unintentionally. Undiagnosed, uncontrolled or intractable bipolar disorder can cause such immense suffering that it leads one to believe that suicide may be the only escape (Nordentoft et al., 2011).

## Anxiety Disorders

Anxiety disorders have been implicated with suicidality, although findings are mixed (Coryell et al., 1982; Henriksson et al., 1996; Khan et al., 2002; Noyes, 1991; Placidi et al., 2000). The discrepancies in the data and consequent uncertainty regarding the reliability of our understanding about suicidality and anxiety disorders can in part be attributed to methodological issues such as many studies are retrospective and generated by multiple techniques of enquiry, a lack of clarity on specific types of anxiety disorder, and the inclusion of persons with varying degrees of illness severity. Khan et al. (2002) found a significant association between anxiety disorders and suicide, reporting suicide risk higher than described in many previous studies, and regardless of the type of anxiety disorder with which the subject was diagnosed. Bartles et al. (2002) reported high amounts of suicidal ideation was associated with co-occurring major depression and anxiety disorder. However, because anxiety and mood disorder are so highly correlated, it is possible that the connection between anxiety and suicide may be explained partly through this comorbidity (Cox et al., 1994; Schmidt et al., 2000).

## Personality Disorders

Specific types of personality disorders have been associated with suicide. Characterized by a pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity that begins by early adulthood and is present in a variety of contexts, **borderline** personality disorder (BPD) has the strongest correlation with suicidality and is often described as the most lethal of all mental disorders, with the usual mechanism of death being suicide (Joiner, 2002; Keel et al. 2003; Qin, 2011). The American Psychiatric Association (2001) estimates that 60% to 70% of individuals with BPD attempt suicide, while during the course of their illness, 5% to 10% ultimately end their lives. Yen et al. (2003) found BPD to be the strongest predictor of suicide, with the majority (77.6%) of those who attempted suicide meeting the diagnostic criteria for BPD. Characterized by long-standing patterns of aggressive behaviour and reckless and impulsive disregard for others, rules and norms (Verona et al., 2001; 2004), antisocial personality disorder has also been associated with suicidality. The combination of frequent runaway aggression, persistent criminality, negative emotionality, and antisocial personality characteristics may be one mechanism explaining its link with heightened suicide risk. (Verona et al., 2001). Uncontrolled and reckless behaviours would serve to elevate risk while intense negative emotional states, impulsivity, and persistence of illness often lead to a higher number of suicide related behaviours, attempts, and deaths in people with BRD and antisocial personality disorder (Joiner, 2002; Zaheer, Links, & Liu, 2008).

## Eating Disorders

Eating disorders (ED) across all subtypes are often a silent, secretive battle with many comorbid medical complications, and represent life-threatening forms of psychopathology renowned for having a disproportionately high mortality rate among all psychiatric disorders (Signorini et al., 2007; Sullivan, 2002). Suicidality is highly prevalent among persons with ED (Bulik, Sullivan, & Joyce, 1999; Corcos et al., 2002; Harris & Barraclough, 1998; Sullivan, 1995; Keel et al., 2003; Franko & Keel, 2006; Signorini et al., 2007; Preti, Camboni, & Miotto, 2011), and several studies report high mortality rates in ED which is partly explained by high rates of suicide (Sullivan, 1995; Nielsen et al., 1998; Emborg, 1999; Herzog et al., 1999; Keel et al., 2003). Comorbidity of ED with other psychiatric illness, particularly mood and anxiety disorders, is commonplace (O'Brien & Vincent, 2003). For example, it is estimated that about 90% of persons with ED are also have depression and other mood related disorders (Preti, Camboni, & Miotto, 2011), while substance misuse and personality disorders are also prevalent among persons with ED (Bulik et al., 2004; Franko & Keel, 2006; Holderness, Brooks-Gunn, & Warren, 1994; Rosenvinge, Martinussen, & Ostensen, 2000). Suicide is of particular concern among those with ED, not only because of high likelihood of comorbidity and difficulties in treatment, but because of the tendency of those with ED to be secretive about their condition, which could translate to individuals concealing signs and symptoms of suicidality.

## Schizophrenia and Psychoses

Schizophrenia is a major mental illness characterized by distorted thinking and perception that tends to run a chronic course. People with schizophrenia have a substantially shorter life expectancy than the general population (Saha et al., 2007), for which suicide, estimated to account for up to 40% of excess premature mortality (Bushe et al., 2010), is partly to blame (Sher & Kahn, 2019). Palmer et al. (2005) estimated a lifetime suicide risk of 4.9% for people with schizophrenia. A 5-year WHO study on 1,056 individuals with psychosis found suicide to be the most common cause of death among those with schizophrenia (Sartorious et al., 1986). Harris and Barraclough (1997) reported the risk of suicide among those with schizophrenia to be 8.5 times higher than the general population, and that between 15% and 26% of people with schizophrenia have made at least 1 suicide attempt by their first treatment contact. Other studies have reported that up to 50% of those with from schizophrenia experienced suicidal ideation, with or without suicide attempt, at some time during the course of their illness (Landmark, Cernovsky, & Merskey, 1987; Planansky & Johnston, 1971; Roy, Mazonson, & Pickar, 1991).

Multiple risk factors have been associated with high suicide risk among individuals with schizophrenia, many of which are shared with other clinical populations, while others appear to be more specific to schizophrenia. For example, some evidence suggests a higher risk of suicide among those with predominantly positive symptoms, compared to others with predominantly negative symptoms (Hawton, 2000). However, it has been argued that the course of the illness, frequent relapses, high severity and chronicity, a downward drift in social and vocational functioning, and a realistic awareness of the deteriorating effect of the illness are better indicators of suicide propensity than a specific schizophrenia subtype (Caldwell & Gottesman, 1990). A systematic review completed by Hawton et al (2005) reported that many of the important risk factors for suicide in schizophrenia were similar to those in the general population, including mood disorder, trauma, and substance misuse. However, additional factors associated with high suicide risk in schizophrenia included fear of mental disintegration, agitation or restlessness, and poor adherence with treatment. Another systematic review conducted by Hor & Taylor (2010) found that factors with the strongest association with later suicide in schizophrenia included being young, male, and highly educated, while illness-related factors such as depression, a history of suicide attempts, active hallucinations and delusions, the presence of insight, comorbid chronic physical illness, and substance misuse were also factors strongly associated with suicide. There has been found to be a high risk of suicide among psychotic persons with high premorbid intellectual functioning (Alaraisanen et al., 2006).

## Substance Use

Substance use and substance use disorders confer substantial risk for suicidality (Borges et al., 2008). It is estimated that 40% of persons seeking treatment for substance use disorder report at least one suicide attempt at some point in their lives (Pompili et al., 2010). However, our understanding of the extent to which the confluence of general suicide risk factors and comorbid mental illness in those who use substances explain the associations between substance use disorders and suicidality remains murky. For example, Darke et al. (2005) described the social profile of heroin users as one of predominant unemployment, low levels of education, social isolation, repeated incarceration, high rates of parental alcoholism, and general psychopathology. Further, while many deaths due to opioid overdoses are accidental, an increasing amount of evidence indicates that the presence of pain plays a role in the decision to end life via opioid overdoses (King, 2018).

Given their widespread exposure to suicide risk factors, it is not surprising that the prevalence of suicidality among substance users is greater than that observed in the general population (Darke et al., 2005). We often see those who experience mental illness turning to drugs or alcohol as a means to cope, and sometimes this can develop into substance use disorder, which cab increase risk of suicidality through loss of inhibition, impulsivity and impaired judgement. Substance use disorders can also result in neurobiological changes that further exacerbate mental illness over time and can be disruptive to relationships causing alienation and loss of social connection (Pompili, 2010). Trauma survivors often turn to alcohol or drugs as a way of coping with resultant psychological pain. The greater the trauma, the greater the risk is for substance misuse, depression, and suicidality (Rosenberg, 2011).

## Physical Morbidity

The idea that physical morbidity and functional impairment are associated with increased risk of suicide is well supported (Johansson, Sundquist, Johansson, & Bergman, 1997; Stenager, Madsen, Stenager & Boldsen, 1998). Some characteristics of physical illness that may predispose individuals to suicide include the nature of the illness (e.g., chronic vs acute), whether or not the illness is debilitating (e.g., interfering with activities of daily living), and if the individual experiences pain (Goldblatt, 2000). Jurrlink, Herrmann, Szalai, Kopp & Redelmeier (2004) examined the association between physical illnesses and suicide among older adults in Ontario found that as the number of acute and chronic illnesses increased, so did the cumulative risk of suicide (Neufeld et al., 2015a; Neufeld et al., 2015b). Specific physiological conditions associated with suicide were congestive heart failure, chronic obstructive pulmonary disease, seizure disorders, urinary incontinence, moderate and severe pain. Physical disorders can have a detrimental impact on mental health and wellbeing, while co-occurrence of physical and mental disorder, known as multi-morbidity, can exacerbate this effect potentially putting those with physical disease at risk of mental illness and suicide (Perlman et al., 2011).

### Neurological Disease

Stenager & Stenager (1992) reported that compared with the general population, suicide risk is five times greater in people with peripheral neurological disorders, and more than five times greater in people with central neurological disorders such as stroke and epilepsy. Some of these findings are supported by Ayalon, Mackin, Arean, Chen, & McDonel-Herr (2007), who reported elevated suicide risk among those with stroke, epilepsy, head injury and Huntington's disease (Coughlin & Sher, 2013; Oquendo et al., 2004). Although there is reportedly a higher risk of suicide among those with comorbid neurological conditions, because these are not uniform in terms of experiences and adaptation, it cannot be assumed that all people with neurological conditions are at risk for suicide, nor can it be assumed that neurological condition in and of itself are the causal factor for suicide risk. As Förstl (2008) explains, even persons with dramatically progressive neurological diseases can have a positive attitude on life with no risk, or desire for ending their life. This suggests that protective factors that mitigate suicidality may exist in the face of neurological condition. Other neurological conditions such as dementia and Parkinson's disease cause organic changes to the brain that can increase risk for suicide through impulsive behaviour and disinhibition (Mann, 2012; Neufeld et al., 2015a). Although suicide risk in dementia is generally considered low (Bellini, De Ronchi, Forti et al., 1998; Draper, Moore & Brodaty, 1998; Lim, Rubin, Coats, & Morris, 2005), an increase in risk can be seen soon after diagnosis (Haw, Harwood, & Hawton, 2009), particularly if the person is younger as the prospect of progressively losing the ability to control and manage one's life is considered (Haw, Harwood, & Hawton, 2009; Qin, 2011). Deficits in cognitive function and impaired insight may protect against suicidality (Conwell, 1995); however, the awareness of cognitive limitations in the early stages of dementia is consider a period where risk is increased (Margo & Finkel, 1990; Rubio et al., 2001; Seyfried, Kales, Ignacio, Conwell, & Valenstein, 2011; Qin, 2011), as are accompanying symptoms of depression (Enache, Winblad, & Aarsland, 2011).

## Pain

There is strong evidence that physical pain is associated with suicide. Fishbain (1996) found increased risk for suicide among persons reporting pain stemming from various physical morbidities (e.g., back pain, cancer, HIV, multiple sclerosis, migraine headaches). Li and Conwell's (2010) study of older adults receiving home care services in the US and found that the risk of suicide-related ideation increased with increasing pain severity; however, this finding was only significant in men. A similar finding with respect to pain and suicide-related behaviour was reported by Waern et al. (2002) and Juurlink et al. (2004). Hinkley and Jaremko (1994) explain that among chronic pain patients, the development of suicide-related ideation is time dependent, in that the longer the pain duration, the greater the likelihood for the presence of suicidal ideation. It is worth noting that not all pain stems from physical illness. Somatic pain experienced by people with depression is as real and debilitating as pain associated with common medical conditions (Callahan & Berrios, 2005). For example, emotional pain

following bereavement (i.e., complicated grief; see [Latham & Prigerson, 2004]), and 'psychache' (i.e., extreme psychological pain; see [Shneidam, 1998]) are other forms of pain that have been linked to suicide risk. These findings suggest that pain may have a direct or mediating effect on suicidality.

## Definition of suicide

Suicide is a difficult concept to pin down because there is no single universally accepted definition. This lack of clarity is problematic because it has implications for surveillance, research and communication efforts regarding what and who is being studied. The concept of suicide in this thesis is consistent with the revised nomenclature of Silverman, Berman, Sanddal, O'Carroll, & Joiner (2007a, 2007b). Suicide related behaviour (previously referred to as suicidality), refers not to a single action or experience, but more broadly to a cluster of associated phenomena, including ideation (i.e., thoughts, cognitions), behaviours (i.e., suicide attempts, self-harm, suicide) and communications (i.e., suicidal threats, gestures, plans). Suicide-related ideation is defined as thoughts of ending one's life or a wish to be dead (Yip et al., 2003), while a suicide attempt is a behavioral expression of self-injury broadly considered a progression of ideation in the overall process of suicide.

With behaviour like a suicide attempt, it can be difficult to determine whether the individual is engaging in purposeful self-harm, which is a broader concept that covers many types of deliberate self-injurious behaviour or is engaging in a self-inflicted and harmful act whereby the aim is to end one's life. While self-directed and dangerous, suicidal and self-harming behaviours are often treated with equal importance, despite what may be marked differences in the intended outcome. The key lies in determining the authenticity of a person's intent to die, it is this key element that distinguishes suicide attempts from other forms of self-harm (e.g., deliberate to one's body tissue without suicidal intent; Prinstein, 2008, Silverman et al., 2007b). It is prudent to distinguish between these term's because they are frequently used interchangeably despite differing on both a conceptual and treatment level (Perlman et al., 2011). Thus, the term 'suicide related behaviour' will be adopted henceforth to refer to the overall suicidal profile, capturing all behavioral and psychological components.

## Theoretical Models of Suicide

The mechanisms that lead some individuals to take their own lives and spare others are debated. Theoretical models were developed to help understand why some individuals die by suicide or are at high risk of suicide related behaviour. Many theories of suicide have developed over time and across disciplines (McIntosh, Santos, & Hubbard, 1994). This study will briefly consider the two prominent theories that are felt to be compatible to place suicide risk in context.

### Diathesis Stress Model

The stress response comprises a complex interaction between social, psychological, and physiological mechanisms that can be induced by a variety of stressors, such as the variety of LTRF aforementioned. Exposures to LTRF can get under our skin, acting as a potent trigger that evoke complex emotional responses that play an important role in the exacerbation of suicide potential (Shneidman, 1996). Ultimately, frequent exposure to the penetrating impact of stress that is high intensity and long duration over extended periods of time can result in stress related pathophysiological and psychopathological changes that culminate in the growing likelihood that a person will manifest active suicidal behaviours (Lupien et al., 2009; van Heeringen & Marusic, 2003). However, that it remains difficult to explain the fact that even extreme stress induced by LTRF does not reliably predict suicidality among all those exposed. This has led to the recognition that the development of suicidal behaviour involves a vulnerability - a distal risk factor which predisposes individuals to suicidality when stress is encountered. The vulnerability hypothesis suggests that reduced capacity in resilience to stress is not a consequence of chronic exposure to stress, but is a pre-existing disposition induced by genetics and/or early exposure to stressful circumstances during sensitive periods of development (Charney & Manji, 2004). The vulnerability hypothesis posits that a predispositional factor, or a set of factors, that make possible a disordered state be conceptualized as a 'diathesis', a term which reflects a constitutional vulnerability to develop a disorder. According to Zuckerman (1999), diathetic persons respond with abnormal or pathological reactions to stimuli and the ordinary conditions of life that are borne by the majority without injury. The diathesis is the necessary antecedent condition for the development of a disorder or problem, which in this context, is suicide. The diathesis alone is not sufficient to produce the disorder, but requires other potentiating or releasing factors to become pathogenic (Zuckerman, 1999). The stress-diathesis model presumes that all people have some level of vulnerability towards any given disorder (Monroe & Hadjiyannakis, 2002). Factors responsible for diathesis may vary. Mann & Haghgighi (2010) suggest that genetic and epigenetic mechanisms may be involved in the etiology of the diathesis, while cognitive and social predispositions - perhaps cultivated by early trauma - may also contribute to vulnerability (van Heeringen et al., 2012). Whatever the nature of diathetic factors, in the context of this discussion, the diathesis encapsulates a vulnerability to stress, and exposure to chronic stress can unmask and ruthlessly expose pre-existing diathesis.

Stressful life events, psychosocial crisis, and/or mental illness may represent stressors that a person is exposed to (Mann et al, 1999); and while these factors are clearly not mutually exclusive, they often combine to increase the overall level of duress a person is placed under (Mann, 2003). When faced with one or a combination of these stressors, individuals may differ with regard to the point at which they develop suicidality depending on the degree to which predispositional risk factors exist and on the degree of experienced stress. (e.g., relatively minor stressors may lead to a disorder in persons who are highly vulnerable). This theory presupposes additivity, i.e., the idea that diathesis and stress add together to produce the disorder. Figure 1 below presents a good visual depiction of the relationship between stress-diathesis while also illustrating the disorder threshold.

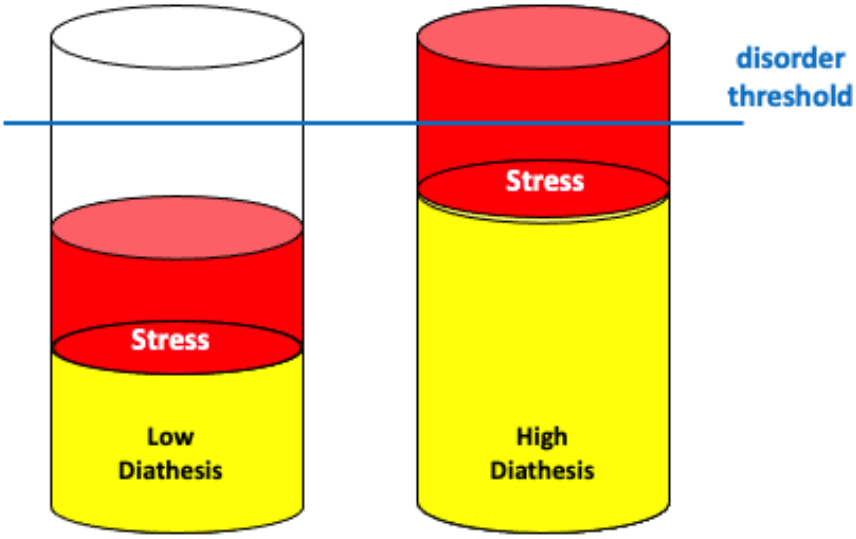


**Figure 1.** Illustrating the diathesis stress model of suicide

Interpreting Figure 1, when a diathesis is present, the expression of suicide will be conditional on the degree of stress: as stress increases so does the risk of suicide in persons who possess the diathesis (Ingram & Luxton, 2005). In this case, the probability of suicide would increase as a function of both levels of stress and strength of the diathesis. The conceptualization of a diathesis as dynamic implies that such a diathesis is continuous. Subsequently, it should be noted that the interaction between stress and a diathesis might not be static, but instead change over time. The diathesis may increase or decrease so that the amount of stress needed for the development of suicidality may need to decrease or increase, respectively (van Heeringen, 2012). The diathesis-stress model of suicide is a good fit to help explain the impact LTRF have on future suicide potential because it helps explain the variance in the ability of LTRF to reliably predict acute suicidality.

## The Interpersonal Theory of Suicide

The interpersonal theory of suicide (IPTS) was recently developed to assist in determining more sensitive and specific predictors of suicide risk (Joiner, 2005; Marty, Segal, Coolidge, & Klebe, 2012). A unique feature of the IPTS is the theory's ability to address the difference between suicidal ideation and suicidal behaviour, which until this point was not addressed by previous theorists. The IPTS proposes that an individual will engage in suicide-related behaviour if he/she has both a) the desire to die; and b) the capability to act on that desire. Unlike other theories of suicide, the IPTS underscores the critical difference between suicide related ideation (e.g., suicide desire) and suicide-related behaviour (e.g., suicide attempt). In other words, IPTS not only addresses who wants to die by suicide,

but who can die by suicide (Ribeiro & Joiner, 2009). The interpersonal theory of suicide is illustrated in Figure 2 (Van Orden et al., 2010).

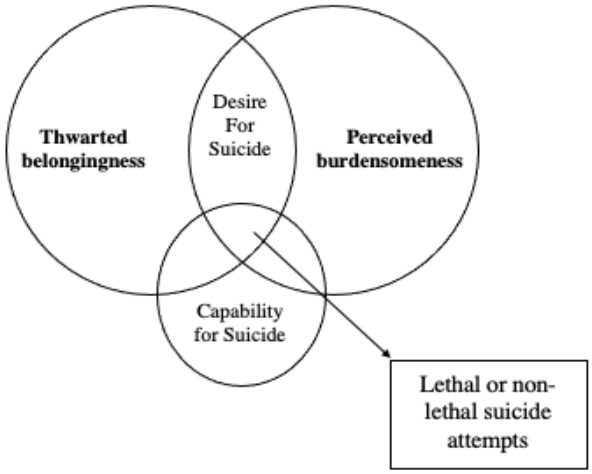


**Figure 2.** Assumptions of the interpersonal theory of suicide (adapted from Van Orden et al., 2010)

According to the theory, the desire to die, or suicide-related ideation results from the convergence of two interpersonal states: perceived burdensomeness (e.g., the feeling of being a burden on others) and thwarted belongingness (e.g., feeling alienated or socially isolated from friends, family or other valued social circles). The third variable, the capacity to carry out the act of suicide, refers the acquired capability for self-harm. This includes the habituation to pain and fearlessness about death that is learned over time (Marty et al., 2012; Van Orden et al., 2010). The IPTS appears well suited to understand the multidimensional nature of suicide risk factors given the increased likelihood of these feelings of burdensomeness accompanying physical illness, the potential for thwarted belongingness that accompanies various psychosocial pressures such as loss of employment or interpersonal conflict, and the stigma that comes with experiencing mental illness.

## Early Warning Signs

It is important to make the distinction between the extent to which the aforementioned risk factors are known to be correlated with suicide (Jacobs et al., 1999), and the extent to which they are known to actually increase the risk of suicide (Rudd et al, 2006). Suicide risk is typically formulated by a temporal sequence of these distal predisposing elements known as ‘long-term’ risk factors (LTRF), that work to precipitate suicide risk over time. If left unaddressed, LTRF - which can act alone or in combination - may progress into the development of proximal ‘short term’ early warning signs (EWS), which represent a disruption in psychological homeostasis whereby usual coping mechanisms fail and the resultant distress and impairment presents tangible evidence that implies heightened risk of suicide

in the near-term (Lewis & Roberts, 2001; Rudd et al., 2006). If LTRF comprise the etiology of suicidality, then EWS can be thought of as its clinical manifestations.

Characterized by suicidal thoughts and behaviours that are self-directed and dangerous, EWS range from being overt and obvious, to subtle and difficult to detect. While LTRF may be associated with a person contemplating suicide at one point in time over the long term, EWS are factors that, in the immediate future (i.e., minutes, hours or days), represent sudden acute elevations in risk that set into motion the process of suicide with the potential to culminate in an emergent state of crisis if left un-treated (Rudd, 2008). According to Perlman et al. (2011), although the presence of LTRF may predispose a person to higher risk of suicide, risk of actual suicide increases dramatically with the presence of EWS (governed by their number and intensity), meaning that acute suicide risk is established by the presence of EWS. The co-occurrence of distal 'LTRF' and proximal 'EWS' leads to the necessary and sufficient conditions required for suicidality to manifest.

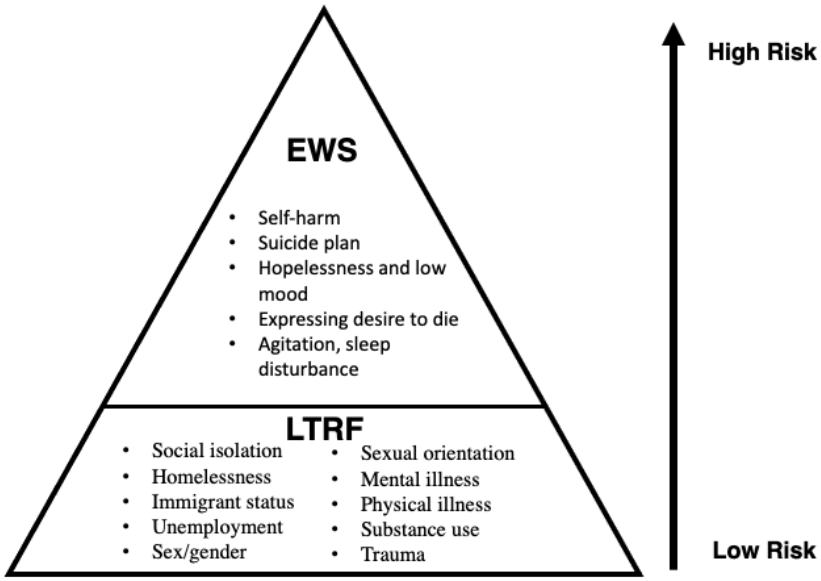


**Figure 2**. Illustration of the Accumulation of Potentiating Long Term Risk Factors (LTRF) and Early Warning Signs (EWS) on Risk of Suicide (adapted from Rudd et al., 2006).

EWS are important because our ability to predict suicide on the basis of LTRF alone is poor as they seldom (if at all) signal imminent suicide risk (Ryan et al., 2010; Oquendo, Currier, & Mann, 2006). Thus, the sensitivity and specificity of LTRF in the context of a relatively rare event like suicide reduces their clinical utility, particularly in acute settings (Powell et al., 2000). Although LTRF may become the focal target of interventions once acute risk is abated, especially given their importance in understanding the origins of risk (Perlman et al., 2011), in the absence of early warning signs (EWS), LTRF clearly represent a less immediate concern. Focus can only shift towards the implementation of interventions that target LTRF as means to avert a person's future progression into suicidal crisis once EWS have been addressed. Understanding which LTRF are most likely to predict the manifestation of

EWS further down the line is of substantial value to clinicians and those concerned with the development of effective interventions and policy.

## Psychiatric Hospital Admission

It may be hard to believe that anyone who has had thoughts about ending their own life may not meet the requirements needed to be admitted into an inpatient mental health program. However, there is a distinct difference between suicidal thoughts and being actively suicidal (going from suicidal thoughts to a suicide attempt). Individuals who are actively suicidal have actually taken steps to end their own lives and may have plans laid out. One the other hand, those with suicidal ideation may just have fleeting thoughts about taking their own lives, but no real plan (Hardy, 2014). Suicide related behaviour is a common reason for people to admitted to a psychiatric hospital (Bergen et al., 2010), and this patient population have a well-established elevated risk of repeat self-harm and suicide (Perry et al., 2012; Hawton et al., 2015). Admission to inpatient psychiatry may benefit persons at risk of suicide because it provides a safe setting where EWS can be addressed, and the process of recovery can begin away from potentiating risk factors (Carroll et al., 2016). Acute inpatient hospitalization is the most intensive level of psychiatric care that includes multiple interventions in a 24-hour secure and supervised treatment environment. The goal of inpatient programming is to stabilize patients who are displaying acute psychiatric conditions associated with a sudden onset, severe course, or an exacerbation of symptoms associated with a more persistent, occurring mental health disorder. In order to identify those most at risk for harming themselves, there is a strict set of criteria that will determine whether or not an individual should be admitted to this highly structured treatment environment. The following criterion is used by many inpatient psychiatric treatment centers when determining if someone needs to be admitted for suicidal ideation (Hardy, 2014):

1. Individual has been evaluated by a licensed clinician and demonstrates symptoms consistent with DSM-5 Axis 1 (e.g., depression, schizophrenia, substance misuse) or 2 diagnosis (e.g., personality disorders)
2. The person is a serious threat to themselves or others, which is evident by one of the following:

    a. Current plan or intent to harm self with available lethal means
    b. Recent severe self-harming behaviour or suicide risk with continued imminent risk due to poor impulse control or the inability to plan for their safety
    c. Imminently dangerous inability to care for one's own physical needs or to participate in such care as a result of disorganized or bizarre behaviour
    d. Other similar clear and reasonable evidence of imminent harm to self

If the intake assessment determines that a person is indeed at risk of harming themselves, then they will be admitted to the inpatient treatment program and placed under around-the-clock monitoring until the crisis has passed and stabilization has been met. During this time, a treatment plan will be developed by a multi-disciplinary team that includes specific goals to be met during hospitalization. After stabilization has been achieved, an individual can then choose from a number of other treatment options to ensure continued care (Hardy, 2014).

### Iatrogenic Suicide Risk

As mentioned, when the perceived risk of suicide is high, emergency psychiatric services initiate hospital admission, either with or without the person's consent. It is a matter of professional debate whether or not suicidal persons should be admitted; some argue that protection should have the greatest priority (Jacobs et al., 2010), while others contend that restricting a person's autonomy may increase the risk of suicide during and after admission (Hunt et al., 2007; Sinclair, Hawton & Gray, 2010). Importantly, admission cannot prevent suicide (Van Hemert et al., 2012). Interestingly, two studies found no association between suicide risk and hospital admission (Mulder, Koopmans, & Lyons, 2005; Unik et al., 2011) while several others found that the probability of involuntary admission was increased by suicide risk (Rabinowitz, Massad, & Fennig, 1995; Lyons et al., 1997; Engleman et al., 1998; Way & Banks, 2001). Those who die by suicide have commonly had previous contact with mental health services. Although previous research has suggested that people with a history of using psychiatric services are at higher risk for suicide, it is unclear whether this link is attributable to individual risk factors or iatrogenic effects of service utilization. Hjorthøj et al. (2014) proposed that previous contact with mental health services is an indicator of future suicide potential, estimating that persons in contact with inpatient psychiatric services in the last year had a 44-fold higher risk of suicide than the general population, whereas those receiving outpatient psychiatric care had an 8- or 6-fold higher risk. It would probably be wrong to conclude that the treatment causally increases risk of suicide; presumably, effective treatment would decrease the risk of suicide compared to a scenario in which that person did not receive treatment. The association is likely explained through selection; people with frequent psychiatric contact might be at higher risk of dying by suicide because their psychiatric symptoms are more severe than those of patients with less frequent contact. As such, the results could indicate that the psychiatric treatment system successfully identifies people who require treatment, implying that people who have been psychiatrically hospitalized constitute an important group for suicide preventive measures.

## Using the interRAI Mental Health Instrument to study LTRF & EWS

High quality screening and assessment are essential in mental health (Perlman et al., 2011). interRAI comprises is a suite of comprehensive, integrated and interoperable electronic health instruments that that can be used to assess the unique needs of individuals across multiple domains (Hirdes et al., 2008; Hirdes et al., 2020). These instruments are rigorously evaluated to ensure stringent psychometric properties suitable for international implementation across all age groups (Burrows et al., 2000; Gibbons et al., 2008; Hirdes et al., 2008; Morris et al., 2000; Lau et al., 2018, 2019; Phillips et al., 2012; Phillips & Hawes, 2015; Stewart et al., 2015; 2019). From this suite, the Resident Assessment Instrument-Mental Health (RAI-MH), the mandated psychiatric assessment system used in all Ontario psychiatric units since October 2005, is the mental health specific screening tool that will constitute the nexus of this study. While a common core set of items can be found across all instruments, the RAI-MH has 170 of its own unique measures that are each designed to capture information pertaining to mental illness. Using the information collected by these items, composite assessment scores are generated by a battery of algorithms known as 'scales' that work in the background by synthesizing portions of the data into a single coherent variable. While there are a variety of scales related to different clinical issues, because the focus of this research is suicide, the 'severity of self-harm scale' (SOS) will constitute a key element in this study. Based on specific items and other scales embedded within the RAI-MH (see appendix), the SOS is a hierarchical clinical algorithm designed to evaluate the severity of suicide risk by measuring specific constellations of clinical EWS known to be associated with acute suicidality to compute a single summary score ranging from 0 to 6. Higher scores indicate increased levels of suicidality, i.e., low risk (score 0-3), moderate risk (score 4), and high risk of harm to self (score 5-6). This composite scale indicates the level of clinical urgency and can be used to support clinical decision making. A strength of the SOS scale is that that subtle, more nuanced signs of suicide not overtly obvious may be detected. For example, some persons truly intent on ending their lives may conceal EWS, in which case the SOS algorithm can assist in detecting incongruity between a person's level of distress and their stated level of suicidal intent (Perlman et al., 2011). Fundamentally, the function of the SOS is to detect the EWS signal, quantifying the earliest detectable signs that imply acute elevations in suicide risk in the near term. As well as identifying the presence of and describing the severity of suicide risk, the SOS also invokes a clinical response by triggering the suicide and purposeful self-harm CAP.

Clinical assessment protocols (CAPs) are clinically facing outputs designed to provide the evidence-base required to plan and evaluate care (Martin et al., 2009). CAPs use RAI-MH embedded items to create predictive algorithms that distinguish between different "trigger levels", which denote varying levels of risk (e.g., moderate versus high), and different contexts that are relevant to the risk question (e.g., with or without accompanying mood symptoms). Trigger levels help clinician's respond to patient needs by providing support to address EWS. Simultaneously, triggering this CAP initiates the processes that target LTRFs, providing a list of initial considerations that combine risk assessment with

guidelines to support care planning. Although addressing acute risk engendered by EWS must clearly remain a clinical priority, identifying and addressing up-stream risk factors must also be completed to ameliorate risk moving forward. Especially as research suggests that effective suicide prevention strategies should also target LTRFs (Mann et al., 2005). The suicide and purposeful self-harm CAP can be used to address immediate and long-term safety issues to prevent future progression towards suicidality (Hirdes et al., 2000).

## Summary & Study Rationale

Reviewing the literature, it is clear that many LTRF have the potential to produce EWS of suicide. However, while the balance of suicide etiology remains debated, the variability among these LTRF in terms of their ability to reliably predict EWS is also evident. In an effort to empirically validate the predictive efficacy of multiple LTRF and promote risk factor research advancement overall, an investigative focus on which LTRF are most likely to precipitate EWS of suicide is necessary. Broadly, this study of suicide risk factors will embody this focus, driven by the imperative that effective intervention and prevention of suicide requires a comprehensive understanding of suicide risk and its psychosocial, psychiatric and physiological dimensions. Although there has been a wide variety of previous research dedicated to the investigation of the associations between LTRF and suicidality, studies in the past have tended to be too narrowly focused often only examining a single domain of risk factors, therefore not adequately taking into account the complexity of multidimensional risk factors and their relationships. Consequently, many empirical studies are based on samples with low statistical power, while the widescale presence of confounding factors not accounted for renders the interpretation of these results less certain. Further, many other studies tend focus on suicide mortality as the primary outcome of interest, but because this event is rare, it can be difficult to investigate. With its expansive capacity to assess a broad range of health indicators, conducting research using data generated by the RAI-MH presents a robust opportunity to examine the relationships between diverse LTRF and EWS. Leveraging this strength by using the Ontario Mental Health Reporting System (OMHRS) dataset, this study will use statistical methodology to estimate the impact diverse LTRF have on two distinct outcomes that each measure phenomena associated with acute elevations in suicide risk:

1. **Suicide Admission** - admission to an inpatient psychiatric facility because of acute risk of suicide (self-harm admission)
2. **Suicide Risk Level** - the severity of suicide risk at admission according to the SOS scale

These outcomes have been chosen because they are relatively easier to study than suicide mortality per se, and because both can be considered indicators of suicide behaviour as they measure phenomena associated with acute elevations in suicide risk that constitute EWS. As well as considering the

predictive efficacy of multiple LTRF, this study will examine the relative value of clinical and diagnostic indicators compared to social indicators to provide context and explanatory power, while also investigating relatively uncommon risk factors that will deepen the overall analysis. Better understanding the predictive ability of diverse LTRF is essential to refining theory, developing accurate risk assessments and effective treatments, and fine-tuning policy. Because the best intervention for suicide is prevention, based on the findings, this study will highlight those risk factors with the most promise for prevention.

# Methodology

## Aims

Based on the existing limitations of the research and a review of the existing literature, four primary objectives were formulated:

1. Examine the distribution of suicide admission rates by sex across age groups
2. Examine the distribution of levels of suicide risk across sex and age groups
3. Examine LTRF that are most likely to predict psychiatric inpatient admission because of suicide risk
4. Examine which LTRF are most likely to produce high levels of suicide risk using the SOS scale

## Ethics

The office of Research Ethics at the University of Waterloo provided ethics clearance for the secondary data analysis of interRAI assessment instruments on [May 15, 2014], under ORE file number [18228].

## Study Design

This study involved a cross-sectional secondary data analysis using information contained in the OMHRS, which houses RAI-MH based mental health assessment data submitted to the Canadian Institute for Health Information (CIHI). CIHI is responsible for assessing data quality, validity, and consistency, alongside tasks such as data anonymization, cleaning and storage. The OMHRS was implemented provincially in 2005 to support the implementation of the RAI-MH which was mandated across inpatient psychiatry by the Ministry of Health and Long-Term Care in the same year. The RAI-MH was collaboratively developed by international researchers via a systematic research process of application and evaluation as a means to address the diverse needs of psychiatric populations (Hirdes et al., 1999; Hirdes et al., 2000; Hirdes et al., 2002; Hirdes et al., 2020). The assessment is completed by a trained health care professional and captures statements by the patient, family accounts, provider interactions and clinical history, all of which together strengthen the validity of the overall assessment (Hirdes et al., 2002). Since its development, OMHRS has gathered RAI-MH assessments from 68 participating hospitals across Ontario. At the time of data analysis, RAI-MH assessments were available from October 2005 to March 2019. The reason this dataset was chosen to examine suicide risk factors is because to date, there has been limited robust, large scale empirical evaluation of the impact of diverse risk factors on outcomes. Because the RAI-MH is a comprehensive mental health assessment instrument, it collects a variety of information spanning multiple areas related to a person's overall health, well-being, and circumstances. The repository of aggregate, population level data found in OMHRS, it is well positioned to provide a breadth of information related to suicide risk factors ready

for analysis. Using the OMHRS dataset, it is possible to determine the prevalence and impact of suicide risk factors among psychiatric inpatients in the Ontario region.

## Data Sources & Sampling

As this study relied on secondary data provided by the OMHRS, no participants were necessarily recruited. The study sample drawn from the OMHRS database is derived from the population of mental health inpatients that have been assessed with the RAI-MH, beginning in 2005 and ending in 2019. Considered a robust and standardized assessment tool, the RAI-MH was mandated across inpatient psychiatry in 2005, and since then all adult mental health inpatients that have had a length of stay of at least three days are assessed with the RAI-MH, with their assessment information submitted to CIHI and compiled in OMHRS. The resulting sample is representative of the adult psychiatric inpatient population in Ontario as all persons receive a comprehensive assessment on day 3 of admission that measures various components of their mental health symptomology, functional capacity, and outcomes.

## Inclusion Criteria

Using the OMHRS data set the study sample will include all adult persons (18+) admitted to inpatient psychiatric beds in Ontario between 2010 and 2019 who stayed long enough to generate a full RAI-MH assessment at admission (>72 hours) and up to 90 days until discharge. Short-stay patients (<72 hours) were excluded from the sample because full assessment records are not available. The lower end of the specified year parameters marks the start point in the data set when the latest version of the SOS scale was introduced. Only including data from this point onwards will prevent the analysis of data generated by to two different versions of the same outcome measure, ensuring continuity by only using the most up-to-date version. Further, opening up the sample to all ages will maximize the proportion of persons at high risk of suicide available for analysis. Casting a wide net will help to highlight important differences based on age, sex, background etc. Overall, the clinical sample is large enough to reflect the distribution of characteristics that exist within the general population, providing a representative sample of mental health inpatients in Ontario. Missing data were handled by deletion. The overall n of the study sample is sufficiently large enough to avoid substantial power loss from missing data, providing the quantity is relatively negligeable. Assembled using the inclusion criteria, the study sample will include the first episode of inpatient psychiatric admission from a total of n=142,523 individuals. Persons that identified as ‘other’ (n=61) for the sex variable in this study accounted for 0.03% of the overall sample and so were removed from the analyses. For privacy reasons, this subgroup would be too small to examine with cross-tabulations, since the risk of identification due to combinations of variables would be elevated. This study will also control for forensic admission as they were not excluded at the start. This is because forensic admissions will have administrative and

clinical decisions driven mainly by criminal justice considerations. The forensic status will be an overriding classification that shapes how these patients are thought of by clinicians.

## Measurements

The RAI-MH is a comprehensive, standardized mental health assessment tool that is designed to appraise the strengths, preferences and needs of a person across a variety of domains, with the primary goal of supporting clinicians through person-centred assessment (Martin et al., 2009). The RAI-MH incorporates several different types of information into one tool, including demographic characteristics, clinical variables, scales, and Clinical Assessment Protocols (CAPs). Scales and CAPs, which are generated based on the scores assigned to relevant items embedded in the RAI-MH, as designed to alert clinicians to areas where an individual might be experiencing serious or imminent problems (e.g., risk of suicide). The reliability and validity of the RAI-MH has been previously established in a variety of studies (Foebel et al, 2013; Gibbons et al, 2008; Hirdes et al, 2008; Jones, Perlman, Hirdes, & Scott, 2010; Martin et al, 2009; Neufeld, Perlman & Hirdes, 2012; Perlman et al, 2013).

### Independent variables

Multiple independent variables spanning multiple domains were tested for their association with suicide admission and suicide risk level. Each of these independent variables considered suicide risk factors were selected based on a review of the literature and the researchers own clinical judgement. The independent variables chosen for analysis are organized into separate blocks based on the domain with which they are affiliated, e.g., 'education and employment' is found in the block of demographic variables, and 'pain' is found in the block of physical health and functioning variables; the following section will describe the organization and operational structure of all variables used in this study. Some have been re-operationalized from their original RAI-MH form *a priori* to analysis to facilitate workability, details of which are described in the list of tables below. A range of CAPs and scales were tested as independent variables in the analysis and are organized accordingly into each block. A detailed description of the CAPs and scales derived from the RAI-MH that are used in this study is presented in the appendix.

#### BLOCK 1 - Descriptive Variables

This group of RAI-MH items provide a comprehensive interpretation of the core sociodemographic features of the sample as well as the frequency of previous mental health service contacts.

**Table 1.** Format of block 1 'demographic' variables

| **Variable** | **interRAI item code** | **RAI-MH format** | **Re-format** |
|---|---|---|---|
| *Sex* | BB1 | (M) Male<br>(F) Female<br>(O) Other | Created binary format:<br>(**1**) Female (ref)<br>(**2**) Male |
| *Age group* | BB2 | Calculated from birth date input | Created categorical age variable:<br>(**1**) 18-44 (ref)<br>(**2**) 45-64<br>(**3**) 65+ |
| *Marital status* | BB3 | (1) Never married<br>(2) Married<br>(3) Partner/significant other<br>(4) Widowed<br>(5) Separated<br>(6) Divorced | Created binary format:<br>(**1**) If '2' then married = 'Yes' (ref)<br>(**2**) If '1, 3, 4, 5, or 6' then married = 'No' |
| *Lived alone* | CC3 | (1) Lived alone<br>(2) Lived w/spouse only<br>(3) Lived w/spouse & other(s)<br>(4) Lived w/child(ren) (but not w/spouse/partner)<br>(5) Lived w/other(s) (not spouse or child(ren)<br>(6) Lived in group setting w/non-relative(s) | Created binary format:<br>(**1**) if '1' then lived alone = 'Yes'<br>(**2**) if '2, 3, 4, 5, or 6' the lived alone = 'No' (ref) |
| *Homelessness* | CC5 | Prior to admission, most recent residence was temporary (e.g., shelter).<br>(0) No<br>(1) Yes | Retained binary format:<br>(**0**) No (ref)<br>(**1**) Yes |
| *Forensic admission* | CC2f<br>CC4a/b<br>A3a/b<br>Q5 | *New binary variable created* | (**1**) if 'cc2f=1, cc4a/b=13, A3a/b=5, & Q5=4', then forensic admission = 'Yes'<br>(**2**) if not, then forensic admission = 'No' (ref) |
| *Education Level* | BB5 | (1) No schooling<br>(2) 8 grades or less<br>(3) 9-11 grades<br>(4) High school<br>(5) Technical or trade school<br>(6) Some college/university<br>(7) Diploma/bachelor's degree<br>(8) Graduate degree<br>(9) Unknown | Created categorical variable:<br>(**1**) if '1' then education level = 'No schooling' (ref)<br>(**2**) if '2,3,4' then education level = '< = high school'<br>(**3**) if '5,6,7,8' then education level = '> high school'<br>(**4**) if '9' then education level = 'unknown' |
| *Employment Status* | O3 | (0) Employed<br>(1) Unemployed but seeking employment | (**0**) if '0' then employment status = 'employed' (ref) |

| | | | |
|---|---|---|---|
| | | (2) Unemployed, not seeking employment<br>(3) Persons with full-time status that does not include remuneration (e.g., homemaker, pensioner, student)<br>(4) Other | (**1**) if '1' or '2' then employment status = 'unemployed'<br>(**2**) if '3' or '4' then employment status = 'other' |
| *Education & Employment CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered for those who are at risk of losing employment or dropping out of school<br>(2) Triggered for those who are in need of support for employment, educational participation, or involvement in volunteer activities | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |
| *Recent admissions* | DD1 | (0) None<br>(1) 1 to 2<br>(2) 3 or more | Created binary format:<br>(**1**) if '0' the recent admissions = 'none' (ref)<br>(**2**) if '1' or '2' then recent admissions = '> 1' |
| *Lifetime admissions* | DD2 | (0) None<br>(1) 1 to 3<br>(2) 4 to 5<br>(3) 6 or more | Retained categorical format:<br>(**1**) 0 (ref)<br>(**2**) 1-3<br>(**3**) 4-5<br>(**4**) 6 |
| *Previous contact with Community Mental Health services* | DD5 | (0) No contact in last year<br>(1) 31 days or more ago<br>(2) 30 days ago or less | Retained categorical format:<br>(**0**) > 1 year ago (ref)<br>(**1**) > 31 days ago<br>(**2**) < 31 days ago |

### BLOCK 2 - Adverse Events & Stressful Circumstances

The events in one's life that are highly emotional in nature or that have potentially life-altering characteristics play a large role in patterns of psychological and social functioning and coping. The broad array of variables available for analysis allows an additional degree of granularity when it comes to considering the impact adverse life events might have as LTRF for the likelihood of suicide admission and enhanced levels of suicide risk. Items embedded in section J ('Ja—p' & 'J2') of the RAI-MH provide a comprehensive overview of an individual's previous exposure to a variety of stressors within the previous 12 months or more than 12 months ago, as well as their overall subjective response to that exposure. Variables in block 2 are intended to capture the presence of exposure to an adverse event or a stressful life circumstance. 16 items from this block are operationalized in such a way so as to provide one with a sense of the recency of their impact. For example, individuals who have been exposed more proximally (i.e., within the last 12 months) and individuals that have also been exposed distally (i.e., more than one year ago prior to assessment).

**Table 2.** Format of block 2 'adverse events and stressful circumstances' variables

| Variable | interRAI item code | RAI-MH format | Re-format |
|---|---|---|---|
| *Serious accident or physical impairment* | J1a | (0) Never<br>(1) > 1 year ago<br>(2) 31 days to 1 year<br>(3) 8 to 30 days<br>(4) 4 to 7 days<br>(5) in the last 3 days | Created new categorical format:<br>(**0**) if '0' then J1a = 'never'<br>(**1**) if '1' then J1a = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1a = '< 1 year ago' |
| *Distress about health of another person* | J1b | | (Created new categorical format:<br>(**0**) if '0' then J1b = 'never'<br>(**1**) if '1' then J1b = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1b = '< 1 year ago' |
| *Death of close family member or friend* | J1c | | Created new categorical format:<br>(**0**) if '0' then J1c = 'never'<br>(**1**) if '1' then J1c = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1c = '< 1 year ago' |
| *Child custody issues* | J1d | | Created new categorical format:<br>(**0**) if '0' then J1d = 'never'<br>(**1**) if '1' then J1d = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1d = '< 1 year ago' |
| *Conflict laden or severed relationship* | J1e | | Created new categorical format:<br>(**0**) if '0' then J1e = 'never'<br>(**1**) if '1' then J1e = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1e = '< 1 year ago' |
| *Failed or dropped out of education program* | J1f | | Created new categorical format:<br>(**0**) if '0' then J1f = 'never'<br>(**1**) if '1' then J1f = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1f = '< 1 year ago' |
| *Major loss of income or serious economic hardship due to poverty* | J1g | | Created new categorical format:<br>(**0**) if '0' then J1g = 'never'<br>(**1**) if '1' then J1g = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1g = '< 1 year ago' |
| *Review hearing* | J1h | | Created new categorical format:<br>(**0**) if '0' then J1h = 'never'<br>(**1**) if '1' then J1h = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1h = '< 1 year ago' |
| *Immigration, including refugee status* | J1i | | Created new categorical format:<br>(**0**) if '0' then J1i = 'never'<br>(**1**) if '1' then J1i = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1i = '< 1 year ago' |
| *Lived in war zone or area of violent conflict* | J1j | | Created new categorical format:<br>(**0**) if '0' then J1j = 'never'<br>(**1**) if '1' then J1j = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1j = '< 1 year ago' |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | J1k | | Created new categorical format:<br>(**0**) if '0' then J1k = 'never'<br>(**1**) if '1' then J1k = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1k = '< 1 year ago' |
| *Victim of crime* | J1l | | (Created new categorical format:<br>(**0**) if '0' then J1l = 'never' |

| | | | |
|---|---|---|---|
| | | | (**1**) if '1' then J1l = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1l = '< 1 year ago' |
| *Victim of sexual assault/abuse* | J1m | | Created new categorical format:<br>(**0**) if '0' then J1m = 'never'<br>(**1**) if '1' then J1m = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1m = '< 1 year ago' |
| *Victim of physical assault/abuse* | J1n | | Created new categorical format:<br>(**0**) if '0' then J1n = 'never'<br>(**1**) if '1' then J1n = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1n = '< 1 year ago' |
| *Victim of emotional abuse* | J1o | | Created new categorical format:<br>(**0**) if '0' then J1o = 'never'<br>(**1**) if '1' then J1o = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1o = '< 1 year ago' |
| *Parental abuse of alcohol or drugs* | J1p | | Created new categorical format:<br>(**0**) if '0' then J1p = 'never'<br>(**1**) if '1' then J1p = '> 1 year ago'<br>(**2**) if '2, 3, 4, or 5' then J1p = '< 1 year ago' |
| *History of physical/emotional/sexual abuse/sexual assault experienced by family member(s)* | J3a | (0) No<br>(1) Yes | Retained binary format:<br>(**0**) No<br>(**1**) Yes |
| *Afraid of caregivers* | J3b | (0) No<br>(1) Yes | Retained binary format:<br>(**0**) No<br>(**1**) Yes |
| *Life event causes sense of horror or intense fear* | J2 | (0) No or not applicable<br>(1) Yes<br>(8) Could not (would not) respond | Retained categorical format:<br>(**0**) No or not applicable (ref)<br>(**1**) Yes<br>(**2**) Could not (would not) respond |
| *Social Relationships CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered to reduce social isolation and family dysfunction<br>(2) Triggered to improve close friendships and family functioning | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |
| *Interpersonal Conflict CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered to reduce widespread conflict<br>(2) Triggered to reduce conflict within specific relationships | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |
| *Trauma CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered to address immediate safety concerns | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |

| | | | |
|---|---|---|---|
| | | (2) Triggered to reduce the impact of prior traumatic events | |
| *Personal Finances CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered for those who are experiencing economic hardship because of a major loss of income or poverty<br>(2) Triggered for those who are not experiencing hardship but who have been assessed to be incapable of managing own property/finances | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |

### BLOCK 3 - Mental Illness

Psychopathological factors that constitute mental illness are LTRF defined according to DSM 5 diagnostic categories (American Psychiatric Association, 2013). Diagnostic items are located in section Q of the RAI-MH and can be ranked by their level of importance (primary, secondary, tertiary diagnosis) at the time of assessment. For this study the ordinal rank was removed in favour of a binary format representing whether or not the disorder was present at the time of admission assessment.

**Table 3.** Format of block 3 'mental illness' variables

| **Variable** | **interRAI item code** | **RAI-MH format** | **Re-format** |
|---|---|---|---|
| *Neurodevelopmental disorder* | Q1a | (1) Primary diagnosis<br>(2) Secondary diagnosis<br>(3) Tertiary diagnosis | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then neurodevelopmental disorders = 'Yes' |
| *Schizophrenia and psychotic disorders* | Q1b | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then schizophrenia & psychotic disorders = 'Yes' |
| *Mood disorder* | Q1d | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then mood disorders = 'Yes' |
| *Anxiety disorder* | Q1e | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then anxiety disorders = 'Yes' |
| *Dissociative disorders* | Q1h | | (**0**) Diagnosis not present (ref) |

| | | | |
|---|---|---|---|
| | | | (**1**) if '1, 2, or 3' then dissociative disorders = 'Yes' |
| *Somatoform disorders* | Q1i | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then somatoform disorders = 'Yes' |
| *Eating disorders* | Q1j | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then eating disorders = 'Yes' |
| *Sleep disorders* | Q1l | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then sleep disorders = 'Yes' |
| *Sexual and gender identity disorders* | Q1n | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then sexual & gender identity disorders = 'Yes' |
| *Neurocognitive disorder* | Q1q | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then neurocognitive disorders = 'Yes' |
| *Personality disorders* | Q1r | | (**0**) Diagnosis not present (ref)<br>(**1**) if '1, 2, or 3' then personality disorders = 'Yes' |

### BLOCK 4 – Substance Use

Block 4 RAI-MH items provide a comprehensive interpretation of the sample's relationship with a range of licit and illicit psychoactive substances as LTRFs. Although not a substance, gambling is also included because it can become and addictive behaviour.

**Table 4.** Format of block 4 'substance use' variables

| **Item** | **interRAI item code** | **RAI-MH format** | **Re-format** |
|---|---|---|---|
| *Alcohol* | C1 | Number of drinks in any single sitting episode in last 14 days:<br>(0) None<br>(1) 1<br>(2) 2 to 4<br>(3) 5 or more | Created binary format:<br>(**0**) if '0' then alcohol = 'No' (ref)<br>(**1**) if '1, 2, or 3' then alcohol = 'Yes' |
| *Smoker* | C5 | Person smokes or chews tobacco daily:<br>(0) No<br>(1) Not in last 3 days but is daily smoker<br>(2) Yes | Created binary format:<br>(**0**) if '0' then smoker = 'No' (ref)<br>(**1**) if '1 or 2' then smoker = 'Yes' |

| | | | |
|---|---|---|---|
| *Gambling* | C6 | Person gambled excessively or uncontrollably during last 3 months:<br>(0) No<br>(1) Yes | Retained binary format:<br>(**0**) 'No' (ref)<br>(**1**) 'Yes' |
| *Inhalants* | C2a | Time since any use of the following substances:<br>(0) Never or > 1 year ago<br>(1) Within the last year<br>(2) Within the last 3 months<br>(3) Within the last month<br>(4) Within the last 7 days<br>(5) Within the last 3 days | Created categorical format:<br>(**0**) if '0' then inhalants = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then inhalants = 'within the last year'<br>(**2**) if '3, 4, or 5' then inhalants = 'within last month' |
| *Hallucinogens* | C2b | | Created categorical format:<br>(**0**) if '0' then hallucinogens = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then hallucinogens = 'within the last year'<br>(**2**) if '3, 4, or 5' then hallucinogens = 'within last month' |
| *Cocaine and Crack* | C2c | | Created categorical format:<br>(**0**) if '0' then crack & cocaine = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then crack & cocaine = 'within the last year'<br>(**2**) if '3, 4, or 5' then crack & cocaine = 'within last month' |
| *Stimulants* | C2d | | (Created categorical format:<br>(**0**) if '0' then stimulants = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then stimulants = 'within the last year'<br>(**2**) if '3, 4, or 5' then stimulants = 'within last month' |
| *Opiates* | C2e | | Created categorical format:<br>(**0**) if '0' then opiates = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then opiates = 'within the last year'<br>(**2**) if '3, 4, or 5' then opiates = 'within last month' |
| *Cannabis* | C2f | | Created categorical format:<br>(**0**) if '0' then cannabis = 'never or > year ago' (ref)<br>(**1**) if '1 or 2' then cannabis = 'within the last year'<br>(**2**) if '3, 4, or 5' then cannabis = 'within last month' |
| *Substance misuse CAP* | *See appendix for contributing RAI-MH items* | (0) Not triggered<br>(1) Triggered due to prior history of problematic substance use<br>(2) Triggered due to current problematic substance use | CAP format retained:<br>(**0**) Not triggered (ref)<br>(**1**) Trigger level 1<br>(**2**) Trigger level 2 |

### BLOCK 5 - Physical Health & Functioning

The following items in block 5 are a range of RAI-MH variables that provide a comprehensive interpretation of LTRFs related to a person's physical health status and functional capacity.

**Table 5.** Format of block 5 'physical health & functioning' variables

| **Item** | **interRAI item code** | **RAI-MH format** | **Re-format** |
|---|---|---|---|
| *Sexual functioning* | I3 | Reports persistent difficulty with sexual functioning during last 30 days (e.g., loss of interest/drive, impaired erection or ejaculation, inhibited female orgasm)<br>(0) No<br>(1) Yes | Retained binary format:<br>(**0**) 'No'(ref)<br>(**1**) 'Yes' |
| *Self-reported health* | I4 | "In general, how would you rate your physical health over the last 3 days?":<br>(0) Excellent<br>(1) Good<br>(2) Fair<br>(3) Poor<br>(8) Could/would not respond | Condensed categorical format created:<br>(**0**) if '0, 1 or 2' then self-report health = 'not in poor health' (ref)<br>(**1**) if '3' then self-reported health = 'in poor health'<br>(**2**) if '8' then self-reported health = 'no response' |
| *Extra Pyramidal Signs and Symptoms (EPSE)* | I2a (Akathisia)<br>I2b (Dyskinesia)<br>I2c (Tremor)<br>I2d (Rigidity)<br>I2e (Slow, shuffling gait)<br>I2f (Bradykinesia)<br>I2g (Dystonia) | Presence of extra-pyramidal signs and symptoms at any point during last 3 days:<br>(0) No<br>(1) Yes | Combined binary format created:<br>(**0**) if i2a, i2b, i2c, i2d, i2e, i2f, i2g = '0' then EPSEs = 'no'<br>(**1**) if i2a, i2b, i2c, i2d, i2e, i2f, i2g = '1' then EPSEs = 'yes' |
| *Pain Scale* | I8a (frequency)<br>I8b (intensity) | Measure of frequency & intensity of pain:<br>(0) No pain<br>(1) Less than daily pain<br>(2) Daily pain but not severe<br>(3) Daily severe pain<br>(4) Daily excruciating pain | Ordinal scale format retained:<br>(**0**) No pain<br>(**1**) Less than daily pain<br>(**2**) Daily pain but not severe<br>(**3**) Daily severe pain<br>(**4**) Daily excruciating pain |
| *Activities of Daily Living (ADL)* | *See appendix for contributing RAI-MH items* | Measure of functional performance, reflecting a person's ability to carry out ADLs:<br>(0) Independent<br>(1) Supervision required<br>(2) Limited impairment<br>(3) Extensive assistance required<br>(4) Extensive assistance required<br>(5) dependent<br>(6) total dependence | Condensed ordinal format:<br>(**0**) if '0' then 'independent'<br>(**1**) if '1-3' the 'assistance required'<br>(**2**) if '4' then 'extensive assistance required'<br>(**3**) if '5-6' the 'dependent' |

| | | | |
|---|---|---|---|
| *Instrumental Activities of Daily Living (IADL)* | *See appendix for contributing RAI-MH items* | Estimate of higher-level functioning, reflecting others' perceptions of a person's ability to carry out IADLs. | Condensed ordinal format:<br>(**0**) 0<br>(**1**) 1-3<br>(**2**) 4-9<br>(**3**) 10-18<br>(**4**) 19-30 |

### BLOCK 6 - Scales

interRAI scales constitute composite measures that are generated to provide an interpretation of a person's capacity in a variety of functional and clinical domains. Multiple RAI-MH contribute to the computation of scale scores which in turn contribute to the computation of CAP scores than can be sued by clinicians to support care delivery. Scales in block 6 that pertain to mood disturbance (e.g., the DRS and DSI) and self-harm/suicide (e.g., SoS) are not tested against the secondary outcome, suicide risk level, because they are structurally involved in its computation.

**Table 6.** Format of block 6 'scales' variables

| ***Item*** | ***RAI-MH format*** | ***Re-format*** |
|---|---|---|
| *Severity of Self-harm Scale (SoS)* | *RAI-MH format retained. Higher scores indicate greater impairment.* | (0) 0<br>(1) 1-3<br>(2) 4<br>(3) 5-6 |
| *Cognitive Performance Scale (CPS)* | | (0) 0<br>(1) 1-2<br>(2) 3-6 |
| *Risk of Harm to Others Scale (RHO)* | | (0) 0<br>(1) 1-3<br>(2) 4<br>(3) 5-6 |
| *Self-Care Index (SCI)* | | (0) 0<br>(1) 1-3<br>(2) 4<br>(3) 5-6 |
| *Social Withdrawal Scale (SWS)* | | (0) 0<br>(1) 1-4<br>(2) 5-8<br>(3) 9-12 |
| *Depression Severity Index (DSI)* | | (0) 0<br>(1) 1-3<br>(2) 4-7<br>(3) 8-15 |
| *Depression Rating Scale (DRS)* | | (0) 0<br>(1) 1-3<br>(2) 4-7<br>(3) 8-15 |
| *Positive Symptoms Scale – Short (PSSS)* | | (0) 0<br>(1) 1-4<br>(2) 5-8<br>(3) 9-12 |
| *Mania Scale (MANIA)* | | (0) 0 |

| | | |
|---|---|---|
| | | (1) 1-3<br>(2) 4-8<br>(3) 9-18 |

## Assessing collinearity between scales

Table 7 below presents a summary of potential collinearity that was used as a decision support tool to map the collinearity between multiple scales used in the analysis. Collinearity is considered as structural, i.e., scales that contribute directly to another's algorithmic computation, and associational, i.e., scales that are conceptually related to one another. For example, the DSI and the DRS measure a similar concept in depression even those they use different items. Scales that were colinear with one another or with the secondary outcome, level of suicide risk, were not tested in the same logistic regression models together.

**Table 7.** Scale collinearity crosswalk as decision support tool for block 6 items against suicide admission

| | **SOS** | **CPS** | **RHO** | **SCI** | **SWS** | **DSI** | **DRS** | **PSSS** | **MANIA** |
|---|---|---|---|---|---|---|---|---|---|
| **SOS** | - | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ |
| **CPS** | ✗ | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **RHO** | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ |
| **SCI** | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✗ | ✗ |
| **SWS** | ✓ | ✓ | ✗ | ✓ | - | ✓ | ✓ | ✓ | ✓ |
| **DSI** | ✗ | ✓ | ✓ | ✓ | ✓ | - | ✗ | ✓ | ✓ |
| **DRS** | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | - | ✓ | ✓ |
| **PSSS** | ✗ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | - | ✓ |
| **MANIA** | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | - |

## Dependent Variables

Two separate dependent variables are examined in this study, one primary and one secondary. Each constitute readily measurable components of suicidality.

(1) Suicide Admission

Persons admitted to psychiatric inpatient units may have many problems contributing to their present situation, and therefore are admitted under a range of pretences. At the beginning of the assessment, the RAI-MH contains a selection of 'Reason for Admission' (RFA) indicators whose purpose is to broadly identify the main problem(s) that contributed to the person's present admission. From this list of RFA categories, admission to inpatient psychiatry because of 'threat or danger to self' has been selected as the primary outcome measure for examination. This binary indicator is measured as 'yes' if the person has stated intentions to hurt him/herself, has actually done so, or others have expressed concern that the person is a danger to him/herself. In the context of this analysis, this variable

will be used to differentiate between person who were admitted to inpatient psychiatry because they were at risk of suicide (henceforth referred to as a 'suicide admission') and others who were not.

(2) Suicide Risk Level

The secondary outcome variable investigated in this study is the severity of suicide risk. This variable constitutes an ordinal outcome that is defined by terciles of suicide risk using the following three categories as described by the interRAI Suicide and Self-harm CAP: (1) Low, (2) Moderate, and (3) High suicide risk. This operational structure will be retained in this analysis. The reason for selecting this particular outcome variable is because the Suicide and Self-harm CAP is a composite measure of self-harm risk with high levels indicating acute suicidality. Including this outcome variable as an EWS indicator supplements the analysis of the primary outcome variable in that it provides a sense of the scale related to the magnitude of suicide risk among psychiatric inpatients, while it also adds additional granularity to the analysis.

## Statistical Analyses

All statistical analyses performed in this study were conducted using SAS® software, version 9.4 of the SAS system for Windows.

### Bivariate Analyses

In the bivariate phase of the analysis, descriptive statistics for all independent variables relative to both outcomes are presented in a series of tables that correspond to the blocks within which they have been organized. Tables 'a' in each block report the distribution of LTRF against the primary outcome, suicide admission, using percentages (%) and counts (n) alongside crude odds ratio (COR) estimates generated to determine the size, direction and significance of each association. The c statistic is also presented for each variable. Tables 'b' in each block report the same statistics but against the secondary outcome variable, the level of suicide risk. Reporting a simple bivariate association is not sufficient to draw robust conclusions about the impact of specific risk factors. Other sources of variation in the data are likely to obscure the relationship we care about meaning that the results illustrated in the bivariate analyses are likely confounded by multiple other factors. Thus, bivariate analysis in this study will constitute the necessary preamble to guide further multivariate regression analyses. The process of selecting candidate predictors for the multivariate modeling stage was based on the interpretation of crude odds ratio estimates to identify associations worthy of further examination. Additionally, each independent variable's perceived clinical significance in the context of suicidality was also carefully considered. Reporting bivariate associations prior to modelling will allow the reader to evaluate whether adjustment led to changes in the estimates.

## Multivariate Analyses

This stage of the analysis entails the construction of two separate multivariate logistic regression models, one for each outcome. The first used binary logistic regression to model the main effects of multiple independent LTRF variables against 'suicide admission', and the second used ordinal logistic regression to model multiple independent LTRF variables against the 'level of suicide risk'. Two preliminary multivariate logistic regression models were developed in a stepwise fashion to identify block variables associated with either outcome. Variables form each block of the bivariate analyses that achieved a significance cut off of $p < 0.05$ were selected for inclusion in each preliminary multivariate logistic regression model. As a means of further reducing the size of the models, variables producing crude odds ratios ranging between 0.83 and 1.20 were withdrawn from consideration at this stage unless there was a strong theoretical reason to leave them in. Each block was separately modelled to ascertain significance between a smaller set of predictor variables and each dependent variable. Within each model, variables that were not statistically significant were removed. Again, non-significance was identified by p-values >0.05. Next, statistically significant variables from the set of preliminary block-based models were entered into a full multivariable model. A manual backwards stepwise method is used to eliminate non-significant variables starting from block 6 and working towards block 1. Consideration for the final predictive models was stringent and the removal of variables was based on the following rules: (1) p-value greater than 0.05, (2) adjusted odds ratios (AOR) falling *within* the parameters 0.83-1.20, (3) AOR estimates with a 95% CI containing 1, and (4) parsimony and lack of collinearity between selected variables. These variable screening cut-points were selected with the intention of eliminating variables whose odds ratios approached a value of 1 so that only variables with relatively large effect sizes remained in the model. Variables that were removed from the model during this screening phase of model construction were re-introduced in the models individually to ensure that their removal did not have a strong impact on the parameter estimates of other variables in the model. The concordance statistic (c-statistic) is used to identify model performance. If the c-statistic value is 0.70 or higher (up to 1), the model will be considered good at predicting the outcome (Austin & Steyerberg, 2012; Cook, 2007; Hermansen, 2008). As variables are removed, the value of the c-statistic will likely decrease, and this will be monitored to better understand the importance of each particular variable in the model. Finally, interaction terms for variables that hypothetically could be related and were relevant were tested individually in the models and only included in the final model if they achieved a significance cut off of $p < 0.05$ or better. It should be noted that regardless of the significance level they achieved in the model, both age and sex variables were retained in all final models.

### Testing Interactions

Due to the well documented differences in the impact LTRFs have between men and women (refs), in each final model, the estimate of the association between certain predictors was tested to see whether it was meaningfully different depending on a person's sex. This phenomenon is known as interaction, where sex modifies the effect of a risk factor on the outcome (e.g., the effect each risk factor has on the likelihood of suicide admission differs (i.e., is modified), depending on a person's sex). The significance cut off for the interactions tested was set to $p < .01$ in order to ensure that interactions were sufficiently strong to warrant inclusion. This study selected and tested interaction terms based on an appraisal of each candidate predictors performance at the bivariate and multivariate block modelling stage, and their selection was also informed by the literature and the researchers own clinical expertise. Interactions effects were evaluated based on their statistical performance in addition to a subjective evaluation of meaningfulness (e.g., clinical importance) of an estimated interaction effect. Interaction terms will be interpreted separately from the main effects of the final multivariate models.

# Results

The results section of this study contains three parts: (1) descriptive statistics that serve to characterize the overall study sample; (2) bivariate analyses testing the associations between multiple sets of predictors against the primary and secondary outcome variables; (3) multivariate analyses where a binary logistic regression model will be fitted to the primary outcome, and an ordinal logistic regression model will be fitted to the secondary outcome.

## Sample Characteristics

The sample size of this study was n = 142,523. Sex across the overall sample was fairly evenly distributed, with the proportion of males (51.5%) marginally outweighing the proportion of females (48.5%). The average age of the overall sample was 45.9 years old [SD 18.2]. 46% of the overall sample (n = 65,593) were admitted to inpatient psychiatry because they were at risk of suicide, 50.1% of whom were females and 49.9% were males. Of the 46% who were suicide admissions, females tended to be slightly older with an average age of 47.5 years [SD 18.3], compared to males who had an average age of 44.3 years [SD 17.9].

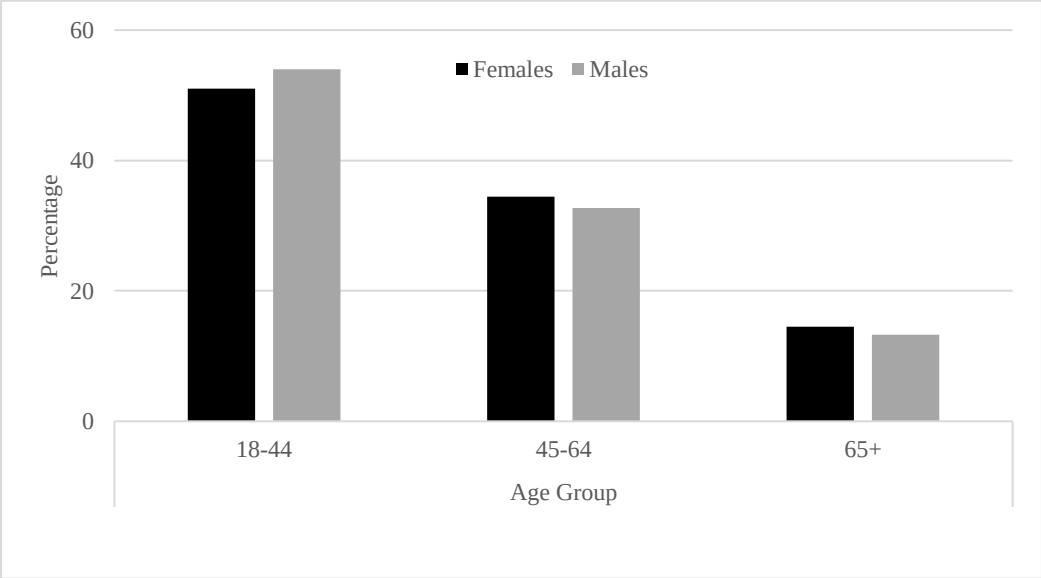


**Figure 4**. Percentage of individuals admitted due to suicide risk by sex and age, Ontario, 2005-2019

Splitting the 46% of suicide admissions by sex into 3 separate young, middle, and older age groups, figure 1 shows that the majority of suicide admissions are 18–44-year-old, containing a slightly higher percentage of men (54%) than women (51%). Relative to younger individuals there is a consistent pattern of decline as age increases; among those middle aged (45-64) a higher percentage of women (34.5%) are suicide admissions than men (32.7%); and similarly, a higher percentage of older women (65+) are suicide admissions (14.5%) than men in the same age group (13.3%). Sex differences by age among suicide admissions are significant ($\chi^2 = 59.2\ p < .0001$).

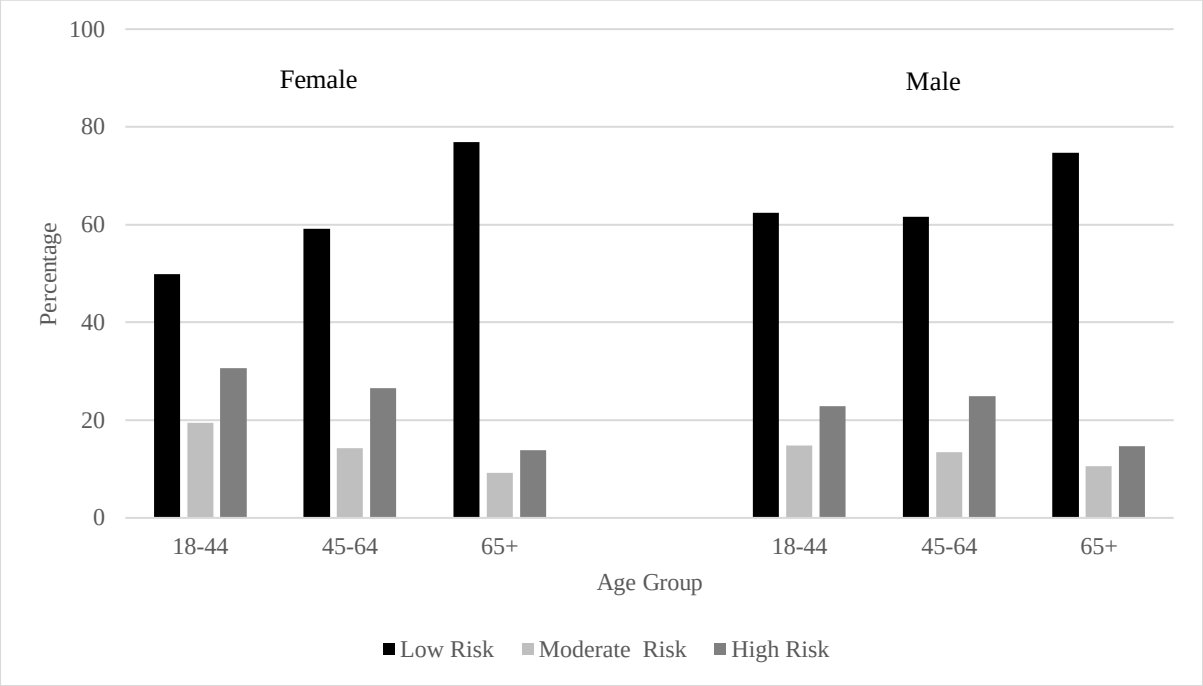


**Figure 5**. Percentage of suicide risk scores by sex and age, Ontario, 2005-2019

***Figure 2*** reports the distribution of SOS suicide risk severity scores by sex and age group and shows that a larger percentage of older people (65+) are in the low-risk group and fewer are in the high-risk groups for both women and men. This pattern of consistent decline in women is less evident in men. Young women (18-44) have more in high-risk group (30.7%) and fewer in low-risk group (49.9%) than younger men at high (22.8%) and low risk (62.4%). These sex differences are minor in the middle (45-64) and older age groups (65+). Age differences by SOS levels are significant for women ($\chi^2 = 2824.5\ p < .0001$) and for men ($\chi^2 = 695.5\ p < .0001$). Further, sex differences by SOS levels are significant for young ($\chi^2 = 1097.9\ p < .0001$), middle ($\chi^2 = 31.4\ p < .0001$) and older aged persons ($\chi^2 = 17.5\ p < .01$).

## Bivariate Analyses

In this second section, data for all the independent variables selected from the RAI-MH are presented. Variables are organized into blocks according to the pre-defined categories detailed in the methodology. Two separate tables are presented for each block containing descriptive information relative to both the primary and secondary outcome variable. Table's marked with the '(X)a' suffix in each block pertain to the primary outcome variable 'suicide admission', and tables with the '(X)b' suffix pertain to the secondary outcome variable 'suicide risk severity'. Each table contains several columns of statistical information. For table group 'a' there are 3 columns of data. In the first column the percentage and frequency of individuals who were suicide admissions is displayed. For example, if the reported percentage for females is higher than that of males, this indicates that women had a higher rate

of being admitted to inpatient psychiatry for suicidality relative to men. The second column reports the bivariate binary crude odds ratio (COR) estimate and the 95% confidence interval (CI), as well as asterisks denoting significance level. And the third column presents the c statistic for each bivariate relationship. For table group 'b' there are 5 columns of data. The first three columns report the percentage and frequency of persons classified as either 'low', 'moderate' and 'high' risk of suicide. The fourth column reports the bivariate ordinal crude odds ratio (COR) estimate and the 95% confidence interval (CI), as well as asterisks denoting significance level. And the fifth column presents the c statistics for each bivariate relationship.

The purpose of the statistics presented in the following bivariate analyses was largely exploratory, while it also served as a basis for identifying variables eligible for consideration at the multivariate modelling stage. To select candidate variables for multivariate modelling, the differences in column percentages, COR estimates, and statistical significance were all considered. Given the large sample size and number of comparisons, any p values above 0.1 were generally disregarded to account for the possibility of a Type 1 error. Further, if a variable had a 95% CI containing 1.00, then it was also excluded from further consideration in the modelling stage unless there was a strong theoretical reason to leave it in. To facilitate the creation of a workable list of predictors suitable for multivariate modelling, bivariate COR estimates were required to exceed in either direction the effect size parameter threshold of 0.83-1.20 in order to be considered. For brevity, whether they achieve statistical significance or not, variables that produce COR estimates that fall within these parameters will not be discussed in the bivariate analyses. As a way to evaluate the predictive ability of each bivariate association, the c statistic was also used to support decision making (Hermansen, 2008).

## BLOCK 1 - Demographic Variables

**Table 8a.** Demographic variables by 'suicide admission' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Sex* | Female | **47.6** (32,889) | *Reference* | 0.52 |
| | Male | **44.6** (32,704) | **0.89** (0.87-0.90)*** | |
| *Age group* | 18-44 | **49.2** (34,437) | *Reference* | 0.54 |
| | 45-64 | **45.3** (22,035) | **0.86** (0.84-0.88)*** | |
| | 65+ | **38.3** (9,121) | **0.64** (0.62-0.66)*** | |
| *Married* | Yes | **45.2** (16,753) | *Reference* | 0.50 |
| | No | **46.3** (48,840) | **1.05** (1.02-1.07)** | |
| *Lived alone* | No | **45.3** (44,584) | *Reference* | 0.51 |
| | Yes | **47.7** (21,009) | **1.10** (1.08-1.13)*** | |
| *Homeless* | No | **45.4** (48,157) | *Reference* | 0.51 |
| | Yes | **47.9** (17,436) | **1.11** (1.08-1.14)*** | |
| *Forensic admission* | No | **46.8** (65,110) | *Reference* | 0.52 |
| | Yes | **14.2** (483) | **0.19** (0.17-0.21)*** | |
| *Education level* | No schooling | **47.2** (1,247) | *Reference* | 0.51 |
| | < = high school | **47.0** (30,099) | **0.99** (0.92-1.07) | |

| | | | | |
|---|---|---|---|---|
| | > high school | **45.2** (26,377) | **0.92** (0.85-1.00)* | |
| | Unknown | **45.2** (7,867) | **0.93** (0.85-1.01) | |
| *Employment status* | Employed | **48.1** (16,373) | *Reference* | 0.52 |
| | Unemployed | **47.1** (35,955) | **0.96** (0.94-0.98)** | |
| | Other | **41.3** (13,265) | **0.76** (0.74-0.78)*** | |
| *Education & Employment CAP* | 0 | **44.7** (42,122) | *Reference* | 0.52 |
| | 1 | **53.0** (9,649) | **1.40** (1.35-1.44)*** | |
| | 2 | **46.1** (13,822) | **1.06** (1.03-1.09)*** | |
| *Recent admissions* | 0 | **46.6** (37,021) | *Reference* | 0.51 |
| | >1 | **45.3** (28,572) | **0.95** (0.93-0.97)*** | |
| *Lifetime admissions* | 0 | **48.1** (25,401) | *Reference* | 0.52 |
| | 1-3 | **45.1** (25,029) | **0.89** (0.87-0.91)*** | |
| | 4-5 | **44.6** (7,334) | **0.87** (0.84-0.90)*** | |
| | 6+ | **44.3** (7,829) | **0.86** (0.83-0.89)*** | |
| *Previous contact with CMH* | >1 year | **49.2** (31,575) | *Reference* | 0.53 |
| | >31 days | **44.2** (11,334) | **0.82** (0.80-0.84)*** | |
| | <30 days | **43.1** (22,684) | **0.78** (0.77-0.80)*** | |
| *Note. C*OR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk * p <.05, ** p < .01, ***p < .0001 | | | | |

Table 8a reports that 47.6% of suicide admissions were female, and 44.6% were male, and this lower male rate of admission is supported by a corresponding reduction in the odds of suicide admission among males (COR= 0.89 95% CI: 0.87-0.90, p<.0001). The age distribution tells us that overall, persons aged 18 to 44 have the highest rates of suicide admission, and that that the odds of suicide admission are reduced as chronological age increases, with persons aged 65+ among the least likely to be admitted for this reason (COR=0.64 95% CI: 0.62-0.66, p<.0001). Persons who are homeless were more likely to experience suicide admission than persons who were not (COR=1.11 95% CI: 1.08-1.14, p<.0001), and persons with forensic status had substantially lower odds of suicide admission compared to their non-forensic counterparts (COR=0.19 95% CI: 0.17-0.21, p<.0001). Although there is a small and significant increase in the odds of suicide admission for persons who are not married compared to others who are, the COR estimate describing this association did not exceeded the pre-determined effect size threshold required to be considered for further analysis. Similarly, the COR estimates describing the relationship between the following variables lived alone, education level, and employment status and the primary outcome were either non-significant, had a confidence interval containing 1, or again, did not necessarily exceeded the pre-determined effect size threshold and therefore will not be considered in further analyses. Individuals who triggered level 1 of the education and employment CAP, indicating risk of losing employment or dropping out of school, had greater odds of suicide admission compared to those who did not trigger this CAP (COR=1.40 95% CI: 1.35-1.44, p<.0001). Variables selected that describe a person's previous level of contact with mental health services tell us that more lifetime admissions appear to correspond with an overall reduction in the odds of suicide admission, where those with 6 or more lifetime admissions were the least likely to be admitted (COR=0.86 95% CI: 0.83-0.89, p<.0001). We see a similar overall reduction in the odds of suicide admission as a person's previous contact with community mental health services (CMH) becomes more recent, with

individuals having CMH contact within the last 30 days among the least likely (COR=0.78 95% CI: 0.77-0.80, p<.0001).

**Table 8b.** Demographic variables by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
|---|---|---|---|---|---|---|
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | % (N) | % (N) | % (N) | | |
| *Sex* | Female | **58.4** (40,329) | **15.6** (10,791) | **26.0** (18,000) | *Reference* | 0.53 |
| | Male | **63.9** (46,918) | **13.8** (10,106) | **22.3** (16,379) | **0.80** (0.78-0.81)*** | |
| *Age* | 18-44 | **56.8** (39,794) | **16.9** (11,803) | **26.3** (18,428) | *Reference* | 0.56 |
| | 45-64 | **60.3** (29,363) | **13.9** (6,751) | **25.8** (12,554) | **0.90** (0.88-0.92)*** | |
| | 65+ | **75.9** (18,090) | **9.8** (2,343) | **14.3** (3,397) | **0.43** (0.42-0.44)*** | |
| *Married* | Yes | **61.2** (22,690) | **16.1** (5,971) | **22.7** (8,408) | *Reference* | 0.50 |
| | No | **61.2** (64,557) | **14.2** (14,926) | **24.6** (25,971) | **1.03** (1.01-1.06)* | |
| *Lived alone* | No | **60.7** (59,771) | **15.5** (15,247) | **23.8** (23,424) | *Reference* | 0.50 |
| | Yes | **62.3** (27,476) | **12.8** (5,650) | **24.9** (10,955) | **0.97** (0.95-0.99)** | |
| *Homeless* | No | **60.9** (64,587) | **15.2** (16,086) | **24.0** (25,464) | *Reference* | 0.50 |
| | Yes | **62.3** (22,660) | **13.2** (4,811) | **24.5** (8,915) | **0.97** (0.94-0.99)** | |
| *Forensic admission* | No | **60.7** (84,493) | **15.0** (20,796) | **24.3** (33,829) | *Reference* | 0.51 |
| | Yes | **80.9** (2,754) | **3.0** (101) | **16.2** (550) | **0.39** (0.36-0.43)*** | |
| *Education level* | No schooling | **73.8** (1,951) | **7.8** (205) | **18.5** (489) | *Reference* | 0.53 |
| | < = High school | **60.7** (38,884) | **14.3** (9,171) | **25.0** (16,005) | **1.75** (1.61-1.91)*** | |
| | >High school | **58.3** (34,083) | **16.2** (9,442) | **25.5** (14,901) | **1.89** (1.74-2.06)*** | |
| | Unknown | **70.9** (12,329) | **12.0** (2,079) | **17.2** (2,984) | **1.10** (1.01-1.21)* | |
| *Employment status* | Employed | **55.7** (18,939) | **17.9** (6,099) | **26.4** (8,995) | *Reference* | 0.53 |
| | Unemployed | **61.9** (47,282) | **13.7** (10,456) | **24.4** (18,642) | **0.81** (0.79-0.83)*** | |
| | Other | **65.5** (21,026) | **13.5** (4,342) | **21.0** (6,742) | **0.69** (0.67-0.71)*** | |
| *Education and Employment CAP* | *0* | **65.1** (61,384) | **13.1** (12,399) | **21.8** (20,560) | *Reference* | 0.55 |
| | *1* | **52.5** (9,555) | **17.3** (3,144) | **30.3** (5,511) | **1.65** (1.60-1.70)*** | |
| | *2* | **54.4** (16,308) | **17.9** (5,354) | **27.7** (8,308) | **1.50** (1.46-1.54)*** | |
| *Recent admissions* | None | **62.1** (49,281) | **15.8** (12,535) | **22.2** (17,602) | *Reference* | 0.51 |
| | >1 | **60.2** (37,966) | **13.3** (8,362) | **26.6** (16,777) | **1.13** (1.11-1.16)*** | |
| *Lifetime admission* | 0 | **62.8** (33,174) | **17.1** (9,048) | **20.1** (10,641) | *Reference* | 0.52 |
| | 1-3 | **60.2** (33,437) | **14.2** (7,889) | **25.6** (14,199) | **1.17** (1.15-1.20)*** | |
| | 4-5 | **60.6** (9,970) | **12.6** (2,066) | **26.9** (4,420) | **1.18** (1.14-1.23)*** | |
| | 6+ | **60.3** (10,666) | **10.7** (1,894) | **29.0** (5,119) | **1.24** (1.19-1.28)*** | |
| *Previous contact with CMH* | >1 year | **62.0** (39,846) | **14.6** (9,349) | **23.4** (15,046) | *Reference* | 0.51 |
| | >31 days | **61.7** (15,820) | **13.3** (3,409) | **25.1** (6,434) | **1.04** (1.01-1.07)** | |
| | <30 days | **60.0** (31,581) | **15.5** (8,139) | **24.5** (12,899) | **1.08** (1.06-1.11)*** | |

*Note. C*OR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

Table 8b reports selected variables against the secondary outcome shows that compared to females, males are less likely to be classified at high risk of suicide (COR= 0.80 95% CI: 0.78-0.81, p<.0001); and that person's aged 18 to 44 years old appear to be the group most likely to be at high risk of suicide as we see falling odds of high suicide risk classification as age increases, with those aged 65+ the least likely to be designated high risk (COR= 0.43 95% CI: 0.42-0.44, p<.0001). Persons designated as forensic admissions had substantially lower odds of being classified as high risk of suicide compared to others who were not forensic (COR=0.39,95% CI: 0.36-0.43, p<.0001). Compared to

individuals with no prior schooling, persons with an education less than or equal to high school substantially were more likely to be classified as high suicide risk (COR=1.75 95% CI:1.61-1.91, p<.0001), whereas those with an education greater than high school were even more likely (COR= 1.89 95% CI: 1.74-2.06, p<.0001). Unemployed persons were less likely than employed persons to be high risk (COR=0.81,95%CI:0.79-0.83, p<.0001), and those who reported 'other' in relation to their employment status had further reduced odds of high-risk classification (COR= 0.69 95% CI: 0.67-0.71, p<.0001). Triggering the education and employment CAP resulted in overall greater odds of high suicide risk classification, with individuals at risk of losing employment or dropping out of school triggering at level 1 being the most likely (COR=1.65 95% CI: 1.60-1.70, p<.0001). None of the variables married, lived alone, or homelessness produced sufficient enough differences in their respective COR estimates to make them eligible for consideration in the modeling phase. Some variables deal with the relationship between a person's previous contact with mental health services and the severity of suicide risk. There is a modest overall increase in the odds of high-risk designation that corresponds with the increasing number of lifetime admissions, with persons admitted more than 6 times having the greatest odds of being at high risk of suicide (COR=1.24,95% CI: 1.19-1.28, p<.0001). Neither of the COR estimates produced to describe the relationship between a person's previous contact with community mental health services and the number of recent admissions relative to the secondary outcome variable necessarily exceeded the pre-determined effect size threshold required to be considered for further analysis.

## BLOCK 2 - Adverse Events & Stressful Circumstances

**Table 9a.** Stress exposure by suicide admission among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Serious accident or physical impairment* | Never | **46.4** (50,859) | *Reference* | 0.51 |
| | > 1 year | **43.9** (10,592) | **0.90** (0.88-0.93)*** | |
| | <1 year | **46.5** (4,142) | **1.00** (0.96-1.05) | |
| *Distress about health of another person* | Never | **47.7** (45,325) | *Reference* | 0.52 |
| | >1 year | **42.8** (11,247) | **0.82** (0.80-0.84)*** | |
| | <1 year | **42.5** (9,021) | **0.81** (0.78-0.83)*** | |
| *Death of close family member or friend* | Never | **48.3** (38,521) | *Reference* | 0.53 |
| | >1 year | **43.0** (21,427) | **0.81** (0.79-0.83)*** | |
| | <1 year | **43.4** (5,645) | **0.82** (0.79-0.85)*** | |
| *Child custody issues* | Never | **46.6** (52,010) | *Reference* | 0.52 |
| | >1 year | **41.6** (10,503) | **0.82** (0.79-0.84)*** | |
| | <1 year | **54.5** (3,080) | **1.37** (1.30-1.45)*** | |
| *Conflict laden or severed relationship* | Never | **43.1** (36,623) | *Reference* | 0.54 |
| | >1 year | **46.3** (14,493) | **1.14** (1.11-1.17)*** | |
| | <1 year | **55.1** (14,477) | **1.62** (1.57-1.66)*** | |
| *Failed or dropped out of education program* | Never | **46.4** (48,223) | *Reference* | 0.51 |
| | >1 year | **44.8** (14,878) | **0.94** (0.91-0.96)*** | |
| | <1 year | **46.4** (2,492) | **1.00** (0.94-1.05) | |
| | Never | **45.1** (49,291) | *Reference* | |

| | | | | |
|---|---|---|---|---|
| *Major loss of income or serious economic hardship due to poverty* | >1 year | **47.6** (8,606) | **1.10** (1.07-1.14)*** | 0.52 |
| | <1 year | **50.7** (7,696) | **1.25** (1.21-1.29)*** | |
| *Review hearing* | Never | **46.6** (63,004) | *Reference* | 0.51 |
| | >1 year | **38.4** (1,340) | **0.72** (0.67-0.77)*** | |
| | <1 year | **33.9** (1,249) | **0.59** (0.55-0.63)*** | |
| *Immigration including refugee status* | Never | **47.0** (58,053) | *Reference* | 0.52 |
| | >1 year | **40.3** (6,982) | **0.76** (0.74-0.79)*** | |
| | <1 year | **36.1** (558) | **0.64** (0.57-0.71)*** | |
| *Lived in war zone or area of violent conflict* | Never | **46.4** (63,575) | *Reference* | 0.51 |
| | >1 year | **37.1** (1,844) | **0.68** (0.64-0.72)*** | |
| | <1 year | **38.3** (174) | **0.72** (0.60-0.87)** | |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | Never | **47.2** (60,453) | *Reference* | 0.52 |
| | >1 year | **36.2** (4,307) | **0.63** (0.61-0.66)*** | |
| | <1 year | **33.8** (833) | **0.57** (0.52-0.62)*** | |
| *Victim of crime* | Never | **46.6** (61,799) | *Reference* | 0.51 |
| | >1 year | **37.6** (2,846) | **0.69** (0.66-0.72)*** | |
| | <1 year | **40.6** (948) | **0.78** (0.72-0.85)*** | |
| *Victim of sexual assault/abuse* | Never | **45.1** (53,649) | *Reference* | 0.52 |
| | >1 year | **50.8** (10,469) | **1.26** (1.22-1.29)*** | |
| | <1 year | **49.2** (1,475) | **1.18** (1.10-1.27)*** | |
| *Victim of physical assault/abuse* | Never | **45.4** (51,402) | *Reference* | 0.51 |
| | >1 year | **49.0** (11,780) | **1.16** (1.13-1.19)*** | |
| | <1 year | **46.6** (2,411) | **1.05** (0.99-1.11) | |
| *Victim of emotional abuse* | Never | **45.0** (46,840) | *Reference* | 0.52 |
| | >1 year | **48.7** (14,004) | **1.16** (1.13-1.19)*** | |
| | <1 year | **48.9** (4,749) | **1.17** (1.12-1.22)*** | |
| *Parental abuse of alcohol or drugs* | Never | **46.6** (56,444) | *Reference* | 0.51 |
| | >1 year | **44.6** (7,558) | **0.92** (0.89-0.95)*** | |
| | <1 year | **35.3** (1,591) | **0.62** (0.59-0.66)*** | |
| *History of familial abuse* | No | **45.6** (56,295) | *Reference* | 0.51 |
| | Yes | **48.7** (9,298) | **1.13** (1.10-1.17)*** | |
| *Fear of family member, friend, caregiver or staff* | No | **45.8** (61,850) | *Reference* | 0.50 |
| | Yes | **49.9** (3,743) | **1.18** (1.12-1.23)*** | |
| *Life event caused sense of horror or intense fear* | No | **45.7** (53,539) | *Reference* | 0.51 |
| | Yes | **49.5** (9,973) | **1.17** (1.13-1.20)*** | |
| | No response | **39.3** (2,081) | **0.77** (0.73-0.81)*** | |
| *Social Relationships CAP* | *0* | **46.4** (30,040) | *Reference* | 0.51 |
| | *1* | **44.0** (17,328) | **0.91** (0.88-0.93)*** | |
| | *2* | **47.5** (18,225) | **1.04** (1.02-1.07)** | |
| *Interpersonal Conflict CAP* | *0* | **46.0** (42,895) | *Reference* | 0.50 |
| | *1* | **45.7** (15,959) | **0.99** (0.96-1.01) | |
| | *2* | **46.9** (6,739) | **1.04** (1.00-1.07)* | |
| *Trauma CAP* | *0* | **45.5** (53,937) | *Reference* | 0.51 |
| | *1* | **47.8** (6,971) | **1.10** (1.06-1.14)*** | |
| | *2* | **50.2** (4,685) | **1.21** (1.16-1.26)*** | |
| *Personal Finance CAP* | *0* | **47.3** (49,179) | Reference | 0.53 |
| | *1* | **37.3** (8,570) | **0.66** (0.64-0.68)*** | |
| | *2* | **50.2** (7,844) | **1.12** (1.09-1.16)*** | |

*Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk * p <.05, ** p < .01, ***p < .0001

Table 9a reports the associations between a variety of exposures to adverse events and stressful life experiences and the likelihood of being admitted to inpatient psychiatry because of suicide related

behaviours. Among persons reportedly distressed about the health of another person within their social network, we see an overall reduction in the odds of suicide admission that is comparable whether that experience be recent (<1 year ago) or historic (>1 year ago). A similar overall and comparable reduction in the odds of admission is seen among those who reported experiencing the death of someone they consider a close family member or friend. For a selection of stressor variables, we note an obvious recency effect of the exposure on the likelihood of suicide admission. For example, individuals experiencing a conflict laden or severed relationship within the last year were substantially more likely to experience admission (COR=1.62 95% CI: 1.57-1.66, p<.0001), and person's experiencing a major loss of income or serious economic hardship due to poverty had greater odds of being admitted if the event occurred within the previous 12 months (COR=1.25 95% CI: 1.21-1.29, p<.0001). While we see a reduction in the odds of suicide admission among individuals experiencing child custody issues more than one year ago, for others exposed within the last year we conversely see an increase in the odds of suicide admission (COR=1.37 95% CI: 1.30-1.45, p<.0001). Overall, individuals with a review hearing were less likely to experience suicide admission, particularly if the experience was more recent (i.e., <1 year ago) (COR=0.59 CI 95%: 0.55-0.63, P<.0001). Interestingly, we see overall reductions in the odds of suicide admission among persons with immigrant or refugee status, particularly if this was within the last 12 months (COR= 0.64 95% CI: 0.57-0.71, p<.0001). There is a similar overall reduction in the odds of admission among individuals who had borne witness to a severe accident, disaster, act of terrorism**,** violence or abuse, again, particularly if exposure was within the previous 12 months (COR= 0.57 95% CI: 0.52-0.62, p<.0001). An overall reduction on the odds of suicide admission is noted among those who reported living in a war zone or area of violent conflict; however, this more prominent among persons reportedly in this situation more than 1 year ago (COR=0.68 95% CI: 0.64-0.62, p<.0001). We see an overall reduction in the likelihood of suicide admission among victims of crime, with persons reporting this experience further in the past (i.e., >1 year ago) least likely (COR=0.69 95% CI: 0.66-0.72, p<.0001). Several other items tested in block 3 that pertain to other instances of victimization generally produce estimates with effect sizes that fall outside of the pre-defined parameters, meaning that they will not be considered for further analysis against the primary outcome. These include **victim** of emotional abuse, sexual assault or abuse, and physical assault or abuse. There is a general reduction in the odds of suicide admission among persons exposed to parental abuse of alcohol or drugs, particularly if the exposure was more recent (i.e., <1 year ago) (COR=0.62 95% CI: 0.59-0.66, p<.0001). The trauma CAP produces an increase in the odds of suicide admission at both trigger levels with those triggering level 2, indicating persons that have experienced one or more traumatic events that evoked an intense sense of horror or fear, most likely to be admitted (COR=1.21 95% CI: 1.16-1.26, p<.0001). Persons triggering level 2 of the personal finances CAP, indicating incapacity to manage one's financial responsibilities, had slightly increased odds of suicide admission; whereas others who triggered level 1, indicating the experience of economic hardship because of poverty, had substantially reduced odds of suicide admission (COR=0.66 95% CI: 0.64-0.68, p<.0001).

| **Table 9b.** Stress exposure by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523) | | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | **%** (N) | **%** (N) | **%** (N) | | |
| *Serious accident or physical impairment* | Never | **62.5** (68,434) | **14.7** (16,051) | **22.9** (25,024) | *Reference* | 0.52 |
| | > 1 year | **57.1** (13,774) | **14.6** (3,520) | **28.3** (6,812) | **1.27** (1.24-1.31)*** | |
| | < 1 year | **56.6** (5,039) | **14.9** (1,326) | **28.6** (2,543) | **1.30** (1.25-1.36)*** | |
| *Distress about health of another person* | Never | **62.5** (59,407) | **14.5** (13,727) | **23.0** (21,861) | *Reference* | 0.52 |
| | > 1 year | **61.5** (16,149) | **13.9** (3,638) | **24.7** (6,488) | **1.06** (1.03-1.09)*** | |
| | < 1 year | **55.0** (11,691) | **16.6** (3,532) | **28.4** (6,030) | **1.35** (1.31-1.39)*** | |
| *Death of close family member or friend* | Never | **62.5** (49,795) | **14.8** (11,775) | **22.8** (18,143) | *Reference* | 0.52 |
| | > 1 year | **60.3** (30,029) | **14.3** (7,122) | **25.4** (12,656) | **1.11** (1.09-1.14)*** | |
| | < 1 year | **57.1** (7,423) | **15.4** (2,000) | **27.5** (3,580) | **1.26** (1.22-1.31)*** | |
| *Child custody issues* | Never | **62.2** (69,383) | **14.6** (16,292) | **23.2** (25,944) | *Reference* | 0.52 |
| | > 1 year | **59.8** (15,099) | **14.1** (3,553) | **26.1** (6,601) | **1.12** (1.09-1.15)*** | |
| | < 1 year | **48.9** (2,765) | **18.6** (1,052) | **32.5** (1,834) | **1.66** (1.58-1.75)*** | |
| *Conflict laden or severed relationship* | Never | **66.7** (56,683) | **13.3** (11,276) | **20.0** (16,970) | *Reference* | 0.57 |
| | > 1 year | **58.0** (18,152) | **14.3** (4,484) | **27.7** (8,672) | **1.50** (1.44-1.52)*** | |
| | < 1 year | **47.2** (12,412) | **19.5** (5,137) | **33.2** (8,737) | **2.14** (2.09-2.20)*** | |
| *Failed or dropped out of education program* | Never | **62.5** (64,953) | **14.7** (15,292) | **22.8** (23,663) | *Reference* | 0.52 |
| | > 1 year | **57.8** (19,212) | **14.2** (4,719) | **28.0** (9,308) | **1.25** (1.22-1.28)*** | |
| | < 1 year | **57.3** (3,082) | **16.5** (886) | **26.2** (1,408) | **1.23** (1.16-1.30)*** | |
| *Major loss of income or serious economic hardship due to poverty* | Never | **63.7** (69,557) | **14.3** (15,562) | **22.1** (24,123) | *Reference* | 0.54 |
| | > 1 year | **55.7** (10,085) | **14.6** (2,649) | **29.6** (5,360) | **1.42** (1.38-1.47)*** | |
| | < 1 year | **50.1** (7,605) | **17.7** (2,686) | **32.2** (4,896) | **1.72** (1.66-1.78)** | |
| *Review hearing* | Never | **60.8** (82,282) | **15.0** (20,241) | **24.3** (32,835) | *Reference* | 0.51 |
| | > 1 year | **66.8** (2,326) | **10.1** (352) | **23.1** (807) | **0.81** (0.76-0.87)*** | |
| | < 1 year | **71.7** (2,639) | **8.3** (304) | **20.0** (737) | **0.64** (0.60-0.69)*** | |
| *Immigration, including refugee status* | Never | **59.7** (73,856) | **15.2** (18,768) | **25.1** (31,021) | *Reference* | 0.52 |
| | > 1 year | **70.3** (12,173) | **11.6** (2,003) | **18.2** (3,154) | **0.64** (0.62-0.66)*** | |
| | < 1 year | **78.7** (1,218) | **8.1** (126) | **13.2** (204) | **0.41** (0.36-0.46)*** | |
| *Lived in war zone or area of violent conflict* | Never | **61.0** (83,562) | **14.8** (20,288) | **24.3** (33,245) | *Reference* | 0.50 |
| | > 1 year | **67.5** (3,355) | **11.2** (559) | **21.3** (1,060) | **0.77** (0.73-0.82)*** | |
| | < 1 year | **72.7** (330) | **11.0** (50) | **16.3** (74) | **0.59** (0.48-0.73)*** | |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | Never | **61.9** (79,346) | **14.6** (18,741) | **23.5** (30,054) | *Reference* | 0.51 |
| | > 1 year | **54.9** (6,540) | **14.6** (1,737) | **30.5** (3,637) | **1.37** (1.32-1.42)*** | |
| | < 1 year | **55.2** (1,361) | **17.0** (419) | **27.9** (688) | **1.30** (1.20-1.41)*** | |
| *Victim of crime* | Never | **61.6** (81,722) | **14.7** (19,508) | **23.7** (31,391) | *Reference* | 0.51 |
| | > 1 year | **56.3** (4,260) | **13.6** (1,026) | **30.1** (2,282) | **1.29** (1.24-1.35)*** | |
| | < 1 year | **54.2** (1,265) | **15.6** (363) | **30.3** (706) | **1.37** (1.27-1.48)*** | |
| *Victim of sexual assault/abuse* | Never | **64.7** (76,931) | **14.1** (16,725) | **21.2** (25,259) | *Reference* | 0.56 |
| | > 1 year | **43.2** (8,913) | **17.8** (3,662) | **39.0** (8,035) | **2.39** (2.32-2.46)*** | |
| | < 1 year | **46.8** (1,403) | **17.0** (510) | **36.2** (1,085) | **2.09** (1.95-2.24)*** | |
| *Victim of physical assault/abuse* | Never | **64.7** (73,275) | **14.2** (16,077) | **21.2** (23,964) | *Reference* | 0.56 |
| | > 1 year | **47.0** (11,283) | **16.9** (4,060) | **36.2** (8,686) | **2.08** (2.03-2.14)*** | |
| | < 1 year | **51.9** (2,689) | **14.7** (760) | **33.4** (1,729) | **1.76** (1.67-1.85)*** | |
| *Victim of emotional abuse* | Never | **66.2** (68,843) | **13.6** (14,182) | **20.2** (20,998) | *Reference* | 0.57 |
| | > 1 year | **47.8** (13,753) | **17.3** (4,983) | **34.9** (10,042) | **2.13** (2.08-2.19)*** | |
| | < 1 year | **47.8** (4,651) | **17.8** (1,732) | **34.4** (3,339) | **2.11** (2.03-2.19)*** | |
| *Parental abuse of alcohol or drugs* | Never | **63.0** (76,263) | **14.5** (17,603) | **22.5** (27,206) | *Reference* | 0.53 |
| | > 1 year | **50.2** (8,500) | **15.6** (2,644) | **34.2** (5,798) | **1.73** (1.68-1.78)*** | |
| | < 1 year | **55.1** (2,484) | **14.4** (650) | **30.5** (1,375) | **1.43** (1.35-1.51)*** | |
| *History of familial abuse* | No | **63.5** (78,378) | **14.3** (17,623) | **22.2** (27,440) | *Reference* | 0.54 |
| | Yes | **46.5** (8,869) | **17.2** (3,274) | **36.4** (6,939) | **2.00** (1.94-2.06)*** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Fear of family member, friend, caregiver or staff* | No | **61.9** (83,600) | **14.5** (19,569) | **23.6 (**31,851) | *Reference* | 0.51 |
| | Yes | **48.6** (3,647) | **17.7** (1,328) | **33.7** (2,528) | **1.69** (1.62-1.77)*** | |
| *Life event causes sense of horror or intense fear* | No | **63.7** (74,535) | **14.2** (16,595) | **22.2** (25,957) | *Reference* | 0.54 |
| | Yes | **45.7** (9,212) | **18.3** (3,691) | **35.9** (7,234) | **2.03** (1.98-2.09)*** | |
| | No response | **66.1** (3,500) | **11.5** (611) | **22.4** (1,188) | **0.93** (0.88-0.98)** | |
| *Social Relationships CAP* | 0 | **64.6** (41,769) | **13.3** (8,618) | **22.1** (14,316) | *Reference* | 0.53 |
| | 1 | **60.6** (23,872) | **14.2** (5,607) | **25.2** (9,933) | **1.19** (1.16-1.22)*** | |
| | 2 | **56.3** (21,606) | **17.4** (6,672) | **26.4** (10,130) | **1.37** (1.33-1.40)*** | |
| *Interpersonal Conflict CAP* | 0 | **59.6** (55,543) | **15.0** (14,019) | **25.4** (23,649) | *Reference* | 0.52 |
| | 1 | **63.9** (22,317) | **13.9** (4,859) | **22.2** (7,769) | **0.84** (0.82-0.86)*** | |
| | 2 | **65.3** (9,387) | **14.1** (2,019) | **20.6** (2,961) | **0.78** (0.75-0.81)*** | |
| *Trauma CAP* | 0 | **64.0** (75,877) | **14.0** (16,616) | **22.0** (26,103) | *Reference* | 0.55 |
| | 1 | **46.9** (6,843) | **18.0** (2,621) | **35.1** (5,126) | **1.97** (1.91-2.04)*** | |
| | 2 | **48.4** (4,517) | **17.8** (1,660) | **33.8** (3,150) | **1.86** (1.79-2.94)*** | |
| *Personal Finances CAP* | 0 | **58.4** (60,711) | **15.7** (16,292) | **25.9** (26,920) | *Reference* | 0.56 |
| | 1 | **78.9** (18,138) | **8.8** (2,030) | **12.2** (2,810) | **0.38** (0.37-0.39)*** | |
| | 2 | **53.8** (8,398) | **16.5** (2,575) | **29.8** (4,649) | **1.21** (1.17-1.25)*** | |

*Note*. COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

All Block 2 variables tested and reported in Table 9b produced significant changes in the odds of high suicide risk classification. Persons who had experienced a serious accident or physical impairment, who reported being distressed about the health of another person, who had experienced the death of a close family member or friend, had failed or dropped out of education program, have borne witness to severe accident, disaster, act of terrorism, or violence or abuse, or had been a victim of crime all had generally greater odds of high suicide risk designation with modest effect sizes in the context of this study. However, there are a selection of variables in this block that also produced greater odds of high suicide risk classification but whose effect sizes stand out, particularly when the exposure was more recent (i.e., < 1 year ago). For example, victims of sexual assault or abuse (COR=2.39 95% CI: 2.32-2.46, p<.0001), victims of physical assault or abuse (COR=2.08 95% CI: 2.03-2.15, p<.0001), victims of emotional abuse (COR=2.13 95% CI: 2.08-2.19, p<.0001), persons involved in conflict laden or experiencing severed relationships (COR=2.14 95% CI: 2.09-2.20, p<.0001), and persons with a history of familial abuse (COR=2.00 95% CI: 1.94-2.06, p<.0001) all had substantially greater odds of being designated high risk of suicide. Other variables displaying notable increases in the odds of high-risk classification also with a prominent recency effect include persons who reported being exposed to parental abuse of alcohol or drugs (COR=1.73 95% CI:1.68-1.78, p<.0001), being fearful of a family member, friend, caregiver or staff (COR=1.69 95% CI: 1.62-1.77, p<.0001), persons experiencing a major loss of income or serious economic hardship due to poverty (COR=1.72 95% CI: 1.66-1.78, <.01), and persons experiencing child custody issues (COR=1.66 95% CI: 1.58-1.75, p<.0001) all had substantially greater odds of high-risk designation overall, but particularly if the exposure occurred within the last 12 months. Further, persons who acknowledged experiencing 1 or more of the stressful events mentioned and also report it to have caused a sense of horror or intense fear were substantially more likely to be designated high risk (COR=2.03 95% CI: 1.98-2.09, p<.0001) compared to those who

did not. Conversely, a smaller selection of items from this block produced measures of association moving in the oppositive direction. For example, individuals experiencing a review hearing were overall less likely to be classified high suicide risk, but particularly if this experience was more recent (i.e., < 1 year ago) (COR=0.64 95% CI: 0.60-0.69, p<.0001). Having immigrant or refugee status was associated with a reduction in the odds of high-risk classification overall, again, particularly if more recently (COR=0.41 95% CI: 0.36-0.46, p<.0001), and persons who reportedly experienced living in a war zone or area of violent conflict, especially if occurring within the last 12 months, had substantially reduced odds of being classified high suicide risk (COR=0.59 95% CI: 0.48-0.73, p<.0001). Among the CAPs tested in this block, the trauma CAP generated the greatest overall increase in the odds of high-risk designation, with those triggering level 1, indicating persons who are in immediate danger due to current abuse, at the greatest risk (COR=1.97 95% CI: 1.91-2.04, p<.0001). A deterioration in social functioning according to the social relationships CAP corresponds with an overall greater odds of higher risk classification, with persons triggering at level 2, indicating a need to improve close friendships and family functioning, the most likely to be at high risk (COR=1.37 95% CI: 1.33-1.40, p<.0001). Conversely, the interpersonal conflict CAP produces an overall reduction in the odds of high-risk classification at both trigger levels, with those among whom there is a need to reduce conflict within specific relationships triggering level 2 the least likely to be designated high suicide risk (COR=0.78 95% CI: 0.75-0.81, p<.0001). Finally, the personal finances CAP demonstrates that persons triggering level 1, which includes those not experiencing hardship but who have been assessed to be incapable of managing their financial responsibilities, are substantially less likely to be designated high risk (COR=0.38 95% CI: 0.37-0.39, p<.0001), whereas persons triggering level 2, which includes those who experiencing economic hardship due to poverty, are more likely to be designated high risk (COR=1.21 95% CI: 1.17-1.25, p<.0001).

## BLOCK 3 - Mental Illness

**Table 10a.** Mental illness by 'suicide admission' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Neurodevelopmental disorder* | No | **46.2** (64,059) | *Reference* | 0.50 |
| | Yes | **40.8** (1,534) | **0.80** (0.75-0.86)*** | |
| *Schizophrenia & psychotic disorders* | No | **50.1** (49,150) | *Reference* | 0.56 |
| | Yes | **37.1** (16,443) | **0.59** (0.57-0.60)*** | |
| *Mood disorders* | No | **36.1** (25,095) | *Reference* | 0.60 |
| | Yes | **55.5** (40,498) | **2.20** (2.16-2.25)*** | |
| *Anxiety disorders* | No | **45.9** (54,478) | *Reference* | 0.50 |
| | Yes | **46.5** (11,115) | **1.03** (1.00-1.05) | |
| *Dissociative disorders* | No | **46.0** (65,439) | *Reference* | 0.50 |
| | Yes | **55.6** (154) | **1.47** (1.16-1.87)** | |
| *Somatoform disorders* | No | **46.0** (65,320) | *Reference* | 0.50 |
| | Yes | **42.7** (273) | **0.87** (0.75-1.02) | |
| *Eating disorders* | No | **46.3** (64,986) | *Reference* | |

| | | | | |
|---|---|---|---|---|
| | Yes | **29.5** (607) | **0.49** (0.44-0.54)*** | 0.51 |
| *Sleep disorders* | No | **46.0** (65,306) | *Reference* | 0.50 |
| | Yes | **47.4** (287) | **1.06** (0.90-1.24) | |
| *Sexual and gender identity disorders* | No | **46.0** (65,450) | *Reference* | 0.50 |
| | Yes | **59.1** (143) | **1.69** (1.31-2.19)*** | |
| *Neurocognitive disorders* | No | **47.0** (58,722) | *Reference* | 0.52 |
| | Yes | **38.9** (6,871) | **0.72** (0.70-0.74)*** | |
| *Personality disorders* | No | **44.2** (58,214) | *Reference* | 0.53 |
| | Yes | **67.6** (7,379) | **2.63** (2.52-2.74)*** | |
| *Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk<br>* p <.05, ** p < .01, ***p < .0001 | | | | |

All block 3 mental health diagnostic variables reported in Table 10a produced significant differences in the odds of suicide admission apart from anxiety, somatoform and sleep disorders. Four variables tested in this block produced significant increases in the odds of suicide admission. The greatest positive COR is seen for personality disorders (COR= 2.63 95% CI: 2.52-2.74, p<.0001), followed by mood disorders (COR= 2.20 95% CI: 2.16-2.25, p<.0001), sexual and gender identity disorders (COR= 1.69 95% CI: 1.31-2.19, p<.0001), and dissociative disorders (COR= 1.47 95% CI:1.16-1.87, p<.05). In the other direction, several other variables in the block produced significant reductions in the odds of suicide admission, the largest effect is seen for eating disorders (COR= 0.49 95% CI: 0.44-0.54, p<.0001), followed by schizophrenia and psychotic disorders (COR=0.59 95% CI: 0.57-0.60, p<.0001), neurocognitive disorders (COR=0.72 95% CI: 0.70-0.74, p<.0001), and neurodevelopmental disorders (COR=0.80 95% CI: 0.75-0.86, p<.0001) who were the diagnostic group least unlikely to experience suicide admission.

**Table 10b.** Mental illness by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
|---|---|---|---|---|---|---|
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | **%** (N) | **%** (N) | **%** (N) | | |
| *Neurodevelopmental disorder* | No | **61.1** (85,806) | **14.6** (20,309) | **24.3** (33,645) | *Reference* | 0.50 |
| | Yes | **64.9** (2,441) | **15.6** (588) | **19.5** (734) | **0.83** (0.77-0.89)*** | |
| *Schizophrenia & psychotic disorders* | No | **54.3** (53,301) | **17.1** (16,749) | **28.6** (28,107) | *Reference* | 0.59 |
| | Yes | **76.5** (33,946) | **9.4** (4,148) | **14.1** (6,272) | **0.37** (0.36-0.38)*** | |
| *Mood disorders* | No | **74.0** (51,406) | **9.8** (6,779) | **16.3** (11.318) | *Reference* | 0.61 |
| | Yes | **49.1** (35,841) | **19.3** (14,118) | **31.6** (23,061) | **2.79** (2.73-2.85)*** | |
| *Anxiety disorders* | No | **63.7** (75,591) | **13.6** (16,159) | **22.7** (26,889) | *Reference* | 0.54 |
| | Yes | **48.8** (11,656) | **19.8** (4,738) | **31.4** (7,490) | **1.73** (1.69-1.78)*** | |
| *Dissociative disorders* | No | **61.2** (87,114) | **14.7** (20,848) | **24.1** (34,284) | *Reference* | 0.50 |
| | Yes | **48.0** (133) | **17.7** (49) | **34.3** (95) | **1.68** (1.35-2.10)*** | |
| *Somatoform disorders* | No | **61.2** (86,874) | **14.7** (20,781) | **24.1** (34,228) | *Reference* | 0.50 |
| | Yes | **58.3** (373) | **18.1** (116) | **23.6** (151) | **1.08** (0.93-1.26) | |
| *Eating disorders* | No | **61.3** (86,155) | **14.6** (20,522) | **24.1** (33,790) | *Reference* | 0.50 |
| | Yes | **53.1** (1,092) | **18.2** (375) | **28.7** (589) | **1.35** (1.24-1.47)*** | |
| *Sleep disorders* | No | **61.2** (86,868) | **14.7** (20,831) | **24.1** (34,219) | *Reference* | 0.50 |
| | Yes | **62.6** (379) | **10.9** (66) | **26.5** (160) | **0.99** (0.85-1.16) | |
| *Sexual and gender identity disorders* | No | **61.3** (87,142) | **14.7** (20,851) | **24.1** (34,288) | *Reference* | 0.50 |
| | Yes | **43.4** (105) | **19.0** (46) | **37.6** (91) | **1.98** (1.56-2.51)*** | |
| *Neurocognitive disorders* | No | **59.3** (73,992) | **15.3** (19,115) | **25.4** (31,763) | *Reference* | 0.53 |
| | Yes | **75.1** (13,225) | **10.1** (1,782) | **14.8** (2,616) | **0.49** (0.47-0.51)*** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Personality disorders* | No | **63.3** (83,279) | **14.2** (18,653) | **22.5** (29,651) | *Reference* | 0.54 |
| | Yes | **36.2** (3,950) | **20.6** (2,244) | **43.3** (4,728) | **2.82** (2.72-2.93)*** | |

*Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

Table 10b shows that much like the effect they had on the primary outcome variable, the same following diagnostic variables significantly increased the odds of high suicide risk classification, with personality disorders topping this selection (COR=2.82 95% CI: 2.72-2.93, p<.0001), similarly followed by mood disorders (COR= 2.79 95% CI: 2.73-2.85, p<.0001) and sexual and gender identity disorders (COR= 1.98 95% CI: 1.56-2.51, p<.0001). Anxiety disorders in this group also significantly increased the likelihood of high suicide risk designation (COR=1.73 95% CI: 1.69-1.78, p<.0001), along with dissociative disorders (COR= 1.68 95% CI:1.35-2.10, p<.0001) and eating disorders (COR= 1.35 95% CI: 1.24-1.47, p<.0001). The following diagnostic variables significantly reduced odds of high suicide risk classification, with schizophrenia and psychotic disorders (COR=0.37 95% CI: 0.36-0.38., p<.0001) associated with the greatest reduction in the odds of high suicide risk designation, followed by neurocognitive disorders (COR=0.49 95% CI: 0.47-0.51, p<.0001), and neurodevelopmental disorders (COR= 0.83 95% CI: 0.77-0.89, p<.0001) which had the smallest reduction in odds of high suicide risk.

## BLOCK 4 - Substance Use & Addiction Behaviours

**Table 11a.** Substance use & addiction behaviours by 'suicide admission' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Alcohol* | No | **45.4** (55,662) | *Reference* | 0.51 |
| | Yes | **50.1** (9,931) | **1.21** (1.18-1.25)*** | |
| *Smoking* | No | **46.0** (41,400) | *Reference* | *N/A* |
| | Yes | **46.0** (24,193) | **1.00** (0.98-1.02) | |
| *Gambling* | No | **46.1** (64,565) | *Reference* | 0.50 |
| | Yes | **42.4** (1,028) | **0.86** (0.80-0.94)** | |
| *Inhalants* | Never or > 1 year ago | **46.0** (64,824) | *Reference* | 0.50 |
| | Within last year | **48.8** (379) | **1.12** (0.98-1.29) | |
| | Within last month | **59.1** (385) | **1.69** (1.45-1.98)*** | |
| *Hallucinogens* | Never or > 1 year ago | **45.9** (63,651) | *Reference* | 0.50 |
| | Within last year | **46.8** (1,047) | **1.04** (0.95-1.13) | |
| | Within last month | **57.6** (895) | **1.60** (1.45-1.77)*** | |
| *Cocaine & Crack* | Never or > 1 year ago | **46.1** (58,992) | *Reference* | 0.51 |
| | Within last year | **39.4** (2,253) | **0.76** (0.72-0.80)*** | |
| | Within last month | **48.6** (4,348) | **1.11** (1.06-1.15)*** | |
| *Stimulants* | Never or > 1 year ago | **45.9** (61,590) | *Reference* | 0.51 |
| | Within last year | **41.1** (1,271) | **0.82** (0.76-0.88)*** | |
| | Within last month | **51.8** (2,732) | **1.27** (1.20-1.34)*** | |
| *Opiates* | Never or > 1 year ago | **46.4** (61,135) | *Reference* | 0.51 |
| | Within last year | **39.8** (942) | **0.76** (0.70-0.83)*** | |
| | Within last month | **41.6** (3,516) | **0.82** (0.79-0.86)*** | |
| *Cannabis* | Never or > 1 year ago | **45.1** (47,205) | *Reference* | |

| | | | | |
|---|---|---|---|---|
| | Within last year | **42.0** (2,121) | **0.88** (0.83-0.93)*** | 0.52 |
| | Within last month | **49.5** (16,267) | **1.19** (1.16-1.22)*** | |
| *Substance Use CAP* | *0* | **42.8** (32,236) | Reference | 0.55 |
| | *1* | **35.9** (3,011) | **0.75** (0.71-0.78)*** | |
| | *2* | **51.6** (30,346) | **1.43** (1.40-1.46)*** | |
| *Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk<br>* p <.05, ** p < .01, ***p < .0001 | | | | |

Table 11a reports the associations between a range of substance use variables and the primary outcome, suicide admission. Each of the tested in this block against the primary outcome produced statistically significant changes in their COR estimates apart from smoking, for which there was no significant effect. Because of the way several of the substance use variables have been operationalized, we can better understand the recency of their impact on the outcome. For example, the odds of suicide admission were greater among those reporting more recent use (i.e., use in the previous 4 weeks) of inhalants (COR=1.69 95% CI: 1.45-1.98, p<.0001, hallucinogens (COR= 1.60 95% CI: 1.45-1.77, p<.0001) crack and cocaine (COR=1.11 95% CI: 1.06-1.15, p<.0001), and stimulants (COR=1.27 95% CI: 1.27,p<.0001), whereas for individuals who reported use of these same substances but less recently (i.e., in the previous 12 months), the increased odds of suicide admission have a smaller effect size that is under the specified threshold (e.g., inhalants and hallucinogens), or the association goes in the other direction and we instead see a significant reduction in the odds of suicide admission (e.g., crack and cocaine and stimulants). Individuals who triggered level 1 of the substance use CAP, indicating prior history of problematic substance use, had reduced odds of suicide admission (COR=0.75 95% CI:0.71-0.78, p<.0001); while those that triggered level 2, indicating current problematic substance use, had increased odds of suicide admission (COR=1.43 95% CI: 1.40-1.46, p<.0001). Alcohol, gambling and cannabis use variables tested against the primary outcome in table 4a all produced COR estimates that did not exceed the required effect size threshold needed for them to be considered for further analysis.

**Table 11b.** Substance use & addiction behaviours by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
|---|---|---|---|---|---|---|
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | **%** (N) | **%** (N) | **%** (N) | | |
| *Alcohol* | No | **62.9** (77,215) | **14.5** (17,732) | **22.6** (27,771) | *Reference* | 0.53 |
| | Yes | **50.7** (10,032) | **16.0** (3,165) | **33.4** (6,608) | **1.68** (1.63-1.72)*** | |
| *Smoker* | No | **63.5** (57,109) | **14.9** (13,369) | **21.7** (19,483) | *Reference* | 0.53 |
| | Yes | **57.3** (30,138) | **14.3** (7,528) | **28.3** (14,896) | **1.33** (1.31-1.36)*** | |
| *Gambling* | No | **61.3** (85,847) | **14.7** (20,598) | **24.0** (33,655) | *Reference* | 0.50 |
| | Yes | **57.8** (1,400) | **12.4** (299) | **29.9** (724) | **1.22** (1.12-1.31)*** | |
| *Inhalants* | Nevr or > 1 y/ago | **61.3** (86,486) | **14.7** (20,687) | **24.0** (33,922) | *Reference* | 0.50 |
| | Within last year | **53.9** (418) | **13.4** (104) | **32.7** (254) | **1.42** (1.24-1.63)*** | |
| | Within last month | **52.6** (343) | **16.3** (106) | **31.1** (203) | **1.43** (1.23-1.65)*** | |
| *Hallucinogens* | Nevr or > 1 y/ago | **61.5** (85,257) | **14.6** (20,251) | **24.0** (33,222) | *Reference* | 0.50 |
| | Within last year | **52.2** (1,168) | **17.6** (395) | **30.2** (676) | **1.43** (1.32-1.55)*** | |
| | Within last month | **52.9** (822) | **16.2** (251) | **31.0** (481) | **1.42** (1.29-1.56)*** | |
| | Nevr or > 1 y/ago | **62.1** (79,340) | **14.8** (18,877) | **23.2** (29,648) | *Reference* | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Cocaine & crack* | Within last year | **56.0** (3,200) | **13.2** (755) | **30.8** (1,762) | **1.35** (1.28-1.42)*** | 0.52 |
| | Within last month | **52.7** (4,707) | **14.2** (1,265) | **33.2** (2,969) | **1.53** (1.47-1.60)*** | |
| *Stimulants* | Nevr or > 1 y/ago | **61.6** (82,650) | **14.7** (19,768) | **23.7** (31,738) | *Reference* | 0.51 |
| | Within last year | **56.5** (1,746) | **13.5** (418) | **30.0** (930) | **1.29** (1.20-1.38)*** | |
| | Within last month | **54.1** (2,851) | **13.5** (711) | **32.4** (1,711) | **1.43** (1.35-1.51)*** | |
| *Opiates* | Nevr or > 1 y/ago | **61.7** (81,211) | **14.8** (19,531) | **23.5** (30,959) | *Reference* | 0.51 |
| | Within last year | **56.8** (1,344) | **11.9** (281) | **31.3** (741) | **1.31** (1.21-1.41)*** | |
| | Within last month | **55.5** (4,692) | **12.8** (1,085) | **31.7** (2,679) | **1.36** (1.31-1.42)*** | |
| *Cannabis* | Nevr or > 1 y/ago | **63.3** (66,161) | **14.2** (14,824) | **22.6** (23,592) | *Reference* | 0.53 |
| | Within last year | **58.1** (2,937) | **13.5** (680) | **28.4** (1,438) | **1.28** (1.21-1.35)*** | |
| | Within last month | **55.2** (18,149) | **16.4** (5,393) | **28.4** (9,349) | **1.39** (1.35-1.42)*** | |
| *Substance Use CAP* | *0* | **68.4** (51,551) | **14.3** (10,801) | **17.2** (12,987) | *Reference* | 0.59 |
| | *1* | **66.4** (5,578) | **12.1** (1,013) | **21.5** (1,810) | **1.14** (1.09-1.20)*** | |
| | *2* | **51.2** (30,118) | **15.5** (9,083) | **33.3** (19,582) | **2.15** (2.11-2.20)*** | |

*Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

All substance use variables described in Table 11b produced statistically significant changes to the crude odds of suicide risk severity. For example, individuals reportedly consuming 5 or more alcoholic beverages in a single sitting at some point in the 14 days prior to assessment (COR=1.68 95% CI: 1.63-1.72, p<.0001), smokers (COR=1.33 95% CI: 1.31-1.36, p<.0001), and gamblers (COR=1.22 95% CI: 1.22, p<.0001) all had greater odds of high suicide risk classification. Use of inhalants (COR=1.41 95% CI: 1.23-1.65, p<.0001) and hallucinogens (COR=1.41 95% CI: 1.29-1.56, p<.0001) both produced comparable increases in the odds of high suicide risk classification, however these estimates showed little difference in terms of effect between those who used in the previous 4 weeks and those who used within the last 12 months. The use of crack and cocaine (COR=1.53 95% CI: 1.47-1.60, p<.0001), stimulants (COR=1.43 95% CI: 1.35-1.51, p<.0001), cannabis (COR=1.39 95% CI: 1.35-1.42, p<.0001) and opiates (COR=1.36 95% CI: 1.31-1.42, p<.0001) also produced greater odds of high suicide risk classification, which were greatest among persons reporting use within the previous 4 weeks prior to assessment. While individuals who had prior history of problematic substance use triggering level 1 of the substance use CAP had greater odds of being designated high risk, individuals that triggered level 2 of the CAP, indicating current problematic substance use, had the greatest odds of high-risk classification (COR=2.15 95% CI: 2.11-2.20, p<.0001).

## BLOCK 5 - Physical Health & Functioning

**Table 12a.** Physical health & functioning by 'suicide admission' among psychiatric inpatients in Ontario, 2005-2019 (n= 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Sexual dysfunction* | No | **46.4** (63,607) | *Reference* | 0.51 |
| | Yes | **36.5** (1,986) | **0.66** (0.63-0.70)*** | |
| *Self-reported health* | Not in poor health | **46.2** (56,506) | *Reference* | 0.51 |
| | In poor health | **46.8** (6,852) | **1.02** (0.99-1.06) | |
| | No response | **39.6** (2,235) | **0.76** (0.72-0.81)*** | |
| | No | **46.2** (64,082) | *Reference* | |

| | | | | |
|---|---|---|---|---|
| *Extra Pyramidal Signs and Symptoms* | Yes | **41.2** (1,511) | **0.82** (0.77-0.88)*** | 0.50 |
| *Pain Scale* | 0 | **46.2** (50,393) | *Reference* | 0.51 |
| | 1 | **42.4** (6,061) | **0.86** (0.83-0.89)*** | |
| | 2 | **47.2** (7,647) | **1.04** (1.01-1.08)* | |
| | 3 | **51.5** (1,275) | **1.24** (1.14-1.34)*** | |
| | 4 | **46.6** (217) | **1.02** (0.85-1.22) | |
| *Activities of Daily Living (ADL)* | 0 | **47.4** (57,571) | *Reference* | 0.52 |
| | 1-3 | **38.9** (6,423) | **0.71** (0.69-0.73)*** | |
| | 4 | **36.0** (912) | **0.62** (0.58-0.68)*** | |
| | 5-6 | **34.0** (687) | **0.57** (0.52-0.63)*** | |
| *Instrumental Activities of Daily Living scale (IADL)* | 0 | **49.6** (43,932) | *Reference* | 0.55 |
| | 1-3 | **44.6** (7,341) | **0.82** (0.79-0.85)*** | |
| | 4-9 | **40.8** (5,919) | **0.70** (0.68-0.73)*** | |
| | 10-18 | **39.3** (3,957) | **0.66** (0.63-0.69)*** | |
| | 19-30 | **34.6** (4,444) | **0.54** (0.52-0.56)*** | |
| *Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk<br>* p <.05, ** p < .01, ***p < .0001 | | | | |

Table 12a reports information on items from block 5 that relate to physical health and functioning. Against the primary outcome, all variables tested produced statistically significant changes in their corresponding COR estimates. Individuals who reportedly experienced problems related to sexual functioning had reduced odds of suicide admission (COR=0.66 95% CI: 0.63-0.70, p<.0001). Individuals who did not subjectively rate their health, either due to cognitive impairment or outright refusal, had a marked reduction in the odds of suicide admission (COR=0.76 95% CI: 0.72-0.81, p<.0001). Individuals reportedly experiencing extra pyramidal signs and symptoms were less likely to be admitted because of suicide risk (COR=0.82 95% CI: 0.77-0.88, p<.0001). According to the pain **scale,** as pain symptoms increase, we see corresponding modest increase in the odds of suicide admission, with those scoring 3 constituting 'daily severe pain' the group most likely to be admitted because of suicide risk (COR=1.24 95% CI: 1.14-1.34, p<.0001). Both the ADL and IDAL scale demonstrate that while there is an overall reduction in the odds of suicide admission, the odds are lower with poorer ADL and IADL performance, with those most impaired in each domain the least likely (ADL: COR=0.57 95% CI: 0.52-0.63, p<.0001; IADL: COR= 0.54 95% CI: 0.52-0.56, p<.0001).

**Table 12b.** Physical health & functioning by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n= 142,523)

| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
|---|---|---|---|---|---|---|
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | **%** (N) | **%** (N) | **%** (N) | | |
| *Sexual dysfunction* | No | **61.5** (84,367) | **14.5** (19,889) | **24.0** (32,827) | *Reference* | 0.51 |
| | Yes | **52.9** (2,880) | **18.5** (1,008) | **28.5** (1,552) | **1.37** (1.30-1.44)*** | |
| *Self-reported health* | Not in poor health | **61.5** (75,125) | **14.6** (17,868) | **23.9** (29,231) | *Reference* | 0.53 |
| | In poor health | **52.5** (7,700) | **16.9** (2,478) | **30.6** (4,478) | **1.43** (1.38-1.47)*** | |
| | No response | **78.4** (4,442) | **9.8** (551) | **8.9** (670) | **0.44** (0.41-0.47)*** | |
| *Extra Pyramidal Signs and Symptoms* | No | **61.1** (84,814) | **14.7** (20,393) | **24.2** (33,651) | *Reference* | 0.50 |
| | Yes | **66.4** (2,433) | **13.8** (504) | **19.9** (728) | **0.79** (0.74-0.85)*** | |
| *Pain Scale* | 0 | **62.9** (68,600) | **14.5** (15,771) | **22.7** (24,703) | *Reference* | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | **59.5** (8,517) | **14.5** (2,078) | **26.0** (3,715) | **1.17** (1.13-1.21)*** | 0.53 |
| | 2 | **53.9** (8,732) | **15.6** (2,532) | **30.5** (4,934) | **1.47** (1.42-1.51)*** | |
| | 3 | **47.8** (1,184) | **17.8** (440) | **34.4** (851) | **1.82** (1.69-1.96)*** | |
| | 4 | **45.9** (214) | **16.3** (76) | **37.8** (176) | **2.03** (1.71-2.41)*** | |
| *Activities of Daily Living (ADL)* | 0 | **58.6** (71,200) | **15.6** (18,931) | **25.8** (31,337) | *Reference* | 0.54 |
| | 1-3 | **74.4** (12,270) | **10.2** (1,686) | **15.4** (2,541) | **0.49** (0.47-0.51)*** | |
| | 4 | **81.5** (2,067) | **6.6** (166) | **12.0** (304) | **0.33** (0.30-0.37)*** | |
| | 5-6 | **84.6** (1,710) | **5.6** (114) | **9.8** (197) | **0.26** (0.23-0.30)*** | |
| *Instrumental Activities of Daily Living Scale (IADL)* | 0 | **55.5** (49,140) | **16.8** (14,857) | **27.8** (24,602) | *Reference* | 0.58 |
| | 1-3 | **62.6** (10,308) | **13.9** (2,290) | **23.5** (3,875) | **0.76** (0.74-0.79)*** | |
| | 4-9 | **66.8** (9,699) | **12.2** (1,770) | **21.0** (3,049) | **0.64** (0.61-0.66)*** | |
| | 10-18 | **71.6** (7,219) | **11.1** (1,117) | **17.3** (1,745) | **0.51** (0.48-0.53)*** | |
| | 19-30 | **84.7** (10,881) | **6.7** (836) | **8.6** (1,108) | **0.23** (0.22-0.24)*** | |

*Note*. COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

Table 12b tells is that persons experiencing sexual dysfunction are more likely to be designated high risk of suicide than others who are not (COR=1.37 95% CI: 1.30-1.44, p<.0001). Individuals self-reportedly in poor health had substantially greater odds of being higher risk of suicide compared to others who were not (COR=1.43 95% CO: 1.38-1.47, p<.0001), while those who could not or would not respond to rate their overall health had substantially lower odds of being designated high suicide risk (COR=0.44 95% CO: 0.41-0.47, p<.0001). Persons reportedly exhibiting extrapyramidal signs and symptoms (COR=0.79 9% CI: 0.74-0.85, p<.0001) were less likely to be classified as high suicide risk. Higher scores on the pain scale correspond with significantly greater odds of high-risk designation, with persons scoring a 4 'daily excruciating pain' most likely to be classified as high risk (COR=2.03 95% CI: 1.71-2.41, p<.0001). Similar to the pattern described against the primary outcome variable in table 5a, we see an overall reduction in the likelihood of high-risk classification across both the ADL and IADL scales, with the reduction in the odds corresponds with a deterioration in performance where individuals who are more impaired are less likely to be designated high risk of suicide (ADL: COR=0.26 95% CI:0.23-0.30, p<.0001; IADL COR=0.23 95% CI: 0.22-0.24, p<.0001)

## BLOCK 6 – InterRAI Scales

**Table 13a**. InterRAI scales by 'suicide admission' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Admission** | | |
|---|---|---|---|---|
| | | **%** (N) | **COR** (95% CI) | ***C*** |
| *Cognitive Performance Scale (CPS)* | 0 | **48.4** (45,107) | *Reference* | 0.54 |
| | 1-2 | **43.3** (15,476) | **0.81** (0.79-0.83)*** | |
| | 3-6 | **36.8** (5,010) | **0.62** (0.60-0.64)*** | |
| *Severity of Self-harm Scale (SoS)* | 0 | **21.3** (6,638) | *Reference* | 0.74 |
| | 1-3 | **31.6** (17,721) | **1.71** (1.65-1.77)*** | |
| | 4 | **75.7** (15,826) | **11.54** (11.07-12.03)*** | |
| | 5-6 | **73.9** (25,408) | **10.50** (10.10-10.86)*** | |
| *Risk of Harm to Others Scale (RHO)* | 0 | **48.6** (20,325) | *Reference* | 0.52 |
| | 1-3 | **45.2** (31,633) | **0.87** (0.85-0.89)*** | |
| | 4 | **47.2** (6,175) | **0.95** (0.91-0.98)** | |

| | | | | |
|---|---|---|---|---|
| | 5-6 | **42.5** (7,460) | **0.78** (0.76-0.81)*** | |
| *Self-Care Index (SCI)* | 0 | **45.1** (18,792) | *Reference* | 0.53 |
| | 1-3 | **48.5** (32,745) | **1.15** (1.12-1.17)*** | |
| | 4 | **44.6** (8,183) | **0.98** (0.95-1.02) | |
| | 5-6 | **39.5** (5,873) | **0.79** (0.76-0.83)*** | |
| *Social Withdrawal Scale (SWS)* | 0 | **37.9** (23,099) | *Reference* | 0.59 |
| | 1-4 | **45.0** (11,403) | **1.34** (1.30—1.38)*** | |
| | 5-8 | **53.1** (18,610) | **1.86** (1.81-1.91)*** | |
| | 9-12 | **58.7** (12,481) | **2.32** (2.25-2.40)*** | |
| *Depression Rating Scale (DRS)* | 0 | **35.0** (9,112) | *Reference* | 0.58 |
| | 1-3 | **43.1** (25,301) | **1.41** (1.36-1.45)*** | |
| | 4-7 | **52.8** (24,423) | **2.08** (2.02-2.15)*** | |
| | 8-14 | **58.6** (6,757) | **2.63** (2.52-2.75)*** | |
| *Depression Severity Index (DSI)* | 0 | **33.9** (12,597) | *Reference* | 0.62 |
| | 1-3 | **41.6** (18,666) | **1.39** (1.35-1.43)*** | |
| | 4-7 | **50.1** (18,360) | **1.96** (1.90-2.02)*** | |
| | 8-15 | **67.0** (15,970) | **3.96** (3.82-4.10)*** | |
| *Mania Scale (MANIA)* | 0 | **47.4** (31,159) | *Reference* | 0.52 |
| | 1-3 | **46.3** (16,683) | **0.96** (0.93-0.98)** | |
| | 4-8 | **44.6** (12,489) | **0.89** (0.87-0.92)*** | |
| | 9-18 | **41.1** (5,262) | **0.77** (0.75-0.80)*** | |
| *Positive Symptoms Scale – Short (PSSS)* | 0 | **48.7** (37,927) | *Reference* | 0.53 |
| | 1-4 | **44.6** (15,434) | **0.85** (0.83-0.87)*** | |
| | 5-8 | **40.2** (9,106) | **0.71** (0.69-0.73)*** | |
| | 9-12 | **42.2** (3,126) | **0.77** (0.73-0.81)*** | |
| *Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk * p <.05, ** p < .01, ***p < .0001 | | | | |

For the handful of scales tested in this block and reported in Table 13a, the impact on the odds of suicide admission is variable. Predictably, as the severity of self-harm increases according to the severity of self-harm scale so to do the overall odds of suicide admission, with the greatest increase observed among those scoring at the higher levels of suicide risk on this scale; '4' (COR=11.54 95% CI: 11.07-12.03, p<.0001) and '5 to 6' (COR=10.50 95% CI: 10.10-10.86, p<.0001). In a pattern that is consistent with our existing understanding, the odds of suicide admission increase incrementally as the degree of impairment increases according to the depression rating scale**,** with the highest odds of admission seen among those who score between 8 and 14 on this scale denoting the presence of more severe negative mood symptomology (COR=2.63 95% CI: 2.52-2.75, p<.0001). Similarly, the greatest odds of suicide admission seen among those scoring between 8 and 15 on the depression severity index, indicating the presence of more severe depressive symptomology (COR=3.96 95% CI: 3.82-4.10, p<.0001). The social withdrawal scale follows a similar trend, albeit not to quite the same magnitude, where the odds of suicide admission increase incrementally as the degree of impairment increases, with the greatest odds of admission seen among those who score 9 to 12 which indicates a greater level of withdrawal from social activities (COR=2.32 95% CI: 2.25-2.40, p<.0001). Conversely, we note an overall reduction in the odds of suicide admission for those that score across the risk of harm to others scale, producing an inconsistent pattern as the risk of harm to others increases, with the odds of admission being lowest for those scoring the highest level of impairment '5 to 6' (COR=0.78 95% CI:

0.76-0.81, p<.0001). We also observe and inconsistent pattern against the self-care index, where the odds of suicide admission are increased among those that score 1 to 3 on this scale, but as the level of impairment increases, the odds of suicide admission tentatively reduce, non-significantly for those who score 4, and significantly for those who score 5 to 6 (COR=0.79 95% CI: 0.76-0.83, p<.0001). For the cognitive performance scale, we see a marked reduction in the odds of suicide admission as the degree of impairment increases, where those most impaired at level 3 to 6 the least likely to be admitted (COR= 0.62 95% CI: 0.60-0.64, p<.0001). For both the mania scale and the positive symptom scale – short, we see fairly comparable overall reductions in the odds of suicide admission that tends to fall as the degree of impairment increases, with persons scoring 9 to 18 on the Mania scale least likely to experience suicide admission (COR= 0.77 95% CI: 0.75-0.80, p<.0001), and persons scoring 5 to 8 on the PSSS the least likely to be admitted (COR= 0.71 95% CI: 0.69-0.73, p<.0001).

**Table 13b.** interRAI scales by 'suicide risk level' among psychiatric inpatients in Ontario, 2005-2019 (n = 142,523)

| **Variable** | **Level** | **Suicide Risk Level** | | | **COR** (95% CI) | ***C*** |
|---|---|---|---|---|---|---|
| | | ***Low*** | ***Moderate*** | ***High*** | | |
| | | **%** (N) | **%** (N) | **%** (N) | | |
| *Risk of Harm to Others Scale (RHO)* | 0 | **60.4** (25,273) | **14.9** (6,227) | **24.7** (10,344) | *Reference* | 0.54 |
| | 1-3 | **58.7** (41,117) | **15.5** (10,830) | **25.8** (18,105) | **1.07** (1.04-1.10)*** | |
| | 4 | **60.4** (7,899) | **13.8** (1,801) | **25.9** (3,388) | **1.02** (0.98-1.06) | |
| | 5-6 | **73.9** (12,958) | **11.6** (2,039) | **14.5** (2,542) | **0.54** (0.52-0.56)*** | |
| *Self-Care Index (SCI)* | 0 | **56.4** (23,507) | **14.8** (6,183) | **28.8** (12,008) | *Reference* | 0.55 |
| | 1-3 | **59.8** (40,415) | **15.7** (10,603) | **24.5** (16,563) | **0.85** (0.83-0.87)*** | |
| | 4 | **66.3** (12,176) | **13.6** (2,495) | **20.1** (3,683) | **0.64** (0.62-0.67)*** | |
| | 5-6 | **74.9** (11,149) | **10.9** (1,616) | **14.3** (2,125) | **0.43** (0.41-0.44)*** | |
| *Social Withdrawal Scale (SWS)* | 0 | **71.3** (43,400) | **10.1** (6,153) | **18.6** (11,348) | *Reference* | 0.60 |
| | 1-4 | **62.9** (15,934) | **13.3** (3,374) | **23.8** (6,016) | **1.45** (1.41-1.49)*** | |
| | 5-8 | **51.7** (18,103) | **18.9** (6,602) | **29.5** (10,319) | **2.18** (2.12-2.23)*** | |
| | 9-12 | **46.1** (9,810) | **22.4** (4,768) | **31.5** (6,696) | **2.57** (2.49-2.65)*** | |
| *Mania Scale (MANIA)* | 0 | **57.4** (37,697) | **15.4** (10,122) | **27.2** (17,872) | *Reference* | 0.55 |
| | 1-3 | **59.8** (21,551) | **15.0** (5,411) | **25.2** (9,090) | **0.91** (0.88-0.93)*** | |
| | 4-8 | **65.6** (18,354) | **14.2** (3,964) | **20.2** (5,664) | **0.70** (0.68-0.72)*** | |
| | 9-18 | **75.4** (9,645) | **10.9** (1,400) | **13.7** (1,753) | **0.44** (0.42-0.46)*** | |

*Note.* COR = crude odds ratio; CI = confidence interval. % indicates the percentage of persons admitted due to suicide risk
* p <.05, ** p < .01, ***p < .0001

In Table 13b, similar to before, the impact this smaller list of scales tested in this block had against the secondary outcome was variable, reduced due to reasons of multicollinearity. We see a substantial incremental increase in the odds of high-risk classification as the degree of impairment increases according to the social withdrawal scale, with the greatest odds of high suicide risk designation seen among those scoring 9 to 12 (COR= 2.57 95% CI: 2.49-2.465, p<.0001). The COR estimates for the risk of harm to others scale tell us that although there is a modest increase in the odds of high-risk classification among those scoring 1 to 3 and 4 on this scale, however, these effects fall outside the pre-specified effect size threshold in this study, while conversely those that score 6 to 9 are substantially less likely to be classified as high risk of suicide (COR= 0.54 95% CI: 0.52-0.56, p<.0001).

According to the self-care index, as the degree of a person's ability to properly care for themselves declines, so does the odds of high suicide risk designation, with the least likely to be designated high risk persons who score between 5 and 6 (COR= 0.43 95% CI: 0.41-0.44, p<.0001).

# Multivariate Analyses

This section will report the model building protocol applied in this study before presenting two final multivariate logistic regression models that detail the predictors of suicide admission and the predictors of suicide risk severity at admission. Independent variables for each model were selected based on the descriptive statistics provided above. To create the final models for each outcome, two sets of preliminary multivariate logistic regression models were constructed using the same block format as that applied in the bivariate analyses. Statistically significant variables from the bivariate stage that also fell outside pre-determined COR parameters (< 0.83 or >1.20) were used, and each block of these items was separately modelled to ascertain significance between a smaller set of variables and each dependent variable. Within each preliminary model, variables that were not statistically significant and those that produced estimates that fell within the pre-defined OR parameters (between 0.83 & 1.20) were removed, and the model was re-run. Non-significance is identified as p >.05. Prior to running the preliminary models, CAPs that contained one or more RAI-MH items or scales as part of their algorithm were removed and tested in a separate model, since both could not be analyzed simultaneously. For example, in Block 2 for the primary outcome several sub-classified models were created (2a, b, c, & d,) because there was substantial structural and associational collinearity between the array of CAPs in this block. This collinearity is mapped in table 7 to support decision making. The most appropriate combination of variables in each block model was chosen on the basis of trying to achieve the greatest parsimony in the final model, while the c statistic for each block model was also taken into consideration. Sex interactions were tested for a small sample of variables in each final model, the selection of which was guided by the literature and the researchers own clinical judgement. The statistical significance threshold used for interaction terms was p >0.01.

## Block Modeling the Primary Outcome – *Suicide Admission*

The following section presents the 6-block modeling process of RA-MH variables that leads to the creation of the final binary multivariate logistic regression model for the primary outcome, suicide admission.

## Block Model 1

| **Table 14.** Block Model 1 – Demographic variables by suicide admission | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Sex* | Males | **0.89** (0.87-0.90)*** | 0.58 |
| *Age group* | 45 to 64 | **0.85** (0.83-0.87)*** | |
| | 65+ | **0.62** (0.60-0.64)*** | |
| *Forensic admission* | Yes | **0.17** (0.16-0.19)*** | |
| *Education & Employment CAP* | 1 | **1.27** (1.23-1.32)*** | |
| | 2 | **0.95** (0.92-0.98)** | |
| *Previous contact with CMH* | > 31 days | **0.81** (0.78-0.83)*** | |
| | < 30 days | **0.76** (0.75-0.78)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the demographic variables tested against suicide admission in block model 1 (Table 14), (1) 'age', (2) 'forensic admission', (3) 'education and employment CAP', and (4) 'previous contact with community mental health services' produced significant OR estimates of an acceptable magnitude. Although 'sex' was also significant, it did not produce a sufficiently large effect size but was nevertheless retained on the basis of its theoretical importance to this study. It is worth pointing out that although the 'employment status' variable did generate a COR estimate outside the effect size parameters for those designated 'other' in the bivariate stage (Table 1a), this variable was excluded in this stage of model building process in favor of the education and employment CAP.

## Block Model 2

| **Table 15.** Block Model 2 – Stress exposure variables by suicide admission | | | |
|---|---|---|---|
| ***Block Model 2a*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Distress about health of another person* | >1 year | **0.91** (0.88-0.94)*** | 0.60 |
| | <1 year | **0.84** (0.81-0.87)*** | |
| *Death of close family member or friend* | >1 year | **0.88** (0.86-0.91)*** | |
| | <1 year | **0.90** (0.86-0.94)*** | |
| *Child custody issue* | >1 year | **0.81** (0.79-0.84)*** | |
| | <1 year | **1.14** (1.08-1.21)*** | |
| *Conflict laden or severed relationship* | >1 year | **1.22** (1.19-1.26)*** | |
| | <1 year | **1.66** (1.61-1.71)*** | |
| *Major loss of income or serious economic hardship due to poverty* | >1 year | **1.17** (1.13-1.21)*** | |
| | <1 year | **1.25** (1.21-1.30)*** | |
| *Review hearing* | >1 year | **0.75** (0.70-0.81)*** | |
| | <1 year | **0.57** (0.53-0.61)*** | |
| *Immigration including refugee status* | >1 year | **0.83** (0.80-0.86)*** | |
| | <1 year | **0.63** (0.56-0.70)*** | |
| *Lived in war zone or area of violent conflict* | >1 year | **1.00** (0.93-1.07) | |

| | | | |
|---|---|---|---|
| | <1 year | **1.23** (1.00-1.52)* | |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | >1 year | **0.63** (0.60-0.66)*** | |
| | <1 year | **0.53** (0.48-0.58)*** | |
| *Victim of crime* | >1 year | **0.74** (0.70-0.77)*** | |
| | <1 year | **0.83** (0.75-0.90)*** | |
| *Victim of sexual assault/abuse* | >1 year | **1.25** (1.21-1.30)*** | |
| | <1 year | **1.19** (1.10-1.29)*** | |
| *Victim of emotional abuse* | >1 year | **1.17** (1.13-1.21)*** | |
| | <1 year | **1.11** (1.06-1.17)*** | |
| *Parental abuse of alcohol or drugs* | >1 year | **0.86** (0.83-0.89)*** | |
| | <1 year | **0.57** (0.53-0.61)*** | |
| *Life event causes sense of horror or intense fear* | Yes | **1.21** (1.17-1.26)*** | |
| | No response | **0.85** (0.80-0.90)*** | |
| ***Block Model 2b*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Child custody issues* | >1 year | **0.78** (0.76-0.80)*** | 0.59 |
| | <1 year | **1.12** (1.06-1.18)*** | |
| *Conflict laden or severed relationship* | >1 year | **1.23** (1.19-1.26)*** | |
| | <1 year | **1.62** (1.57-1.67)*** | |
| *Review hearing* | >1 year | **0.75** (0.70-0.80)*** | |
| | <1 year | **0.58** (0.54-0.62)*** | |
| *Immigration including refugee status* | >1 year | **0.80** (0.78-0.83)*** | |
| | <1 year | **0.58** (0.52-0.65)*** | |
| *Parental abuse of alcohol or drugs* | >1 year | **0.82** (0.80-0.85)*** | |
| | <1 year | **0.50** (0.47-0.54)*** | |
| *Trauma CAP* | 1 | **1.08** (1.04-1.12)*** | |
| | 2 | **1.18** (1.13-1.24)*** | |
| *Personal Finances CAP* | 1 | **0.70** (0.68-0.72)*** | |
| | 2 | **1.10** (1.07-1.14)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the stress exposure variables tested in block model 2a against suicide admission (Table 15), 10 of the 14 tested produced significant and sufficiently strong effects to be considered for further analyses: (1) 'child custody issue', (2) 'conflict laden or severed relationship', (3) 'major loss of income or serious economic hardship due to poverty', (4) 'review hearing', (5) 'immigration or refugee status', (5) 'lived in war zone or area of violent conflict', (6) 'witness to severe accident, disaster, act of terrorism, violence or abuse', (7) 'victim or crime', (8) 'victim of sexual assault/abuse', (9) 'parental abuse of alcohol or drugs', and (10) 'life event causes sense of intense horror or fear'. Block model 2b removed multiple of the aforementioned variables from block 2a that are structurally embedded within the Trauma CAP, including: (5) 'lived in war zone', (6) 'witness to severe accident, disaster, act of terrorism, violence or abuse', (7) 'victim of crime', (8) 'victim of sexual assault', (10) 'life event causes sense of intense horror or fear'. Variable (3) 'major loss of income or serious economic hardship' was also removed from block model 2b due to its conceptual relationship to the Personal Finances CAP. In pursuit of parsimony, and with a negligible difference in c statistic between the two models, block model 2b is preferred over block model 2a and will be carried forward into the multivariate modeling stage.

## Block Model 3

| **Table 16.** Block Model 3 – Mental illness by suicide admission | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Neurodevelopmental disorder* | Yes | **0.94** (0.87-1.00) | 0.63 |
| *Schizophrenia & Psychotic disorders* | Yes | **0.90** (0.87-0.92)*** | |
| *Mood disorders* | Yes | **2.19** (2.13-2.25)*** | |
| *Dissociative disorders* | Yes | **1.40** (1.09-1.78)** | |
| *Eating disorders* | Yes | **0.43** (0.39-0.48)*** | |
| *Sexual & gender identity disorders* | Yes | **1.63** (1.25-2.13)** | |
| *Neurocognitive disorders* | Yes | **0.61** (0.59-0.63)*** | |
| *Personality disorders* | Yes | **2.55** (2.45-2.66)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the mental illness variables tested in block model 3 (Table 16), (1) 'mood disorders', (2) 'dissociative disorders', (3) 'eating disorders', (4) 'sexual and gender identity disorders', (5) 'neurocognitive disorders', and (6) 'personality disorders' each produced significant odds ratio estimates of sufficient magnitude to be considered eligible for further analyses.

## Block Model 4

| **Table 17.** Block Model 4 – Substance use & addictions by suicide admission | | | |
|---|---|---|---|
| ***Block Model 4a*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Alcohol* | Yes | **1.22** (1.18-1.26)*** | 0.53 |
| *Inhalants* | Within last year | **1.24** (1.07-1.44)** | |
| | Within last month | **1.51** (1.28-1.77)*** | |
| *Hallucinogens* | Within last year | **1.20** (1.09-1.32)** | |
| | Within last month | **1.45** (1.30-1.62)*** | |
| *Cocaine* | Within last year | **0.77** (0.72-0.81)*** | |
| | Within last month | **1.03** (0.98-1.08) | |
| *Stimulants* | Within last year | **0.94** (0.86-1.02) | |
| | Within last month | **1.26** (1.19-1.34)*** | |
| *Opioids* | Within last year | **0.77** (0.70-0.84)*** | |
| | Within last month | **0.75** (0.71-0.79)*** | |
| ***Block Model 4b*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Substance Use CAP* | 1 | **0.75** (0.72-0.79)*** | 0.55 |
| | 2 | **1.43** (1.40-1.47)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the substance use and addiction variables tested in block model 4a (Table 17), (1) 'alcohol', (2) 'inhalants', (3) 'hallucinogens', (4) 'cocaine', (5) 'stimulants', and (6) 'opioids' each produced significant odds ratio estimates of sufficient magnitude to be considered eligible for further analysis. Block model 4b reported in the same table (Table 10) contains only the substance use CAP, which uses all of the aforementioned variables in its computation. Subsequently block model 4b will

be carried forward to the final model construction stage for the sake of parsimony. This decision is supported by a preferable c statistic value for block model 4b (0.55 vs 0.53).

## Block Model 5

| **Table 18.** Block Model 5 – Physical health & functioning by suicide admission | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Sexual dysfunction* | Yes | **0.63** (0.59-0.66)*** | 0.56 |
| *Self-reported health* | In poor health | **1.09** (1.05-1.13)*** | |
| | No response | **0.98** (0.93-1.04) | |
| *EPSEs* | Yes | **0.92** (0.86-0.99)* | |
| *Pain scale* | 1 | **0.89** (0.85-0.92)*** | |
| | 2 | **1.06** (1.03-1.10)** | |
| | 3 | **1.26** (1.16-1.36)*** | |
| | 4 | **1.04** (0.87-1.25) | |
| *ADL* | 1-3 | **0.96** (0.92-1.00)* | |
| | 4 | **0.94** (0.86-1.03) | |
| | 5-6 | **0.87** (0.79-0.97)** | |
| *IADL* | 1-3 | **0.82** (0.79-0.85)*** | |
| | 4-9 | **0.70** (0.68-0.73)*** | |
| | 10-18 | **0.66** (0.63-0.69)*** | |
| | 19-30 | **0.56** (0.53-0.59)*** | |
| *Note*. OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the physical health and functioning variables tested in block model 5 (Table 18), (1) 'sexual dysfunction', (2) 'pain scale', and (3) the 'IADL scale' each produced significant changes in their respective odds ratio estimates making them eligible for further analysis.

## Block Model 6

| **Table 19.** Block Model 6 – InterRAI scales by suicide admission | | | |
|---|---|---|---|
| ***Block Model 6a*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Severity of Self-harm Scale* | 1-3 | **1.64** (1.59-1.70)*** | 0.75 |
| | 4 | **10.54** (10.10-10.99)*** | |
| | 5-6 | **9.73** (9.37-10.09)*** | |
| *Social Withdrawal Scale* | 1-4 | **1.16** (1.12-1.20)*** | |
| | 5-8 | **1.34** (1.30-1.38)*** | |
| | 9-12 | **1.54** (1.48-1.59)*** | |
| *Mania Scale* | 1-3 | **0.94** (0.91-0.97)*** | |
| | 4-8 | **0.98** (0.95-1.01) | |
| | 9-18 | **1.03** (0.99-1.08) | |
| ***Block Model 6b*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Risk of Harm to Others Scale* | 1-3 | **0.80** (0.78-0.82)*** | 0.64 |
| | 4 | **1.02** (0.97-1.06) | |
| | 5-6 | **1.04** (1.00-1.09) | |
| *Cognitive Performance Scale* | 1-2 | **0.80** (0.78-0.82)*** | |
| | 3-6 | **0.67** (0.64-0.70)*** | |
| *Social Withdrawal Scale* | 1-4 | **1.24** (1.20-1.28)*** | |

| | | | |
|---|---|---|---|
| | 5-8 | **1.46** (1.42-1.50)*** | |
| | 9-12 | **1.64** (1.58-1.70)*** | |
| *Depression Severity Index* | 1-3 | **1.32** (1.28-1.36)*** | |
| | 4-7 | **1.76** (1.71-1.82)*** | |
| | 8-15 | **3.29** (3.17-3.42)*** | |
| *Mania Scale* | 1-3 | **0.90** (0.87-0.92)*** | |
| | 4-8 | **0.86** (0.84-0.89)*** | |
| | 9-18 | **0.83** (0.80-0.87)*** | |
| ***Block Model 6c*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Risk of Harm to Others Scale* | 1-3 | **0.82** (0.80-0.84)*** | 0.63 |
| | 4 | **0.99** (0.95-1.03) | |
| | 5-6 | **0.95** (0.91-0.99)* | |
| *Cognitive Performance Scale* | 1-2 | **0.76** (0.74-0.78)*** | |
| | 3-6 | **0.60** (0.58-0.62)*** | |
| *Social Withdrawal Scale* | 1-4 | **1.29** (1.25-1.33)*** | |
| | 5-8 | **1.65** (1.61-1.70)*** | |
| | 9-12 | **1.94** (1.87-2.01)*** | |
| *Depression Rating Scale* | 1-3 | **1.34** (1.29-1.38)*** | |
| | 4-7 | **1.92** (1.86-1.99)*** | |
| | 8-14 | **2.44** (2.33-2.57)*** | |
| *Mania Scale* | 1-3 | **0.89** (0.86-0.91)*** | |
| | 4-8 | **0.82** (0.79-0.84)*** | |
| | 9-18 | **0.72** (0.69-0.76)*** | |
| ***Block Model 6d*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Positive Symptom Scale Short* | 1-4 | **0.97** (0.95-1.00) | 0.64 |
| | 5-8 | **0.86** (0.83-0.89)*** | |
| | 9-12 | **0.91** (0.86-0.96)** | |
| *Social Withdrawal Scale* | 1-4 | **1.24** (1.20-1.28)*** | |
| | 5-8 | **1.46** (1.42-1.50)*** | |
| | 9-12 | **1.64** (1.58-1.70)*** | |
| *Depression Severity Index* | 1-3 | **1.30** (1.26-1.34)*** | |
| | 4-7 | **1.69** (1.64-1.75)*** | |
| | 8-15 | **3.10** (2.98-3.22)*** | |
| *Mania Scale* | 1-3 | **0.90** (0.87-0.92)*** | |
| | 4-8 | **0.90** (0.87-0.93)*** | |
| | 9-18 | **0.92** (0.88-0.96)** | |
| *Cognitive Performance Scale* | 1-2 | **0.82** (0.80-0.84)** | |
| | 3-6 | **0.70** (0.68-0.73)** | |
| ***Block Model 6e*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Positive Symptom Scale Short* | 1-4 | **0.91** (0.89-0.94)*** | 0.63 |
| | 5-8 | **0.76** (0.73-0.78)*** | |
| | 9-12 | **0.78** (0.74-0.82)*** | |
| *Social Withdrawal Scale* | 1-4 | **1.29** (1.25-1.33)*** | |
| | 5-8 | **1.64** (1.60-1.69)*** | |
| | 9-12 | **1.93** (1.86-2.00)*** | |
| *Depression Rating Scale* | 1-3 | **1.33** (1.28-1.37)*** | |
| | 4-7 | **1.89** (1.82-1.95)*** | |
| | 8-14 | **2.38** (2.26-2.50)*** | |
| *Cognitive Performance Scale* | 1-2 | **0.79** (0.77-0.81)*** | |

| | | | |
|---|---|---|---|
| | 3-6 | **0.64** (0.61-0.66)*** | |
| *Mania Scale* | 1-3 | **0.90** (0.87-0.92)*** | |
| | 4-8 | **0.87** (0.84-0.89)*** | |
| | 9-18 | **0.82** (0.79-0.86)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Although a number of the scales tested in block model 6 (Table 19) produced significant odds ratio estimates sufficient for further consideration, sub-block model 6a will continue to the multivariate stage due to the largest effect sizes seen against the 'SOS scale', as well as the markedly higher c statistic for 6a (0.75) compared to the c statistic estimates produced by each of the other sub-blocks in this model; d (0.64), c (0.63), d (0.64), and e (0.63).

## Combined Modeling – *Suicide Admission*

The application of combined modeling protocols in this study meant that all variables tested in each respective block that exceeded the parameters of the pre-defined odds ratio effect size threshold (< 0.83 or > 1.20) *and* were statistically significant at the <.05 level were combined and tested together. Each stage of combined modelling identified variables that were statistically significant at the <.05 level and that exceeded the effect size parameters (< 0.83 or > 1.20), while systematically removing variables that did not meet these criteria across several iterations as combined models were re-run until all the variables left were significant and produced a sufficient effect magnitude in either direction. Changes in the c statistic for each combined model were also monitored to ensure the models tested remained or achieved an acceptable degree of fit.

**Table 20.** Block variables included in the suicide admission model building process

| **Variables** | **Model 1** | **Model 2** | **Model 3** | **Final Model** |
|---|---|---|---|---|
| **Block 1** | | | | |
| *Sex* | X | X | X | X |
| *Age group* | X | X | X | X |
| *Forensic admission* | X | X | X | X |
| *Previous contact with CMH services* | X | X | X | X |
| *Education & Employment CAP* | X | - | - | - |
| **Block 2** | | | | |
| *Child custody issues* | X | X | X | X |
| *Conflict laden or severed relationship* | X | X | X | X |
| *Major loss of income/serious economic hardship* | X | - | - | - |
| *Review hearing* | X | - | - | - |
| *Immigration/refugee status* | X | - | - | - |
| *Lived in warzone* | X | X | X | X |
| *Witness to severe accident/disaster/terrorism* | X | X | X | X |
| *Victim of crime* | X | X | X | X |
| *Victim of sexual assault/abuse* | X | - | - | - |
| *Parental abuse of drugs or alcohol* | X | X | X | X |
| *Subjective horror* | X | - | - | - |

| | | | | |
|---|---|---|---|---|
| **Block 3** | | | | |
| *Mood disorders* | X | X | X | X |
| *Dissociative identity disorders* | X | X | X | X |
| *Eating disorders* | X | X | X | X |
| *Sexual & gender identity disorders* | X | - | - | - |
| *Neurocognitive disorders* | X | - | - | - |
| *Personality disorders* | X | X | X | X |
| **Block 4** | | | | |
| *Substance use CAP* | X | X | - | - |
| **Block 5** | | | | |
| *Sexual dysfunction* | X | X | X | X |
| *Pain Scale* | X | X | X | X |
| *IADL Scale* | X | - | - | - |
| **Block 6** | | | | |
| *Severity of Self-harm Scale* | X | X | X | X |
| *Social Withdrawal Scale* | X | X | X | X |
| **C-statistic** | **0.79** | **0.79** | **0.79** | **0.79** |

## Combined Model 1:

Combined model 1 for suicide admission (Table 20**)** contained and tested together all variables from each block that exceeded the pre-defined odds ratio effect size threshold (< 0.83 or > 1.20) *and* were statistically significant. For variables to continue on the second round of combined modelling, they must also adhere to the effect size threshold convention and meet statistical significance at the <.05 level. Variables (1) 'review hearing', (2) 'immigration or refugee status', (3) 'victim of sexual assault/abuse', (4) 'life event caused sense of horror or intense fear', and (5) 'sexual or gender identity disorders' ceased to be significant in this combined model and were therefore discarded before the model was re-run. Although (6) 'major loss of income or serious economic hardship due to poverty', (7) 'neurocognitive disorder' and (8) 'IADL scale' achieved significance, these 3 variables did not necessarily exceed the pre-defined effect size threshold parameters required to be included in further analyses. The c-statistic of 0.79 falls within the pre-specified parameters considered acceptable for good model fit.

## Combined Model 2:

All variables carried over from combined model 1 and re-tested in combined model 2 produced statistically significant effects on suicide admission at the p <.05 level. Although significant, the 'substance use CAP' at either trigger level (((trigger level 1) COR= 0.82 95% CI: 0.77-0.86, p<.0001) ((trigger level 2) COR= 1.15 95% CI: 1.12-1.18, p<.0001)) did not meet the required effect size to warrant further consideration, and so was removed before the model was re-run. The c-statistic was unchanged from combined model 1 (0.79) and therefore remains an acceptable model fit estimate.

## Combined Model 3:

Apart from the substance use CAP which has been removed, all remaining variables carried over from combined model 2 and re-tested were significant against suicide admission and produced sufficiently large enough effect sizes to be retained in the final model. No variables were removed at the combined model 3 stage. Again, the c-statistic was unchanged (0.79) and therefore remains an acceptable model fit estimate.

## Final Model:

The final multivariate binary logistic regression model (Table 14) predicting the likelihood a person will be admitted to an inpatient psychiatric facility because they are at risk of suicide contains the following 24 variables: (1) 'sex', (2) 'age group', (3) 'forensic status', (4) 'previous contact with community mental health services', (5) 'education and employment CAP', (6) 'severity of self-harm scale', (7) 'social withdrawal scale', (8) 'child custody issues', (9) 'conflict laden or severed relationship', (10) 'lived in a warzone', (11) 'witness to a severe accident, disaster, act of terrorism, violence or abuse', (12) 'victim of crime', (13) 'parental abuse of drugs or alcohol', (14) 'mood disorders', (15) 'dissociative disorders', (16) 'eating disorders', (16) 'personality disorders', (17) 'pain scale', and (18) the 'IADL scale'. The model fit statistic, which remained stable throughout at c = 0.79, is considered acceptable for a final multivariate binary logistic regression model.

## Testing Interaction Terms:

The following variables in the final suicide admission model were tested as sex interaction terms: (1) 'age', (2) 'severity of self-harm scale', (3) 'social withdrawal scale', (4) 'interpersonal conflict CAP', and (5) 'mood disorders'; among which (1) 'age', (2) 'severity of self-harm scale', and (5) 'mood disorders', each produced statistically significant interaction terms.

**Table 21.** Final Model – Suicide Admission

| **Variable** | **Level** | **PE** (SE) | **AOR** (95% CI) | **P** |
|---|---|---|---|---|
| *Sex* | Male | **-0.23** (0.03) | See figure X for interaction | - |
| *Age group* | 45-64 | **-0.25** (0.02) | See figure X for interaction | - |
| | 65+ | **-0.41** (0.03) | See figure X for interaction | - |
| *Forensic status* | Yes | **-1.51** (0.05) | **0.22** (0.20-0.25) | <.0001 |
| *Previous contact w/CMH* | > 31 days | **-0.27** (0.02) | **0.76** (0.74-0.79) | <.0001 |
| | < 30 days | **-0.38** (0.01) | **0.68** (0.67-0.70) | <.0001 |
| *Severity of Self-harm Scale* | 1-3 | **0.50** (0.03) | See figure X for interaction | - |
| | 4 | **2.22** (0.03) | See figure X for interaction | - |
| | 5-6 | **2.21** (0.03) | See figure X for interaction | - |
| *Social Withdrawal Scale* | 1-4 | **0.15** (0.02) | **1.17** (1.13-1.21) | <.0001 |
| | 5-8 | **0.25** (0.02) | **1.29** (1.25-1.33) | <.0001 |
| | 9-12 | **0.38** (0.02) | **1.47** (1.41-1.52) | <.0001 |
| *Child custody issues* | >1 year | **-0.24** (0.02) | **0.79** (0.76-0.82) | <.0001 |
| | <1 year | **0.04** (0.03) | **1.04** (0.98-1.11) | 0.22 |
| *Conflict laden or severed relationship* | >1 year | **0.11** (0.02) | **1.11** (1.08-1.15) | <.0001 |
| | <1 year | **0.22** (0.02) | **1.25** (1.21-1.29) | <.0001 |

| | | | | |
|---|---|---|---|---|
| *Lived in war zone or area of violent conflict* | >1 year | **0.06** (0.04) | **1.06** (0.98-1.14) | 0.13 |
| | <1 year | **0.35** (0.11) | **1.43** (1.14-1.78) | <.01 |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | >1 year | **-0.55** (0.03) | **0.57** (0.55-0.60) | <.0001 |
| | <1 year | **-0.72** (0.05) | **0.49** (0.44-0.54) | <.0001 |
| *Victim of crime* | >1 year | **-0.25** (0.03) | **0.78** (0.73-0.82) | <.0001 |
| | <1 year | **-0.12** (0.05) | **0.88** (0.80-0.98) | <.05 |
| *Parental abuse of drugs or alcohol* | >1 year | **-0.22** (0.20) | **0.81** (0.77-0.84) | <.0001 |
| | <1 year | **-0.61** (0.04) | **0.54** (0.50-0.59) | <.0001 |
| *Mood disorders* | Yes | **0.36** (0.02) | See figure X for interaction | - |
| *Dissociative identity disorders* | Yes | **0.28** (0.14) | **1.32** (1.01-1.73) | <.05 |
| *Eating disorders* | Yes | **-1.06** (0.06) | **0.35** (0.31-0.39) | <.0001 |
| *Personality disorders* | Yes | **0.66** (0.02) | **1.93** (1.84-2.03) | <.0001 |
| *Sexual dysfunction* | Yes | **-0.63** (0.03) | **0.54** (0.50-0.57) | <.0001 |
| *Pain Scale* | 1 | **-0.21** (0.02) | **0.81** (0.78-0.84) | <.0001 |
| | 2 | **-0.09** (0.02) | **0.91** (0.88-0.95) | <.0001 |
| | 3 | **-0.05** (0.02) | **0.96** (0.87-1.05) | 0.34 |
| | 4 | **-0.18** (0.11) | **0.83** (0.67-1.03) | 0.10 |
| Model c statistic: **0.79** | | | | |

*Note.* PE = parameter estimate; SE = standard error. AOR = adjusted odds ratio; CI = confidence interval. P = p-value.

Table 21 presents the final model for the primary outcome, suicide admission. Persons maintaining forensic status at admission were substantially less likely to be admitted because of suicidality (AOR= 0.22 95% CI: 0.20-0.25, p<.0001), while overall persons who had had previous contact with community mental health services were less likely to be admitted for suicidality, particularly for contact less than 30 days ago (AOR= 0.68 95% CI: 0.67-0.70, p<.0001). Increasing scores on the social withdrawal scale are associated with incrementally greater odds of suicide admission, with those scoring at the top level between 9 and 12 the most likely (AOR= 1.47 95% CI: 1.41-1.52, p<.0001). Persons reportedly experiencing child custody issues were less likely to experience suicide admission if these issues were further in the past (i.e., more than 1 year ago), but slightly more likely if these issues were more recent (i.e., within the last year) (AOR= 1.04 95% CI: 0.98-1.11, p 0.22), however the proximal association was statistically insignificant with a 95% CO containing 1. Persons reportedly exposed to a conflict laden or severed relationship were overall more likely to be admitted to an inpatient facility with suicidality, particularly if this exposure was more recent (i.e., within the last year) (AOR= 1.25 95% CI: 1.21-1.29, p<.0001). Persons who reported living in a war zone or area of violent conflict were similarly more likely to be admitted for suicidality overall, however, those that reported this exposure more than 1 year ago produced an AOR estimate with a small and insignificant effect size, whereas those that were exposed more recently (i.e., within the last year) produced a substantial increase in the odds, albeit with a much wider 95% CI, that was this time statistically significant (AOR= 1.43 95% CI: 1.14-1.78, p<.01). We observed a significant overall reduction in the odds of suicide admission among persons who reported bearing witness to severe accident, disaster, act of terrorism, violence or abuse, especially if the event was more recent (i.e., within the last year) (AOR= 0.49 95% CI: 0.44-0.54, p<.0001). And those that had previously been a victim of crime were overall less likely to be admitted for suicidality, particularly if this exposure occurred

more than 1 year ago (AOR= 0.78 95% CI: 0.73-0.82, p<.0001). Persons who reported witnessing parental abuse of alcohol or drugs were overall less likely to be admitted for suicidality, particularly if this reportedly occurred within the last year (AOR= 0.54 95% CI: 0.50-0.59, p<.0001). Persons with personality disorders (AOR= 1.93 95% CI: 1.84-2.03, p<.0001) and dissociative identity disorders (AOR= 1.32 95% CI: 1.01-1.73, p<.05) both had greater odds of suicide admission compared to those who did not; while persons with eating disorders had substantially reduced odds of suicide admission (AOR= 0.35 95% CI: 0.31-0.39, p<.0001). Persons reportedly experiencing sexual dysfunction were substantially less likely to experience suicide admission (AOR= 0.54 95% CI: 0.50-0.57, p<.0001). Among those reporting varying levels of pain according to the pain scale, we see a non-linear but nevertheless overall reduction in the odds of suicide admission, with persons reporting daily severe pain among the least less likely to be admitted for suicidality (AOR= 0.96 95% CI: 0.87-1.05, p 0.34), and those reporting less than daily pain the least likely to be admitted for suicidality (AOR= 0.81 95% CI: 0.78-0.84, p<.0001).

## Interpretation of Interaction Terms

The following section will describe the sex interaction terms tested between (1) 'age', (2) 'severity of self-harm scale', and (3) 'mood disorders' against suicide admission.

### Interaction 1 – *Sex & Age*

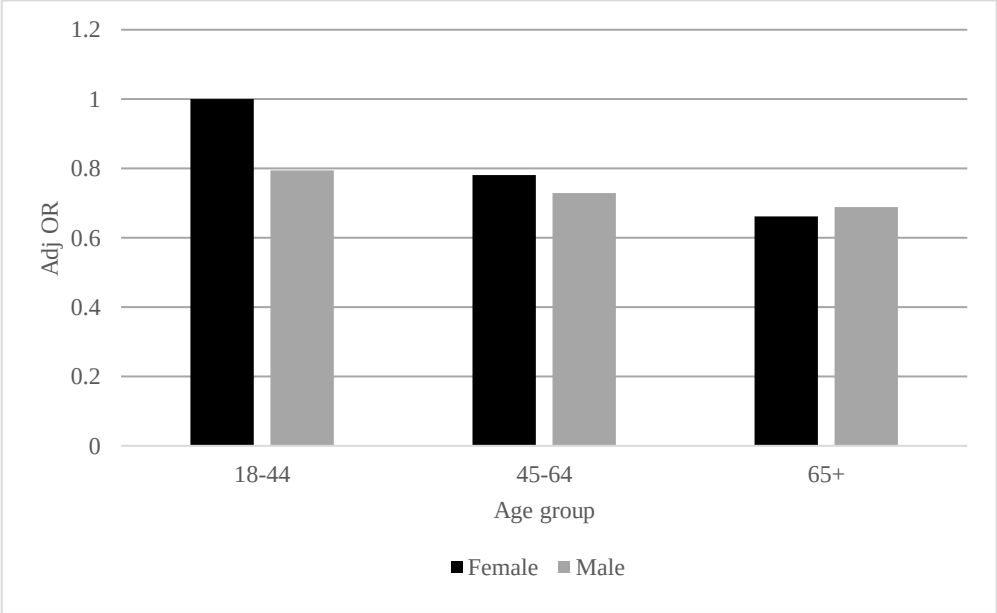


**Figure 6.** Interaction between sex & age against suicide admission

Figure 6 depicts the interaction between 'sex' and 'age' against suicide admission. The sex gap is strongest in younger persons (18-44), where men (OR: 0.79) have lower odds of suicide admission

than women (OR: 1.00 *reference*). This sex difference narrows with age, women aged 45-64 have slightly greater odds of suicide admission (OR: 0.78) than men (OR: 0.73), and we see a slight reversal among those 65+ where men (OR=0.69) have slightly higher odds of suicide admission than women (OR=0.66).

### Interaction 2 – *Sex & Severity of Self-Harm*

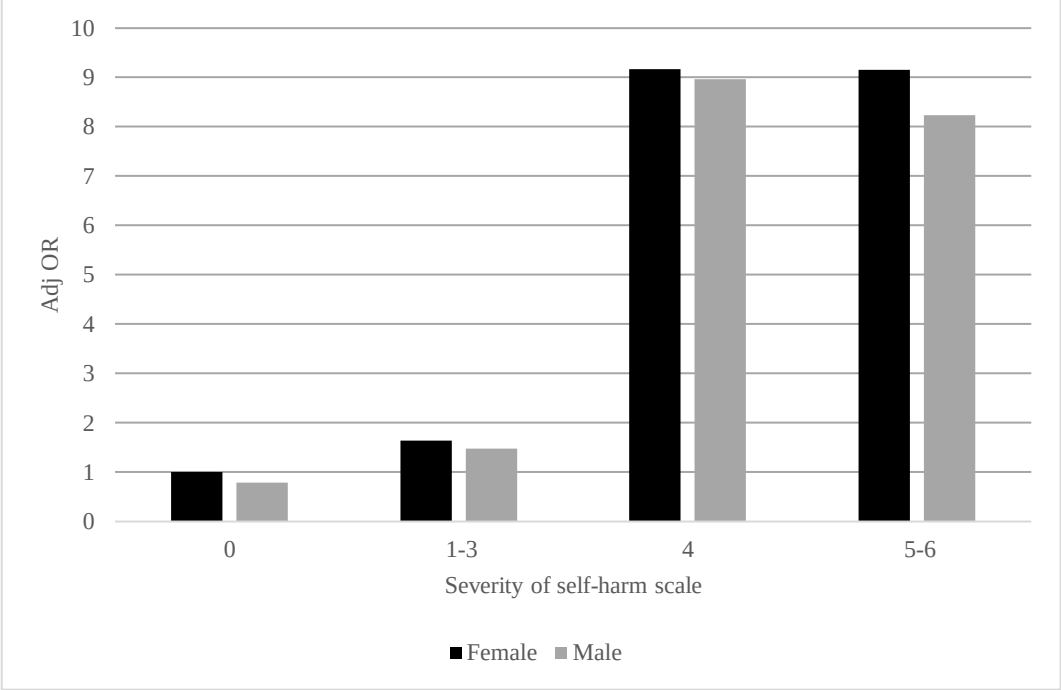


**Figure 7.** Interaction between sex & the SOS scale against suicide admission

Figure 7 depicts the interaction between 'sex' and 'SOS scale' scores against suicide admission. There is a clear difference in the odds of suicide admission between SOS 0-3 and 4+. While there are slight sex differences in the odds of suicide admission across SOS categories, the most prominent is in the 5-6 group where the odds of suicide admission are lower for men (OR: 8.24) than women (OR: 8.97).

### Interaction 3 – *Sex & Mood Disorders*

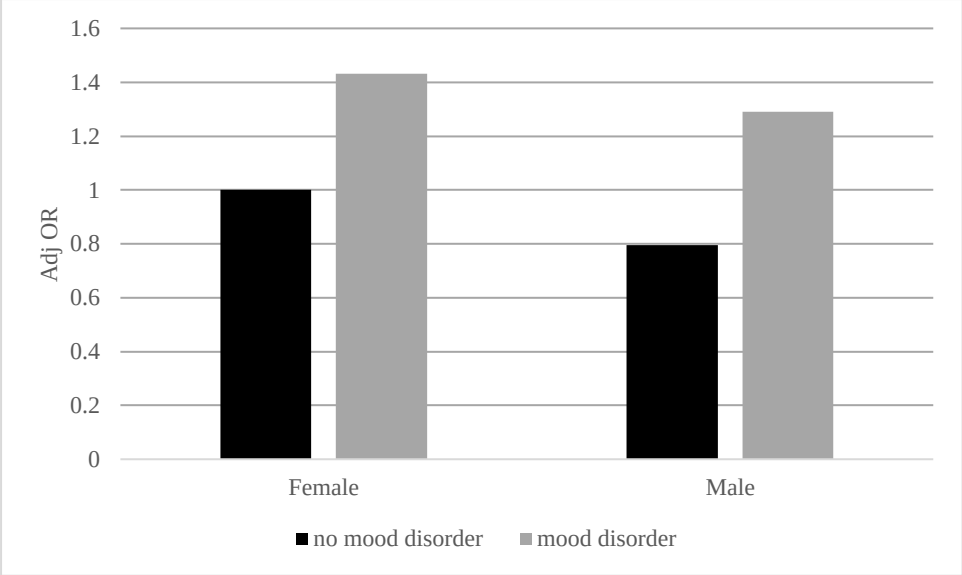


**Figure 8.** Interaction between sex & mood disorders against suicide admission

Figure 8 depicts the interaction between 'sex' and 'mood disorders' against suicide admission. Mood disorders are associated with greater odds of suicide admission for both women and men. Compared to women with (OR: 1.43) and without (OR: 1.00 *reference*) a diagnosis of mood disorder, men with (OR: 1.29) and without (OR: 0.79) mood disorder have lower odds of suicide admission, and this sex difference is wider between mood disorder and no mood disorder in males.

## Block Modeling the Secondary Outcome – *Suicide Risk Level*

The following section presents the 6-block modeling process of RA-MH variables that leads to the creation of the final ordinal multivariate logistic regression model for the secondary outcome, suicide risk level.

### Block Model 1

**Table 22.** Block Model 1 – Demographic variables by suicide risk level

| **Variable** | **Level** | **OR** (95% CI) | **c** |
|---|---|---|---|
| *Sex* | Males | **0.78** (0.76-0.79)*** | 0.59 |
| *Age group* | 45 to 64 | **0.92** (0.90-0.94)*** | |
| | 65+ | **0.48** (0.46-0.49)*** | |
| *Forensic admission* | Yes | **0.37** (0.34-0.40)*** | |
| *Education & Employment CAP* | 1 | **1.44** (1.40-1.49)*** | |
| | 2 | **1.33** (1.29-1.36)*** | |
| *Lifetime admissions* | 1-3 | **1.15** (1.12-1.18)*** | |
| | 4-5 | **1.18** (1.14-1.23)*** | |
| | 6+ | **1.27** (1.23-1.32)*** | |

*Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001

The variables tested in block model 1 against suicide severity (Table 22) that produced odds ratio estimates that were significant and of a sufficient effect size included: (1) 'sex', (2) 'age group', (3) 'forensic admission', (4) 'education and employment CAP', and (5) 'lifetime admissions to inpatient psychiatry'. Although in block 1 of the bivariate analyses (Table 1b) the variable 'employment status' did produce a COR estimate at level 'other' with an effect size magnitude sufficient for it to be considered for further analysis, this variable has been discarded in the multivariate phase of block modeling in favor of the education and employment CAP.

## Block Model 2

**Table 23.** Block Model 2 – Stress exposure variables by suicide risk level

| ***Block Model 2a*** | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR (95% CI)** | **c** |
| *Serious accident or physical impairment* | >1 year | **1.09** (1.06-1.12)*** | 0.63 |
| | <1 year | **1.18** (1.13-1.24)*** | |
| *Distress about health of another person* | >1 year | **0.93** (0.90-0.96)*** | |
| | <1 year | **1.01** (0.97-1.04) | |
| *Death of close family member or friend* | >1 year | **0.99** (0.97-1.02) | |
| | <1 year | **1.00** (0.97-1.02) | |
| *Child custody issues* | >1 year | **0.93** (0.90-0.96)*** | |
| | <1 year | **1.08** (1.03-1.14)* | |
| *Conflict laden or severed relationship* | >1 year | **1.24** (1.21-1.28)*** | |
| | <1 year | **1.76** (1.71-1.81)*** | |
| *Failed or dropped out of education program* | >1 year | **1.04** (1.01-1.07)** | |
| | <1 year | **1.08** (1.01-1.14)* | |
| *Major loss of income or serious economic hardship due to poverty* | >1 year | **1.19** (1.15-1.23)*** | |
| | <1 year | **1.33** (1.29-1.38)*** | |
| *Review hearing* | >1 year | **0.74** (0.68-0.79)*** | |
| | <1 year | **0.59** (0.55-0.63)*** | |
| *Immigration, including refugee status* | >1 year | **0.72** (0.70-0.75)*** | |
| | <1 year | **0.39** (0.34-0.44)*** | |
| *Lived in war zone or area of violent conflict* | >1 year | **0.88** (0.82-0.94)** | |
| | <1 year | **0.79** (0.64-0.99)* | |
| *Witness to severe accident, disaster, act of terrorism, violence or abuse* | >1 year | **0.93** (0.89-0.97)** | |
| | <1 year | **0.81** (0.74-0.88)*** | |
| *Victim of crime* | >1 year | **0.78** (0.74-0.82)*** | |
| | <1 year | **0.85** (0.77-0.92)** | |
| *Victim of sexual assault/abuse* | >1 year | **1.56** (1.51-1.62)*** | |
| | <1 year | **1.44** (1.33-1.56)*** | |
| *Victim of physical assault/abuse* | >1 year | **1.10** (1.06-1.15)*** | |
| | <1 year | **0.94** (0.87-1.00) | |
| *Victim of emotional abuse* | >1 year | **1.34** (1.29-1.39)*** | |
| | <1 year | **1.31** (1.25-1.38)*** | |
| *Parental abuse of alcohol or drugs* | >1 year | **1.06** (1.02-1.10)** | |
| | <1 year | **0.90** (0.85-0.96)** | |
| *History of familial abuse* | Yes | **1.12** (1.08-1.16)*** | |
| *Fear of family member, friend, caregiver or staff* | Yes | **0.96** (0.91-1.00) | |
| *Life event causes sense of horror or intense fear* | Yes | **1.32** (1.28-1.37)*** | |
| | No response | **0.78** (0.74-0.83)*** | |

| ***Block Model 2b*** | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Distress about health of another person* | >1 year | **1.01** (0.98-1.04) | 0.62 |
| | <1 year | **1.07** (1.04-1.10)*** | |
| *Child custody issues* | >1 year | **1.05** (1.02-1.08)** | |
| | <1 year | **1.38** (1.31-1.45)*** | |
| *Failed or dropped out of education program* | >1 year | **1.16** (1.13-1.19)*** | |
| | <1 year | **1.09** (1.03-1.15)*** | |
| *Review hearing* | >1 year | **0.81** (0.75-0.87)*** | |
| | <1 year | **0.57** (0.53-0.61)*** | |
| *Immigration including refugee status* | >1 year | **0.69** (0.66-0.71)*** | |
| | <1 year | **0.37** (0.33-0.42)*** | |
| *Parental abuse of alcohol or drugs* | >1 year | **1.29** (1.25-1.34)*** | |
| | <1 year | **0.97** (0.91-1.03) | |
| *Personal Finances CAP* | 1 | **0.42** (0.40-0.43)*** | |
| | 2 | **1.13** (1.10-1.17)*** | |
| *Interpersonal Conflict CAP* | 1 | **0.85** (0.83-0.88)*** | |
| | 2 | **0.79** (0.76-0.82)*** | |
| *Social Relations CAP* | 1 | **1.08** (1.05-1.11)*** | |
| | 2 | **1.34** (1.31-1.38)*** | |
| *Trauma CAP* | 1 | **1.66** (1.60-1.72)*** | |
| | 2 | **1.61** (1.54-1.68)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Although 10 out of 19 stress exposure variables in block model 2a (Table 23) were eligible for further analysis based on their odds ratio estimates and statistical significance, this combination was disregarded in favour of the other combination reported in block 2b. This decision was made on the basis of striving to achieve better parsimony in the final model as multiple individuals variables in block 2a (e.g., 'lived in warzone or area of violent conflict', 'witness to severe accident, disaster, act of terrorism, violence or abuse', 'victim of crime', 'sexual assault/abuse', 'physical assault/abuse', 'emotional abuse', 'parental abuse of alcohol or drugs', and 'life event causes sense of horror or intense fear'), are structurally colinear with Trauma CAP. Further, the variable 'major loss of income or serious economic hardship' was also removed from block model 2b due to its conceptual relationship to the personal finances CAP; and 'conflict laden relationship' was removed because of its conceptual association with the social relations CAP. We note minimal change in the c statistic estimate between each model.

## Block Model 3

| **Table 24.** Block Model 3 – Mental illness by suicide risk level | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Neurodevelopmental disorders* | Yes | **0.98** (0.92-1.05) | 0.67 |
| *Schizophrenia & Psychotic disorders* | Yes | **0.62** (0.60-0.64)*** | |
| *Mood disorders* | Yes | **2.37** (2.31-2.43)*** | |
| *Anxiety disorders* | Yes | **1.28** (1.24-1.32)*** | |
| *Dissociative disorders* | Yes | **1.41** (1.12-1.78)** | |
| *Eating disorders* | Yes | **1.07** (0.98-1.16) | |

| | | | |
|---|---|---|---|
| *Sexual & gender identity disorders* | Yes | **1.83** (1.43-2.35)*** | |
| *Neurocognitive disorders* | Yes | **0.40** (0.38-0.41)*** | |
| *Personality disorders* | Yes | **2.58** (2.48-2.68)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the mental illness variables tested against suicide severity from block model 3 (Table 24), (1) 'schizophrenia and psychotic disorders', (2) 'mood disorders', (3) 'anxiety disorders', (4) 'dissociative disorders', (5) 'sexual and gender identity disorders', (6) 'neurocognitive disorders', and (7) 'personality disorders' each produced significant odds ratio estimates of a sufficient effect size to be considered eligible for further analysis.

## Block Model 4

**Table 25.** Block Model 4 – Substance use & addictions by suicide risk level

| ***Block Model 4a*** | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Alcohol* | Yes | **1.51** (1.47-1.56)*** | 0.56 |
| *Smoker* | Yes | **1.14** (1.11-1.17)*** | |
| *Gambling* | Yes | **1.04** (0.96-1.12) | |
| *Inhalants* | Within last year | **1.15** (1.00-1.32) | |
| | Within last month | **1.10** (0.94-1.28) | |
| *Hallucinogens* | Within last year | **1.06** (0.97-1.16) | |
| | Within last month | **0.98** (0.88-1.08) | |
| *Cocaine & crack* | Within last year | **1.07** (1.01-1.13)* | |
| | Within last month | **1.14** (1.09-1.20)*** | |
| *Stimulants* | Within last year | **0.98** (0.90-1.06) | |
| | Within last month | **1.08** (1.02-1.14)* | |
| *Opioids* | Within last year | **1.04** (0.96-1.13) | |
| | Within last month | **1.08** (1.03-1.13)** | |
| *Cannabis* | Within last year | **1.15** (1.08-1.22)*** | |
| | Within last month | **1.19** (1.16-1.23)*** | |
| ***Block Model 4b*** | | | |
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Smoker* | Yes | **0.99** (0.97-1.02) | 0.59 |
| *Gambling* | Yes | **1.00** (0.93-1.09) | |
| *Substance Use CAP* | 1 | **1.15** (1.09-1.20)*** | |
| | 2 | **2.16** (2.11-2.21)*** | |
| *Note.* OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Apart from alcohol, none of the variables in block model 4a (Table 25) produced odds ratio estimates that were either significant or of a sufficient effect size necessary for them to be considered eligible for further analysis. While both (1) 'smoking' and (2) 'gambling' in block model 4b were neither significant nor sufficiently affective of the outcome, the (3) 'substance use CAP' was, and thus block model 4b will be carried forward to the final model construction stage. This decision is supported by block model 4b's preferable c statistic value - 4a (0.56), 4b (0.59).

## Block Model 5

| **Table 26.** Block Model 5 – Physical health & functioning by suicide risk level | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Sexual dysfunction* | Yes | **1.14** (1.08-1.21)*** | 0.60 |
| *Self-reported health* | In poor health | **1.42** (1.38-1.48)*** | |
| | No response | **0.72** (0.68-0.78)*** | |
| *EPSEs* | Yes | **0.94** (0.87-1.01) | |
| *Pain scale* | 1 | **1.20** (1.16-1.25)*** | |
| | 2 | **1.45** (1.40-1.50)*** | |
| | 3 | **1.69** (1.57-1.83)*** | |
| | 4 | **1.76** (1.48-2.09)*** | |
| *ADL* | 1-3 | **0.87** (0.83-0.91)*** | |
| | 4 | **0.81** (0.73-0.90)** | |
| | 5-6 | **0.70** (0.61-0.79)*** | |
| *IADL* | 1-3 | **0.77** (0.75-0.80)*** | |
| | 4-9 | **0.65** (0.63-0.68)*** | |
| | 10-18 | **0.53** (0.50-0.55)*** | |
| | 19-30 | **0.27** (0.25-0.28)*** | |
| *Note*. OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

Among the physical health and functioning variables tested in block model 5 (Table 26), (1) 'self-reported health', (2) 'pain scale', (3) 'ADL scale', and (4) the 'IADL scale' produced significant odds ratio estimates or the requisite effect size to be considered eligible for further analysis.

## Block Model 6

| **Table 27.** Block Model 6 – InterRAI scales by suicide risk level | | | |
|---|---|---|---|
| **Variable** | **Level** | **OR** (95% CI) | **c** |
| *Social Withdrawal Scale* | 1-4 | **1.56** (1.51-1.61)*** | 0.64 |
| | 5-8 | **2.46** (2.39-2.53)*** | |
| | 9-12 | **3.27** (3.17-3.38)*** | |
| *Self-Care Index* | 1-3 | **0.63** (0.62-0.65)*** | |
| | 4 | **0.44** (0.43-0.46)*** | |
| | 5-6 | **0.31** (0.30-0.33)*** | |
| *Risk of Harm to Others Scale* | 1-3 | **1.10** (1.07-1.13)*** | |
| | 4 | **1.35** (1.30-1.41)*** | |
| | 5-6 | **0.79** (0.76-0.83)*** | |
| . OR = odds ratio; CI = confidence interval. * p <.05, ** p < .01, ***p < .0001 | | | |

It is notable that block model 6 (Table 27) reporting the effects of scales against the secondary outcome, suicide severity, is substantially sparser than the corresponding block testing scales against the primary outcome, suicide admission in Table 12. This is because multiple scales of interest in this study are either conceptually or structurally colinear with the SOS CAP than constitutes the secondary outcome measure being investigated, suicide severity; these collinearities are detailed in table 7 in the methodology chapter of this study. Further, although the 'mania scale' reported in the bivariate analyses (Table 6b) produced COR estimates that were of a magnitude deemed eligible for further testing, the scale was ultimately excluded on the basis of its collinearity with the 'self-care index', which was preferred because it produced slightly larger crude effects. The 'depression rating scale' was also

removed due to its associational collinearity with the 'depression severity index' which is itself structurally embedded within the SOS based suicide severity outcome.

## Combined Modeling – *Suicide Severity*

As previously stated, the application of combined modeling protocols in this study meant that all variables tested in each respective block that exceeded the parameters of the pre-defined odds ratio effect size threshold (< 0.83 or > 1.20) *and* were statistically significant at the <.05 level were combined and tested together. Each stage of combined modelling identified variables that were statistically significant at the <.05 level and that exceeded the effect size parameters (< 0.83 or > 1.20), while systematically removing variables that did not meet these criteria across several iterations as combined models were re-run until all the variables left were significant and produced a sufficient effect magnitude in either direction. Changes in the c statistic for each combined model were also monitored to ensure the models tested remained or achieved an acceptable degree of fit.

**Table 28.** Block variables included in the suicide risk level model building process

| **Variables** | **Model 1** | **Model 2** | **Final Model** |
|---|---|---|---|
| **Block 1** | | | |
| *Sex* | X | X | X |
| *Age group* | X | X | X |
| *Forensic admission* | X | X | X |
| *Education & Employment CAP* | X | X | X |
| *Lifetime psychiatric admissions* | X | X | X |
| **Block 2** | | | |
| *Social Withdrawal Scale* | X | X | X |
| *Self-Care Index* | X | X | X |
| *Risk of Harm to Others Scale* | X | X | X |
| **Block 3** | | | |
| *Child custody issues* | X | - | - |
| *Review hearing* | X | - | - |
| *Immigration/refugee status* | X | X | X |
| *Parental abuse of drugs or alcohol* | X | - | - |
| *Personal finances CAP* | X | - | - |
| *Interpersonal conflict CAP* | X | X | X |
| *Social relations CAP* | X | X | X |
| *Trauma CAP* | X | X | X |
| **Block 4** | | | |
| *Schizophrenia & psychotic disorders* | X | X | X |
| *Mood disorders* | X | X | X |
| *Anxiety disorders* | X | - | - |
| *Dissociative Identity disorders* | X | - | - |
| *Sexual & gender identity disorders* | X | X | X |
| *Neurocognitive disorders* | X | X | X |
| *Personality disorders* | X | X | X |
| **Block 5** | | | |
| *Substance use CAP* | X | X | X |

| Block 6 | | | |
|---|---|---|---|
| *Self-reported health* | X | X | X |
| *Pain Scale* | X | X | X |
| *ADL Scale* | X | X | X |
| *IADL Scale* | X | X | X |
| **C-statistic** | **0.73** | **0.73** | **0.73** |

## Combined Model 1:

Combined model 1 (Table 28) contained and tested together all variables that exceeded the pre-defined odds ratio effect size threshold (< 0.83 or > 1.20) *and* were statistically significant when tested in their respective blocks. For variables to continue on the second round of combined modelling, they must similarly adhere to the effect size threshold convention and meet statistical significance at the <.05 level. While 'sex' was significant in combined model 1, the effect size was technically not large enough to be considered in subsequent combined models. However, due to its theoretical importance, 'sex' was retained throughout the combined modeling process. After being tested together, the following variables were removed from the combined model 1: (1) 'child custody issues' was significant but the effect size was not big enough; (2) 'review hearing' was significant but the effect size was also not big enough; (3) 'parental abuse of alcohol or drugs' was significant but similarly, the effect size was not big enough; (4) 'personal finances CAP' was also significant but the effect size was not big enough at either level; (5) 'dissociative identity disorder' did produce an effect size big enough but was statistically insignificant and the 95% CI contained 1; and finally, (6) 'anxiety disorders' while significant did not produce an effect size big enough to be carried forward. The c-statistic falls within the pre-specified parameters satisfying the criteria considered tolerable for acceptance of good model fit. The c statistic for combined model 1 was 0.73 and therefore is considered an acceptable model fit estimate.

## Combined Model 2:

When the model was re-run after removing the aforementioned variables from combined model 1, all variables - apart from 'sex' which was kept in the model for the same reasons already explained - tested achieved statistical significance at the <.05 level and exceeded the required effect size threshold; therefore, no further variables were removed from combined model 2. The c statistic remained stable at 0.73.

## Final Model:

Because all variables produced significant estimates in combined model 2 that were of requisite effect size magnitude, they were all retained to create the final model for suicide severity. The final multivariate ordinal logistic regression model predicting the severity of suicide risk at admission contains the following 22 variables: (1)' sex', (2) 'age', (3) 'forensic admission', (4) 'education and employment CAP', (5) 'lifetime psychiatric admissions', (6) 'social withdrawal scale', (7) 'self-care

index', (8) 'risk of harm to others scale', (9) 'immigration/refugee status', (10) 'interpersonal conflict CAP', (11) 'social relations CAP', (12) 'trauma CAP', (13) 'schizophrenia and psychotic disorders', (14) 'mood disorders', (15) 'sexual and gender identity disorders', (16) 'neurocognitive disorders', (17) 'personality disorders', (18) 'substance use CAP', (19) 'self-report health', (20) 'pain scale', (21) 'ADL scale', and (22) the 'IADL scale'. The c statistic for the final model remained unchanged at 0.73 meaning the variables included are a good fit to model the outcome.

## Testing Interaction Terms:

The following variables in the final model were tested as sex interaction terms: (1) 'age', (2) 'social withdrawal scale', (3) 'interpersonal conflict scale', (4) 'social relationships CAP', (5) 'trauma CAP', (6) 'mood disorders', and (7) the 'substance use CAP'; among which (1) 'age', (2) 'social withdrawal scale', (6) 'mood disorders', and (7) the 'substance use CAP' each produced statistically significant interaction terms.

**Table 29**. Final model – Suicide Risk Level

| **Variable** | **Level** | **PE** (SE) | **AOR** (95% CI) | **P** |
|---|---|---|---|---|
| *Sex* | Male | **-0.17** (0.03) | See figure X for interaction | - |
| *Age group* | 45-64 | **-0.17** (0.02) | See figure X for interaction | - |
| | 65+ | **-0.50** (0.03) | See figure X for interaction | - |
| *Forensic status* | Yes | **-0.43** (0.05) | **0.65** (0.60-0.71) | <.0001 |
| *Lifetime psychiatric admissions* | 1-3 | **0.23** (0.01) | **1.26** (1.22-1.29) | <.0001 |
| | 4-5 | **0.40** (0.02) | **1.49** (1.43-1.55) | <.0001 |
| | 6+ | **0.55** (0.02) | **1.73** (1.66-1.80) | <.0001 |
| *Education & Employment CAP* | 1 | **0.19** (0.02) | **1.21** (1.17-1.25) | <.0001 |
| | 2 | **0.04** (0.01) | **1.04** (1.01-1.07) | 0.05 |
| *Social Withdrawal Scale* | 1-4 | **0.40** (0.02) | See figure X for interaction | - |
| | 5-8 | **0.68** (0.02) | See figure X for interaction | - |
| | 9-12 | **0.88** (0.03) | See figure X for interaction | - |
| *Self-Care Index* | 1-3 | **-0.08** (0.01) | **0.93** (0.90-0.95) | <.0001 |
| | 4 | **-0.22** (0.02) | **0.80** (0.77-0.84) | <.0001 |
| | 5-6 | **-0.27** (0.03) | **0.76** (0.73-0.81) | <.0001 |
| *Risk of Harm to Others Scale* | 1-3 | **0.04** (0.01) | **1.04** (1.01-1.07) | 0.01 |
| | 4 | **0.32** (0.02) | **1.37** (1.31-1.44) | <.0001 |
| | 5-6 | **0.01** (0.02) | **1.01** (0.97-1.06) | 0.59 |
| *Immigration/refugee status* | >1 year | **-0.08** (0.02) | **0.92** (0.89-0.96) | <.0001 |
| | <1 year | **-0.60** (0.07) | **0.55** (0.48-0.62) | <.0001 |
| *Interpersonal Conflict CAP* | 1 | **-0.14** (0.01) | **0.87** (0.84-0.89) | <.0001 |
| | 2 | **-0.20** (0.02) | **0.82** (0.78-0.85) | <.0001 |
| *Social Relationships CAP* | 1 | **0.24** (0.02) | **1.27** (1.23-1.31) | <.0001 |
| | 2 | **0.06** (0.01) | **1.06** (1.03-1.09) | <.0001 |
| *Trauma CAP* | 1 | **0.30** (0.02) | **1.35** (1.30-1.40) | <.0001 |
| | 2 | **0.30** (0.02) | **1.34** (1.29-1.40) | <.0001 |
| *Schizophrenia & psychotic disorders* | Yes | **-0.46** (0.02) | **0.63** (0.61-0.65) | <.0001 |
| *Mood disorders* | Yes | **0.66** (0.02) | See figure X for interaction | - |
| *Sexual & gender identity disorders* | Yes | **0.57** (0.13) | **1.77** (1.37-2.30) | <.0001 |
| *Neurocognitive disorders* | Yes | **- 0.62** (0.02) | **0.54** (0.52-0.56) | <.0001 |

| | | | | |
|---|---|---|---|---|
| *Personality disorders* | Yes | **0.72** (0.02) | **2.06** (1.98-2.14) | <.0001 |
| *Substance misuse CAP* | 1 | **0.14** (0.04) | See figure X for interaction | - |
| | 2 | **0.75** (0.02) | See figure X for interaction | - |
| *Self-reported health* | In poor health | **0.13** (0.02) | **1.14** (1.10-1.19) | <.0001 |
| | No response | **-0.24** (0.04) | **0.78** (0.73-0.84) | <.0001 |
| *Pain Scale* | 1 | **0.02** (0.03) | **1.01** (0.97-1.05) | 0.67 |
| | 2 | **0.10** (0.02) | **1.17** (1.13-1.21) | <.0001 |
| | 3 | **0.16** (0.06) | **1.28** (1.18-1.39) | <.0001 |
| | 4 | **0.33** (0.12) | **1.34** (1.12-1.61) | <.01 |
| *ADL Scale* | 1-3 | **-0.08** (0.02) | **0.93** (0.89-0.97) | <.01 |
| | 4 | **-0.15** (0.06) | **0.86** (0.77-0.97) | <.05 |
| | 5-6 | **-0.23** (0.07) | **0.80** (0.69-0.91) | <.01 |
| *IADL Scale* | 1-3 | **-0.03** (0.02) | **0.97** (0.94-1.01) | 0.11 |
| | 4-9 | **-0.09** (0.02) | **0.92** (0.88-0.96) | <.0001 |
| | 10-18 | **-0.14** (0.03) | **0.87** (0.82-0.91) | <.0001 |
| | 19-30 | **-0.50** (0.03) | **0.62** (0.58-0.67) | <.0001 |
| Model c statistic: **0.73** | | | | |
| *Note.* PE = parameter estimate; SE = standard error. AOR = adjusted odds ratio; CI = confidence interval. P = p-value. | | | | |

Table 29 presents the final model for the primary outcome, suicide risk level. Persons with forensic status at admission were substantially less likely to be admitted because of suicide risk compared to others without forensic status (AOR= 0.65 95% CI: 0.60-0.71, p<.0001). Overall, persons with a history of psychiatric admissions had greater odds of being designated high suicide risk compared to those with no lifetime history of admission, and we see a climbing likelihood of high suicide risk designation as the number of previous lifetime admissions goes up; for example, persons with 6+ lifetime admissions were the most likely to be designated high-risk of suicide compared to those with less or none (AOR= 1.73 95% CI: 1.66-1.80, p<.0001). While persons who triggered the education and employment CAP were overall more likely to be designated high risk of suicide compared to those who did not, those who triggered at level 1 were most likely (AOR= 1.21 95% CI: 1.17-1.25, p<.0001). According to the self-care index**,** there is an overall reduction in the odds of high risk designated that falls in line with increasing impairment, with persons scoring the at highest level of this scale among the least likely to be designated high-risk (AOR= 0.76 95% CI: 0.73-0.81, p<.0001). The **r**isk of harm to others scale tells that although there is if at all a minimal increase in the odds of high suicide risk designation among those scoring 1-3 and 5-6, there is a much more substantial increase in the likelihood of high suicide risk designation among those scoring a 4 on this scale (AOR= 1.37 95% CI: 1.31-1.44, p<.0001). Individuals reportedly maintaining immigration or refugee status demonstrate and overall reduction in the odds of being designated high suicide risk, particularly if this status was achieved more recently within the previous 12 months (AOR= 0.55 95% CI: 0.48-0.62, p<.0001). Persons triggering either level of the interpersonal conflict CAP were less likely to be designated as high suicide risk, with those trigger level 2 among the least likely (AOR= 0.82 95% CI: 0.78-0.85, p<.0001). While persons triggering the social relationships CAP were demonstrably more likely to be designated as high risk, particularly those who triggered level 1 of this CAP (AOR= 1.27 95% CI: 1.23-1.31, p<.0001). Persons triggering the trauma CAP at either level were comparably more likely to be designated as high-risk of

suicide, with those triggering at level 1 fractionally more likely (AOR= 1.35 95% CI: 1.30-1.40, p<.0001). Persons with schizophrenia and psychotic disorders (AOR= 0.63 95% CI: 0.61-0.65, p<.0001) and neurocognitive disorders (AOR= 0.54 95% CI: 0.52-0.56, p<.0001) were less likely to be designated high suicide risk respectively. Whereas persons with either personality disorders (AOR= 2.06 95% CI: 1.98-2.14, p<.0001) or sexual and gender identity disorders (AOR= 1.77 95% CI: 1.37-2.30, p<.0001) were both substantially more likely to be designated high risk of suicide. Persons reportedly in poor health were more likely to be designated high risk of suicide compared to others not in poor health (AOR= 1.14 95% CI: 1.10-1.19, p<.0001); and we observe increasing odds of high suicide risk designation as the severity of pain symptoms increase through the levels, with persons reporting daily excruciating pain among those most likely (AOR= 1.34 95% CI: 1.12-1.61, p<.01). We see a similar downward trend of falling odds of high suicide risk designation for both the ADL and IADL scale, where persons with the most impairment according to either of these scales (ADL (5-6): AOR= 0.80 95% CI: 0.69-0.91, p<.01; IADL (19-30): AOR= 0.62 95% CI: 0.58-0.67, p<.0001) among the least likely to be classified as high suicide risk respectively.

## Interpretation of Interaction Terms

The following section will describe the sex interaction terms tested between (1) 'age', (2) 'social withdrawal scale', (3) 'mood disorders', and (4) the 'substance use CAP' against suicide severity.

### Interaction 1 – *Sex & Age*

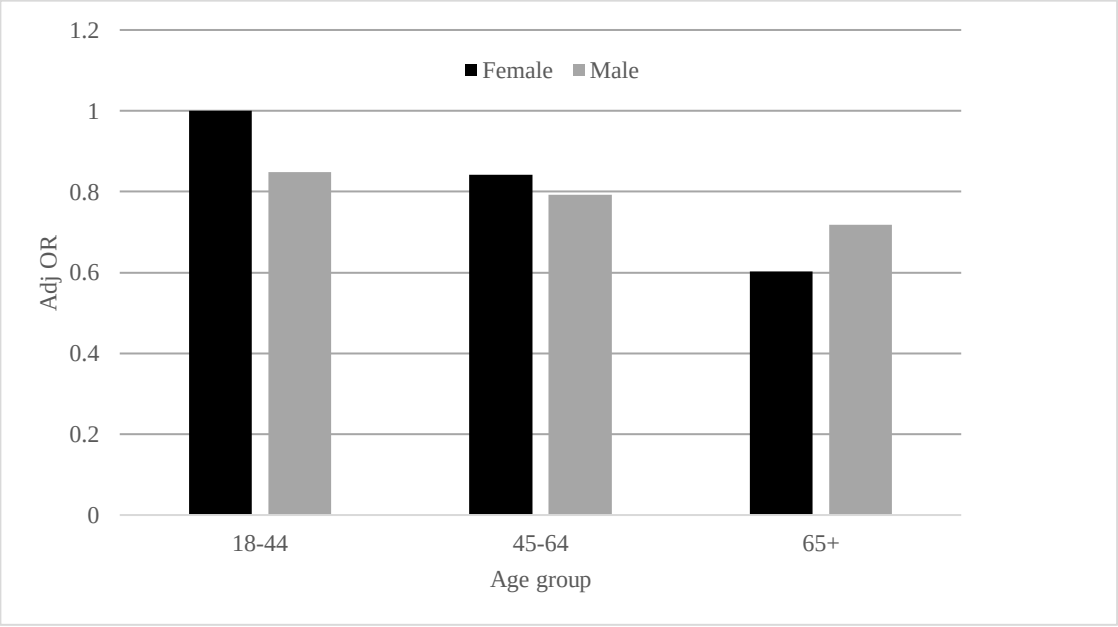


**Figure 9.** Interaction between sex & age against suicide severity

Figure 9 depicts the interaction between sex and age against suicide severity. We note the odds of high suicide risk classification drop among the higher age groups, e.g., men aged 18-44 had lower odds of high suicide risk (OR: 0.85) than women (OR: 1.00 *reference*); and men aged 45-64 had lower odds of high suicide risk (OR: 0.79) than women (OR: 0.84). This sex difference is inverted among those aged 65+, where men have greater odds of being high suicide risk (OR: 0.72) than women (OR: 0.60).

### Interaction 2 – *Sex & the Social Withdrawal Scale*

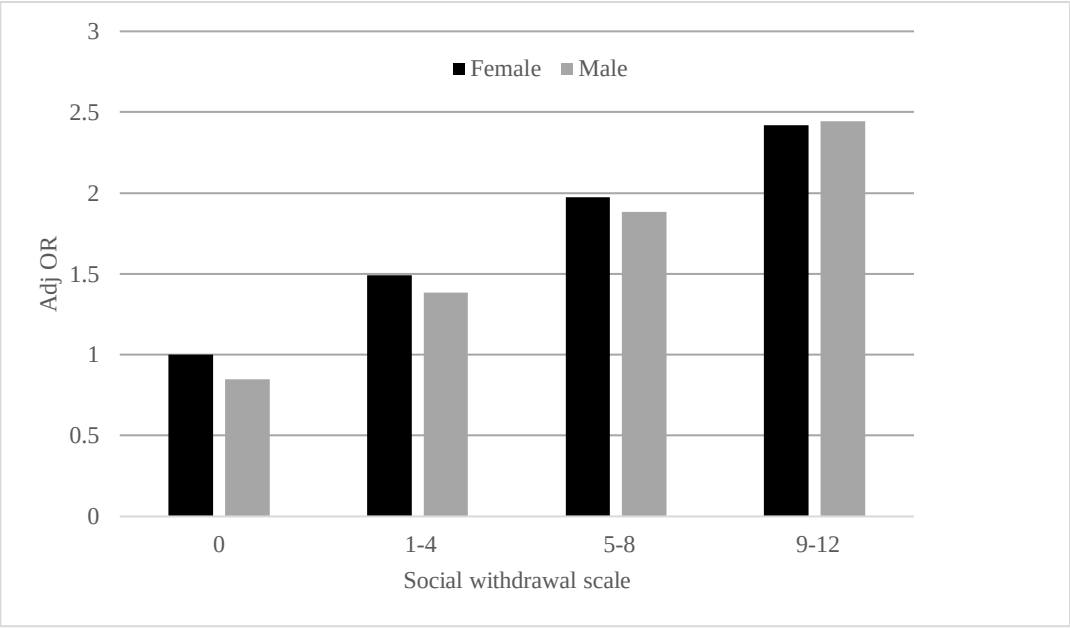


**Figure 10.** Interaction between sex & social withdrawal scale against suicide severity

**Figure 10** depicts the interaction between sex and the social withdrawal scale against suicide severity. We note the odds of high suicide risk classification increases with higher social withdrawal scale scores for both women and men. Women tend to have slightly greater odds of high suicide risk, but this difference narrows up until social withdrawal score 9-12, where the trend is inverted, and men have marginally greater odds (OR: 2.44) of being high suicide risk than women (OR: 2.42).

### Interaction 3 – *Sex & Mood Disorders*

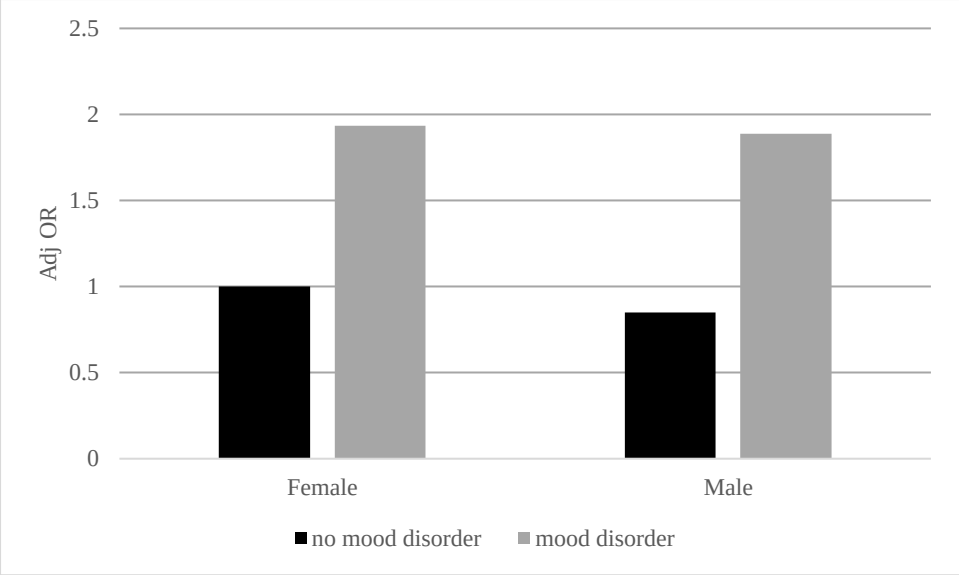


**Figure 11.** Interaction between sex & mood disorders against suicide severity

Figure 11 depicts the interaction between sex and mood disorders against suicide severity. We note that a diagnosis of mood disorder is associated with greater odds of high being classified high suicide risk for both females and males, but this difference is somewhat more pronounced among men ('no mood disorder', OR: 0.85; 'mood disorder', OR: 1.89) than women ('no mood disorder', OR: 1.00 *reference*; 'mood disorder', OR: 1.93). However, in both diagnostic categories, males have lower odds than females.

### Interaction 4 – *Sex & the Substance use CAP*

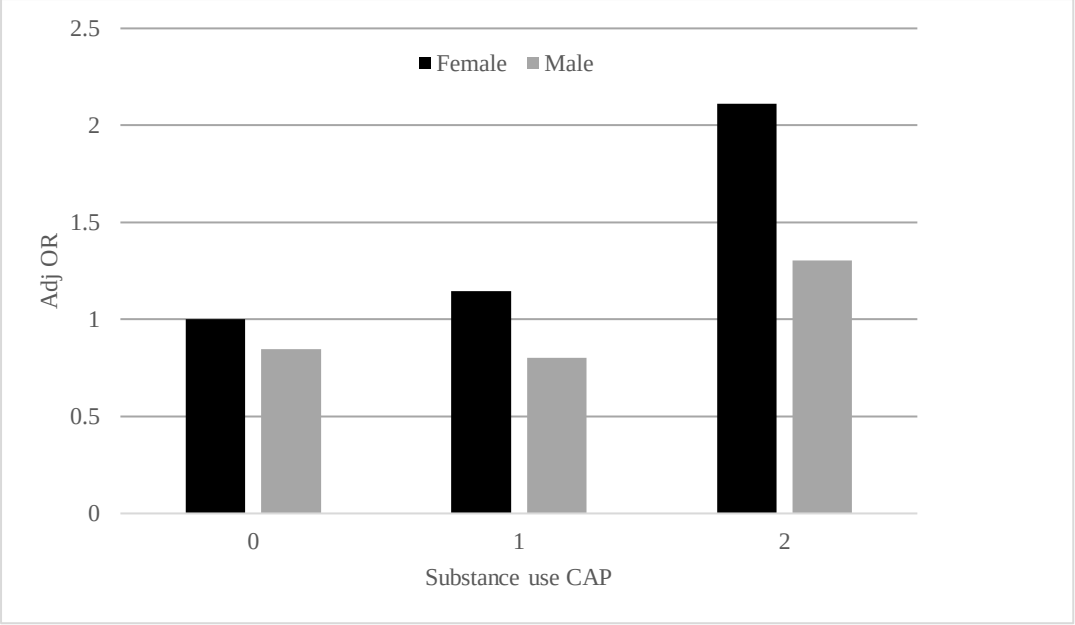


**Figure 12.** Interaction between sex & substance use CAP against suicide severity

Figure 12 depicts the interaction between sex and the substance use CAP against suicide severity. Compared to females, we note lower odds for males in all groups. Substance use increases the odds of high suicide risk for both men and women, particularly for current use (trigger level 2). The difference between the odds of high suicide risk widens with substance use, where females with current use have substantially greater odds of being high suicide risk (OR: 2.11) than males also with current use (OR: 1.30).

# Discussion

The primary goal of this thesis was to examine the associations between suicide LTRF and EWS using a large and representative sample of Ontario psychiatric inpatients to contribute an additional piece to ongoing suicide risk factor research efforts. In pursuit of this goal, four main aims were formulated. The first, to examine the distribution of suicide admission rates by sex across age groups, and the second, to examine the distribution of levels of suicide risk across sex and age groups were exploratory in nature and based on the fact that multiple sex and age differences in suicide related outcomes had been cited in the literature; subsequently these aims did not posit any a priori predictions. Both the third and fourth aim sought to use multiple LTRF highlighted in the literature to predict two distinct outcomes each felt to represent suicide EWS. The first of these outcomes was admission to an inpatient psychiatric facility because of self-harm, and the second outcome pertained to high levels of suicide according to the ordinal ranking structure of the interRAI suicide and self-harm CAP. Neither the third nor fourth aim contained any specific hypotheses but were a means to build on existing knowledge about LTRF. In this section, interpretations of sex and age differences in EWS propensity will be presented, and then important multidimensional LTRF in relation to each EWS outcome will be discussed.

Overall rates of suicide admission show that suicide related behaviour remains a problem in psychiatry. Almost half (46%) of the overall sample (n=142,523) were admitted because they were a threat or danger to themselves, i.e., they may have stated intentions to hurt themselves or actually done so, or others have expressed concern about the safety and wellbeing of the person. This is a substantial proportion of the overall sample used in this study, highlighting the prevalence of suicide related behaviour among those admitted to inpatient psychiatry. Further, the overall rates of suicide admission and high levels of suicide risk demonstrably affect people of all ages, however, the analyses show that there are meaningful differences in relation to these factors between men and women and different age groups. Notable in the results of this study are the differences between the final sets of LTRFs that predict each respective outcome, i.e., some LTRFs that predict suicide admission do not similarly predict high levels of suicide risk and vis-versa, while among those that do predict both, in some instances the strength and direction of the associations vary. The following discussion will highlight prominent LTRFs from each model that *increase* or *decrease* the odds of suicide admission/high suicide risk.

### Factors that increase the odds of suicide admission:

In the final multivariate model for suicide admission, the following variables *increased* the odds of suicide admission: (1) social withdrawal, (2) conflict laden or severed relationship, (3) lived in warzone or area of violent conflict, (4) dissociative identity disorder, and (5) personality disorders. Examined as sex-based interaction terms, (6) severity of self-harm and (7) mood disorders were also

associated with substantive increases in the odds of suicide admission. Although multiple increased the propensity for suicide admission, based on their effect sizes, several variables stood out.

In the final multivariate model, the odds of suicide admission increase incrementally in correspondence with higher levels of social withdrawal. After adjusting for other significant covariates, this pattern does not deviate from that which we observed in the bivariate analyses. This finding is consistent with a raft of other research suggesting that social connections are protective against suicide risk (Joiner, 2002), and that person's without meaningful social connections are more vulnerable to suicide (Awata et al., 2005; Bartels et al., 2002; Clarke et al., 2004; Conwell, Van Orden & Caine, 2011; Dennis, Wakefield, Molloy, Andrews, & Friedman, 2007; Heisel, 2006; Kennedy, Metz, & Lowinger, 1996; Rowe, Conwell, Schulberg, & Bruce, 2006; Rubenowitz, Waern, Wilelmson, & Allbeck, 2001; Yip et al., 2003). Given the universally understood human need to be valued, to have relations, and to belong to social groups, it is not difficult to see how the denial of satisfying these instinctual drives could increase the risk of suicide related behaviours and consequently, suicide admission. Also related to psychosocial stress, albeit with an effect not as strong as that observed at the bivariate level, we continue to see an overall increase in the odds of suicide admission among person's experiencing ongoing conflict as part of a significant relationship in the final model, particularly if reportedly occurring more recently. This finding further supports the notion that meaningful and satisfying connections with others are important protective factors against suicide risk.

At the bivariate level, persons who reportedly lived in a warzone or area of violent conflict had lower overall odds of suicide admission at the bivariate level, particularly if this experience was historic (i.e., > 1 year ago). However, the direction of this association changes notably at the multivariate level, with individuals now overall more likely to experience suicide admission, particularly among those exposed more recently (i.e., within the last year). The recency effect this type of exposure has on the propensity for suicide admission is noteworthy, perhaps suggesting the potentially overwhelming impact sudden acute trauma or stress has on the stability of an individual's mental state.

In relation to mental illness variables, predictably, personality disorders are strongly associated with a substantial increase in the odds of suicide admission at the bivariate and multivariate levels of the analysis, which is consistent with findings reported widely in the literature (Joiner, 2002; Keel et al. 2003; Qin, 2011; Verona et al., 2001; 2004; Yen et al, 2003). However, the variable 'personality disorders' in this study does not differentiate between different subtypes, which would afford more granularity in terms of determining the degree of risk conferred by each particular type. The association between mood disorders and suicide are well documented throughout the literature. At the bivariate stage of this study, mood disorders increased the odds of suicide admission markedly. In the multivariate analysis, the association between mood disorders and suicide admission is interpreted through via a sex interaction term, where we observe that mood disorders remain strongly associated with greater odds of suicide admission for both men, and slightly more so for women. Also consistent with the findings described in the bivariate analysis, the odds of suicide admission are increased among

those with dissociative identity disorder (DID) in the final multivariate model, which perhaps is not too surprising considering that we understand there is a strong association between DID and historical childhood trauma (Gleaves, 1996; Kluft, 1985; Midgley, 2002; Putnam, 1989; Spiegal, 1984), which itself has a well-documented relationship with suicide in later life. It is worth noting that in the overall sample, a relatively small number of people with DID were suicide admissions (n=154), likely in part reflecting the rarity of DID as a diagnosis, which means that the association between DID and suicide admission should be interpreted with additional caution.

### Factors that decrease the odds of suicide admission:

In the final multivariate model for suicide admission, the following variables *decreased* the odds of suicide admission: (1) previous contact with community mental health services (CMH), (2) witness to severe accident, disaster, act of terrorism, violence or abuse, (3) victim of crime, (4) parental abuse of drugs or alcohol, (5) eating disorders, (6) sexual dysfunction, and (7) pain. Examined as sex-based interaction term, (8) age was also associated with substantive decrease in the odds of suicide admission. Among this list, a handful of variables stand out.

Previous contact with community mental health services (CMH) in the year prior to admission appears to confer a protective effect as individuals in touch with CMH previously had overall lower odds of suicide admission, particularly if this contact had occurred more recently. After adjusting for other significant covariates, this association did not deviate markedly from the bivariate association between previous CMH contact and suicide admission. This finding is important because there is much in the literature related to prior contact with mental health services being indicative of elevated future suicide potential, whereas this finding suggests it is important to keep in mind the protective benefits conferred by mental health services in relation to mitigating suicide risk and keeping people out of hospital, particularly if they are community focused.

A surprising finding in this study was that eating disorders (ED) are associated with substantially lower odds of suicide admission at both the bivariate and multivariate level. Although the strength and direction of the bivariate association is perhaps not too surprising given the relationship is likely confounded by other important factors, such as the tendency of those with ED to have high levels of comorbidity with other mental illnesses like mood, anxiety, personality, and substance use disorders (O'Brien & Vincent, 2003; Preti, Camboni, & Miotto, 2011; Bulik et al., 2004; Franko & Keel, 2006; Holderness, Brooks-Gunn, & Warren, 1994; Rosenvinge, Martinussen, & Ostensen, 2000), when these covariates are accounted for in the final model, it becomes clearer that characteristics perhaps specific to ED may be protective in some way against admission to hospital for suicide related behaviour. This finding implies that persons with ED are more likely to be admitted to inpatient psychiatry because of particular aspects of their ED condition per se, rather than concurrent symptoms of suicidality. These findings are interesting because they appear to be at odds with existing research suggesting ED is highly correlated with suicide (Bulik, Sullivan, & Joyce, 1999; Corcos et al., 2002; Harris & Barraclough,

1998; Sullivan, 1995; Keel et al., 2003; Franko & Keel, 2006; Signorini et al., 2007; Preti, Camboni, & Miotto, 2011), but if that were reliably the case, then we could reasonably presume that we might see a similar effect in relation to the suicide admission outcome used in this study among this diagnostic group, which in itself is an EWS indicator of suicide. ED in the context of this study does not predict suicide admission.

At the bivariate level, incremental increases in the pain scale were associated with inconsistent and marginal increases in the odds of suicide admission overall, with persons reporting 'daily severe pain' at the greatest odds of suicide admission. At the multivariate level, while there remains an inconsistent pattern, this time there is an overall reduction on the odds of suicide admission, where again persons reporting 'daily severe pain' maintain the highest odds of suicide admission. The literature suggests that there is a strong link between pain and suicide (Fishbain, 1996; Juurlink et al., 2004; Li and Conwell, 2010; Waern et al., 2002), however, there appears to be no such replication of this association in relation to suicide admission in this study.

Bearing witness to a severe accident, disaster, act of terrorism, violence or abuse was associated with a strong overall reduction in the odds of suicide admission irrespective of whether the exposure occurred recently or further in the past. While this incident reasonably constitutes a trauma, and we understand that trauma can be highly correlated with suicide especially if chronic in nature, this effect could be explained through the classification of the exposure being an isolated incident which may be why we do not see any kind of positive association with suicide admission.

### Factors that increase the odds of high suicide risk:

In the final multivariate model for suicide risk level, the following variables *increased* the odds of high suicide risk designation: (1) lifetime psychiatric admissions, (2) education and employment CAP, (3) risk of harm to others scale, (4) social relationships CAP, (5) trauma CAP, (6) sexual and gender identity disorders, (7) personality disorders, (8) self-reported 'poor' health, and (9) pain. Examined as sex-based interaction terms, (8) social withdrawal scale, (9) mood disorders, and (10) the substance use CAP was also associated with substantive increases in the odds of suicide admission. Among this list of variables associated with elevated odds of high suicide risk designation, the following variables stand out.

Among persons with multiple lifetime admissions to a mental health facility we see a corresponding increase in the odds of high suicide risk designation as previous admissions accumulate. This trend is evident at the bivariate level but gets stronger at the multivariate level after controlling for other covariates, giving credence to the notion that persons with previous contact with mental health services have greater suicide potential.

Several of the CAPs in the final multivariate model predicting the level of suicide risk were associated with greater odds of high suicide risk designation overall. These included the education and employment CAP, the social relationships CAP, the trauma CAP and the substance use CAP. Examined

as a sex interaction term in this study, the substance use CAP when triggered was predominantly associated with greater odds of high levels of suicide risk in both men and women, especially among those who reportedly had current problematic substance use. The destabilizing effect substance misuse has on mental health is well documented so this finding it is perhaps not unusual. However, what is particularly interesting is that the effect *current* problematic substance imparts is especially high among women, who were almost twice as likely as men to be classified as high risk of suicide in this category. The standout estimate in relation to the education and employment CAP indicated that persons who are at risk of losing employment or dropping out of school have substantially greater odds of being designated high risk of suicide. Other persons in need of support for employment, educational participation or involvement in volunteer activities also flagged by this CAP similarly have increased odds of high risk of suicide designation, however, the effect denoted by this AOR estimate while significant, was not as pronounced. The overall increase in the odds of high suicide risk designation among persons flagged as requiring support in relation to education and employment implies the protective effect and stabilizing influence active participation in work. learning and/or other meaningful activities of this nature can have on a person's mental wellbeing. We know that social connections and meaningful social participation are important protective factors the preserve out mental wellbeing an increase our quality of life. Therefore, the finding produced by the social relationships CAP indicating that persons experiencing social isolation and family dysfunction have greater odds of being designated high suicide risk is not out of keeping with this existing understanding. Also, designed to determine an individual's level of withdrawal from social activities, the social withdrawal scale produces similar findings. Examined against the level of suicide risk as a sex interaction term, this scale shows that as the degree of social withdrawal increases, so do the odds of high suicide risk designation for both men and women with no stark differences between them. Again, these findings highlight the protective influence of positive social factors in relation to suicide. Trauma was highlighted in the literature as an important causal factor in relation to suicide. For some people, trauma can have substantial impact on their overall health and wellbeing, particularly if experienced in childhood during sensitive periods of psychosocial development. For others, exposure to trauma and adversity across the life course can also have a pervasive impact, sometimes giving rise to conditions like post-traumatic stress disorder. It was therefore not unsurprising for this study to corroborate this understanding of the detrimental impact of trauma on mental wellbeing. What was interesting however, was that persons in immediate danger due to experiencing current abuse, whether that be sexual, physical or emotional in nature, have almost indistinguishably greater odds of high suicide risk designation as others who are not currently in immediate danger, but who have experienced previous traumatic life events in the past; this is evidenced by very little difference between each AOR estimates for each level of the trauma CAP. This finding is useful because by indicating the pervasive nature of trauma across the life course on the proclivity for suicide, it reiterates an important area that necessitates targeted therapeutic intervention to mitigate risk and prevent progression into suicide.

Among the variables pertaining to mental illness, unsurprisingly and consistent with the bivariate findings and the reviewed literature, a diagnosis of personality disorder produces a strong and highly significant estimate that indicates a substantial increase in the odds of being designated high suicide risk for this group of individuals. More interesting among the psychiatric indicators making it into the final multivariate model is the strength of the AOR estimate produced by sexual and gender identity disorders, which also maintained substantially greater odds of being designated high suicide risk after controlling for confounding factors. This finding is important because among psychiatric populations sexual and gender identity disorders are relatively uncommon, evidenced in this study by the relatively low rates for this diagnostic category seen among suicide admissions (n=143), as-well-as moderate (n=46) and high levels of suicide risk (n=91). It is also broadly acknowledged that there is a paucity in our understanding of the strength and direction of the association between sexual and gender identity disorders and suicide related outcomes, and this finding helps highlight the nature of a relationship worthy of further investigative focus.

An important finding in this study is demonstrated against the pain scale. The pain scale is a composite measure that captures to fundamental facets of the overall pain experience, frequency and intensity. Indicators on the pain scale range from 0 'no pain', to 4 'daily excruciating pain'. Against the level of suicide risk, every incremental increase in pain score is associated with a corresponding increase in the odds of high suicide risk designation. This finding implies the corrosive impact of uncontrolled or poorly controlled pain on an individual's propensity for suicide, highlighting the important and often underappreciated association between physical and mental wellbeing. In support of this finding, we note that a subjective rating of ill health is predictive of higher levels of suicide risk, where persons who reportedly perceive their physical health as 'poor' have greater odds of high suicide risk designation compared to those do not.

### Factors that decrease the odds of high suicide risk:

In the final multivariate model for suicide risk level, the following variables *decreased* the odds of high suicide risk: (1) self-care index, (2) immigration/refugee status, (3) interpersonal conflict CAP, (4) schizophrenia and psychotic disorders, (5) neurocognitive disorders, (6) ADL scale, and (7) IADL scale. Examined as sex-based interaction term, (8) age was also associated with substantive decrease in the odds of high suicide risk designation.

Several of the variables predicting reduced odds of high suicide risk can be broadly classified as relating to impairment in the level of a person's capacity to function either cognitively or physically. Speaking to the former, a high degree of cognitive effort is employed during processes of rumination and planning, both of which are important facets required to coherently and meaningfully plot one's own demise via suicide. If cognitive processes become deranged either through functional or organic neurologic disturbance, then the higher order cognitive processes required to coherently plan and carry out suicide in these individuals might well be insufficient, promoting the idea that if authentic suicide

risk is to manifest, cognitive faculties must be largely preserved. It has been proposed in the literature that deficits in cognitive function may protect against suicidality (Conwell, 1995), a postulation substantiated by the fact that we see markedly reduced odds of high suicide risk among those with neurocognitive disorders in this study. Further, when controlling for influential comorbidities such as mood disorder, trauma, and substance use, schizophrenia and psychotic disorders were also associated with a substantially lower odds of high suicide risk in the final model. One explanation for this effect might similarly be that among individuals with schizophrenia, which is characterized by distorted thinking and perception, cognitive capacity is likely to be diminished among those exhibiting both positive and negative symptomology, a key feature of this condition that serves to mitigate the potential risk of suicide related behaviours. Supporting this idea is the reduced odds of high suicide risk noted among those with deteriorating ability to take care of themselves according to the self-care index. As the self-care index is based on psychiatric symptoms that include indicators of cognition such as decision making, insight, and abnormal thought processes (amongst others), the self-care index is designed to indicate a person's inability to care for themselves. While associated with an overall reduction in the odds of high suicide risk, we note that as a person's ability to take care of themselves deteriorates based on the emerging constellation of aforementioned signs and symptoms of deteriorating cognitive function, so do the odds of being designated high suicide risk. This hypothesis is further supported by the bivariate finding showing that a deterioration in cognitive performance according to the cognitive performance scale was also associated with falling odds of suicide admission, where those with the highest degree of cognitive deficit were among the least likely to be admitted for self-harming behaviours.

Functional decline in ADL and IADL domains were both associated with incrementally reducing odds of high suicide risk designation. Persons that are dysfunctional in these domains may well be suicidal, but if they lack the functional capabilities to act on their proclivity, suicide is less likely to occur. These finding further add to the argument that deterioration in mind and body may well render a person less susceptible to suicide related behaviours because they either physically or mentally lack the abilities required to carry out complex tasks, explaining why we might see lower propensity for high levels of suicide risk among these variables. Additionally, physiological and cognitive decline is correlated with aging, and increasing age in the context of modelling the level of suicide risk in this study was associated with reduced odds of high suicide risk designation for both women and men.

Another stand out finding in this model is the fact that immigration/refugee status was associated with overall reduced odds of high suicice risk. Much was reported in the literature regarding the potential for elevated suicide risk among this group of people, explained through the hardship of adjusting to life in a new country different from the culture and background individuals are accustomed to. Interestingly, this effect is most pronounced among the most recent migrants who produced the lowest odds of high suicide risk. However, the odds of high suicide risk do appear to creep up slightly among immigrants/refugees the longer they spend in their new geographical locale, implying that the

potential for higher suicide risk maybe delayed until after the acute shock of their transition. This is an intriguing finding given what we know about the hardship new immigrants face when settling in a new country and is clearly worthy of further investigation.

As mentioned, there are few similarities between the LTRFs that made it into both final multivariate logistic regression models. This implies that the LTRFs that make people suicidal are not necessarily the same LTRF that clinicians consider when they rate suicide as a reason for admission to hospital. Only two variables in the multivariate analysis increased the odds of both suicide admission and high suicide risk: (1) personality disorders and (2) mood disorders, while only one variable included in both final models decreased the odds of both suicide admission and the level of high suicide risk: (1) age.

## Strengths and Limitations

One of the major strengths of this study is the inclusion of a large and fully representative sample of mental health inpatients in Ontario (with the exception of forensic patients). By ensuring that

all mental health patients across the province were included in the analysis, more accurate conclusions could be drawn from the results, as there was no subset of the population that was missing.

Another strength of this study was that it contained a wide variety of risk factors spanning multiple psychosocial, psychiatric and physiological dimensions. Few previous studies in this space have investigated the combined effects of diverse suicide risk factors, instead attempting to explain suicide by focusing on one particular domain of possible risk factors. This approach may be too narrowly focused to estimate the relative importance of different types of risk factor and their relationships. Considering together a broad array of multidimensional LTRF allows this study to make more reliable assertions regarding their potential to predict EWS, while examining the relative value of clinical and diagnostic indicators compared to social indicators provides context and explanatory power.

Another strength of this study was the quality of the data contained within the OMHRS dataset. Mandated across inpatient psychiatry in Ontario since 2005, the RAI-MH is a comprehensive, standardized mental health assessment tool, the reliability and validity of which has been robustly established in a variety of studies (Foebel et al, 2013; Gibbons et al, 2008; Hirdes et al, 2008; Jones, Perlman, Hirdes, & Scott, 2010; Martin et al, 2009; Neufeld, Perlman & Hirdes, 2012; Perlman et al, 2013). Leveraging the strengths of the data generated by the RAI-MH provides further confidence in the analysis and conclusions drawn.

A final strength of this study is the good model performance against both outcomes of interest in the multivariate modelling stage. Each of the final models for ‘suicide admission’ and ‘level of suicide risk’ produced c statistic estimates of 0.79 and 0.73 respectively.

Limitations of this study included is cross-sectional design, which provides only a snapshot in time of the association between LTRF and EWS rather than a broader longitudinal picture of these relationships as time progresses. Further, this study uses as sample of psychiatric inpatients that is Ontario-centric, restricting the ability of these findings to reliably apply cross-nationally. There is also limited data in this study on culture and race, which are likely to have an important effect on nature of LTRF as well as the ability to predict EWS. Finally, limitations due to privacy concerns preclude some people from the analyses. For example, persons highlighted in the literature at elevated risk of suicide related outcomes are those that identify as transgender, however, these were excluded from the sample due to concerns around small cell counts.

## Implications

This study has the potential to have a broad impact on future practice, policy, and research. To begin with, the multidimensional nature of LTRF supported by this study indicate that clinicians should take into account the full spectrum of suicide risk factors form multiple domains of functioning, treating

the whole person rather than focusing on factors that are clinically orientated. It is clear that a person's social and physical wellbeing constitute vital components of mental health, and if a holistic approach is not taken towards care, then any meaningful therapeutic gains might be more unstable or even more difficult to achieve, potentially exacerbating suicide potential. Further, it is clear that suicidality is driven by more than just personal factors like diagnosis, and that broader sociocultural factors are also important elements in the complex causal pathways that lead to suicide. For example, poverty, equity and marginalization within society are important factors to consider in the broader picture of suicide. Finally, it is clear than further research is required in this area to build on existing knowledge and generate new insights into the complexity of suicide. This could be achieved through the design and implementation of longitudinal research studies to more reliably investigate the temporal sequence of LTRF and EWS and how they develop across the life course; the use of suicide deaths as outcomes would provide more robust evidence related to which risk factors are most likely to culminate in the worst possible outcome; cross-national comparisons with other geographic settings with divergent sociocultural contexts; and importantly, there is a need to conduct robust suicide research within other clinical populations outside inpatient psychiatry, for example, among community mental health and child and youth service populations.

## Conclusion

It is clear from the research findings in this study that suicide LTRF are multidimensional, and therefore it is important to target diverse elements of a person's physical, mental and social functioning when seeking to ameliorate future suicide potential. This understanding promotes the inherent value of taking a multidisciplinary approach to the provision of care, support and treatment of persons at risk of suicide.

# References

Afifi, T. O., Enns, M. W., Cox, B. J., Asmundson, G., Stein, M., & Sareen, J. (2008). Population attributable fractions of psychiatric disorders and suicide ideation and attempts associated with adverse childhood experiences. *American Journal of Public Health*, 98, 946–952.

Afifi, T. O., Boman, J., Fleisher, W., & Sareena, J. (2009). The relationship between child abuse, parental divorce, and lifetime mental disorders and suicidality in a nationally representative adult sample. *Child Abuse & Neglect*, 33, 139–147.

Afifi, T. O., Taillieu, T., Zamorski, M. A., Turner, S., Cheung, K., & Sareen, J. (2016). Association of child abuse exposure with suicidal ideation, suicide plans, and suicide attempts in military personnel and the general population in Canada. *JAMA Psychiatry*, 73(3), 229–238.

Alaraisanen, A., Miettunen, J., Lauronen, E., Rasanen, P., & Isohanni, M. (2006). Good school performance is a risk factor of suicide in psychoses: a 35-year follow up of the Northern Finland 1966 Birth Cohort. *Acta Psychiatrica Scandinavica*, 114, 357–362.

American Psychiatric Association. (2001). Practice Guideline for the Treatment of Patients with Borderline Personality Disorder. *American Journal of Psychiatry*, 158(Oct supplement).

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed).

Austin, P. C. & Steyerberg, E. W. (2012) Interpreting the concordance statistic of a logistic regression model: Relation to the variance and odds ratio of a continuous explanatory variable. *BMC Medical Research Methodology*, 12, 1-8.

Awata, S., Seki, T., Koizumi, Y., Sato, S., Hozawa, A., Omori, K., Kuriyama, S., Arai, H., Nagatomi, R., Matsuoka, H., & Tsuju, I. (2005). Factors associated with suicidal ideation in an elderly urban Japanese population: A community-based cross-sectional study. *Psychiatry and Clinical Neurosciences, 59,* 327-336.

Ayalon, L., Mackin, S., Arean, P., Chen, H., & McDonel Herr, E. (2007). The role of cognitive functioning and distress in suicidal ideation in older adults. *Journal of the American Geriatrics Society, 55,* 1090-1094.

Bagary, M. (2011). Epilepsy, antiepileptic drugs and suicidality. *Current Opinions in Neurology*, 24(2), 177-82.

Bartles, S. J., Coakley, E., Oxman, T. E., Constantion, G., Oslin, D., et al. (2002). Suicidal and death ideation in older primary care patients with depression, anxiety, and at-risk alcohol use. *American Journal of Geriatric Psychiatry*, 10, 417–27.

Baumeister, R. F. & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117, 497–529.

Beck, A. T., Steer, R. A., Kovacs, M., & Garrison, B. (1985). Hopelessness and eventual suicide: A 10-year prospective study of patients hospitalized with suicide ideation. *American Journal of Psychiatry, 142,* 559-563.

Bellini, M., De Ronchi, D., Forti, P., Maioli, F., & Ravaglia, G. (1998). Suicidal thoughts and dementia. *Archive of Gerontology and Geriatrics, 6,* 33-38.

Bergen, H., Hawton, K., Waters, K., Cooper, J., & Kapur, N. (2010). Epidemiology and trends in non-fatal self-harm in three centres in England: 2000–2007. *British Journal of Psychiatry*, 197(6), 493–498.

Bertolote, J. M., Fleischmann, A., Leo, D. D., et al. (2003). Suicide and mental disorders: do we know enough? *British Journal of Psychiatry*, 183, 382–383.

Biermann, T., Sperling, W., Bleich, S., Kornhuber, J., & Reulbach, U. (2008). Particularities of suicide in the elderly: A population-based study. *Aging Clinical and Experimental Research*, 21, 470-474.

Boardman, A. P., Grimbaldeston, A. H., Handley, C., Jones, P. W. & Willmott, S. (1999). The North Staffordshire suicide study: a case–control study of suicide in one health district. *Psychological Medicine*, 29, 27–33.

Bolton, J. M., Gunnell, D., & Turecki, G. (2015). Suicide risk assessment and intervention in people with mental illness. *British Medical Journal*, 351.

Borges, G., Angst, J., Nock, M. K., Ruscio, A. M., & Kessler, R. C. (2008). Risk factors for the incidence and persistence of suicide-related outcomes: A 10-year follow-up study using the National Comorbidity Surveys. *Journal of Affective Disorders, 105*, 25–33.

Bostwick, J. M. & Pankratz, V. S. (2000). Affective disorders and suicide risk: a re-examination. *American Journal of Psychiatry*, 157, 1925–32.

Breault, K. D. (1986). Suicide in America: a test of Durkheim theory of religious and family integration. *American Journal of Sociology*, 92, 628–56.

Briere, J., Madni, L. A., & Godbout, N. (2016). Recent suicidality in the general population: Multivariate association with childhood maltreatment and adult victimization. *Journal of Interpersonal Violence*, 31, 3063–3079.

Bruffaerts, R., Demyttenaere, K., Borges, G., Haro, J. M., Chiu, W. T., Hwang, I., & Alonso, J. (2010). Childhood adversities as risk factors for onset and persistence of suicidal behaviour. *The British Journal of Psychiatry*, 197(1), 20–27.

Bulik, C. M., Sullivan, P. F., & Joyce, P. R. (1999). Temperament, character and suicide attempts in anorexic nervosa, bulimia nervosa and major depression. *Acta Psychiatrica Scandanavica*, 100, 27−32.

Bulik, C. M., Klump, K. L., Thornton, L., Kaplan, A. S., Devlin, B., Fichter, M. M., et al. (2004). Alcohol use disorder comorbidity in eating disorders: A multi-centre study. *Journal of Clinical Psychiatry*, 65, 1000−1006.

Burrows, A., Morris, J., Simon, S., Hirdes, J., & Phillips, C. (2000). Development of a minimum data set-based depression rating scale for use in nursing homes. *Journal of Age and Ageing*, 29, 165–172.

Bushe, C., Taylor, M., & Haukka, J. (2010). Mortality in schizophrenia– A measurable clinical endpoint. *Journal of Psychopharmacology*, 24(4), 17–25.

Bylund Grenklo, T., Kreicbergs, U., Hauksdóttir, A., Valdimarsdóttir, U. A., Nyberg, T., Steineck, G., & Fürst, C. J. (2013). Self-injury in teenagers who lost a parent to cancer: A nationwide, population-based, long-term follow-up. *JAMA Pediatrics*, 167(2), 133–140.

Caldwell, C. B. & Gottesman, I. I. (1990). Schizophrenics kill themselves too: A review of risk factors for suicide. *Schizophrenia Bulletin*, 16, 571–589.

Callahan, C. M. & Berrios, G. E. (2005). Reinventing depression. A history of the treatment of depression in primary care, 1940-2004. New York NY: Oxford University Press.

Canadian Coalition for Seniors Mental Health [CCSMH] (2006). The assessment and treatment of depression. National Guidelines for Seniors Mental Health. Toronto, ON: Baycrest.

Carroll, R., Corcoran, P., Griffin, E., Perry, I., Arensman, E., Gunnell, D., & Metcalfe, C. (2016). Variation between hospitals in inpatient admission practices for self-harm patients and its impact on repeat presentation. *Social Psychiatry and Psychiatric Epidemiology*, (51) 1485–1493.

Cavanagh, J., Carson, A., Sharpe, M., & Lawrie, S. (2003). Psychological autopsy studies of suicide: a systematic review. *Psychological Medicine,* 33(3), 395–405.

Centers for Disease Control and Prevention. (2011). Sexual identity, sex of sexual contacts, and health-risk behaviours among students in grades 9–12—Youth risk behavior surveillance, selected sites, United States, 2001–2009. *Morbidity and Mortality Weekly Report* 60(June 6), 1–134.

Centers for Disease Control and Prevention [CDC] (2007). Nonfatal self-inflicted injuries among adults aged > or =65 years-United States, 2005. *Morbidity and Mortality Weekly Reports*, 56, 989-993.

Charney, D. S. & Manji, H. K. (2004). Life stress, genes, and depression: multiple pathways lead to increased risk and new opportunities for intervention. *Science Signalling*, 5.

Chioqueta, A. P. & Stiles, T. C. (2003). Suicide risk in outpatients with specific mood and anxiety disorders. *Crisis*, 24, 105–12.

Clarke, D., E., Colantonio, A., Heslegrave, R., Rhodes, A., Links, P., & Conn, D. (2004). Holocaust experience and suicidal ideation in high-risk older adults. *American Journal of Geriatric Psychiatry*, 12, 65-74.

Clements-Nolle, K., Marx, R., Guzman, R., & Katz, M. (2001). HIV prevalence, risk behaviours, health care use, and mental health status of transgender persons: implications for public health intervention. *American Journal of Public Health*, 91(6), 915–921.

Conwell, Y. (1995). Suicide among elderly persons. *Psychiatric Services*, 46, 563-564.

Conwell, Y., Van Orden, K., & Caine, E. (2011). Suicide in older adults. *Psychiatric Clinics of North America, 34*, 451-468.

Coohey, C., Easton, S. D., Kong, J., & Bockenstedt, J. K. W. (2015). Sources of psychological pain and suicidal thoughts among homeless adults. *Suicide and Life-Threatening Behaviour,* 45(3), 271–280.

Cook, N. R. (2007). Use and misuse of the receiver operating characteristic curve in risk prediction. *Circulation*, 115(7), 928–35.

Corcos, M., Taieb, O., Benoit-Lamy, S., Paterniti, S., Jeammet, P., & Flament, M. F. (2002). Suicide attempts in women with bulimia nervosa: Frequency and characteristics. *Acta Psychiatrica Scandanavica*, 106, 381−386.

Coryell, W., Noyes, R., & Clancy, J. (1982). Excess mortality in panic disorder: a comparison with primary unipolar depression. *Archives of General Psychiatry*, 39, 701–703.

Coughlin, S. S. & Sher, L. (2013). Suicidal behavior and neurological illnesses. *Journal of Depression and Anxiety*, 9, 12443.

Cox, B. J., Direnfeld, D. M., Swinson, R. P., & Norton, G. R. (1994). Suicidal ideation and suicide attempts in panic disorder and social phobia. *American Journal of Psychiatry*, 151, 882–8.

Cornette, M. M., Abramson, L. Y., & Bardone, A. M. (2000). Toward an integrated theory of suicidal behaviours: Merging the hopelessness, self-discrepancy, and escape theories. *Suicide Science: Expanding the Boundaries*, 43-65. Norwell, MA: Kluwer Academic Publishers.

Crosby, A., LaVonne, O., & Stevens, M. R. (2013). Suicides—United States, 2005-2009. *Morbidity and Mortality Weekly Report,* 62(3), 179–183.

Darke, S., Williamson, A., Ross, J., & Teesson, M. (2005). Attempted suicide among heroin users: 12-month outcomes from the Australian Treatment Outcome Study (ATOS). *Drug and Alcohol Dependence,* 78, 177–186.

Dawes, M., Mathias, C., & Richard, D. (2008). Adolescent suicidal behaviour and substance use: Developmental mechanisms. *Substance Abuse: Research and Treatment,* 2, 13-28.

De Leo, D. & Spathonis, K. (2004). Suicide and suicide behaviour in late-life. Suicidal Behaviour: Theories and Research Findings, 253-286. Göttingen, Germany: Hogrefe & Huber Publishers.

Dennis, M. S., Wakefield, P., Molloy, C., Andrews, H., & Friedman, T. (2007). A study of self-harm in older people: Mental disorder, social factors and motives. *Aging & Mental Health,* 11, 520-525.

Devries, K. M., Mak, J. T., Child, J. C., Falder, G., Bacchus, L. J., Astbury, J., & Watts, C. H. (2014). Childhood sexual abuse and suicidal behavior: A meta-analysis. *Pediatrics*, 133, 1331–1344.

Dooley, D., Fielding, J. & Levi, L. (1996). Health and unemployment. *Annual Review of Public Health,* 17, 449–465.

Draper, B., Moore, C., & Brodaty, H. (1998). Suicidal ideation and the "wish to die" in dementia: the role of depression. *Age and Ageing,* 27, 503-507.

Dube, S. R., Anda, R. F., Felitti, V. J., Chapman, D. P., Williamson, D. F., & Giles, W. H. (2001). Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span. *JAMA*, 286, 3089–3096.

Durkheim, E. (1897). Suicide: a study in sociology. New York: Free Press.

Engleman, N. B., Jobes, D. A., Berman, A. L., & Langbein, L. I. (1988). Clinicians' decision making about involuntary commitment. *Psychiatric Services,* 49(7), 941–945.

Enns, M. W., Cox, B. J., Afifi, T. O., De Graaf, R., Ten Have, M., & Sareen, J. (2006). Childhood adversities and risk for suicidal ideation and attempts: A longitudinal population-based study. *Psychological Medicine,* 36(12), 1769–1778.

Emborg, C. (1999). Mortality and causes of death in eating disorders in Denmark 1970–1993: A case register study. *International Journal of Eating Disorders*, 25, 243−251.

Evans, E., Hawton, K., & Rodham, K. (2005). Suicidal phenomena and abuse in adolescents: A review of epidemiological studies. *Child Abuse and Neglect,* 29, 45–58.

Farberow, N. L. & Lilman, R. E. (1975). Suicide prevention. in Resnick HLP, Ruben HL (eds): *Emergency Psychiatric Care,* 103-188. Bowie. Md, Charles Press.

Fishbain, D. A. (1996). Current research on chronic pain and suicide. *American Journal of Public Health,* 86, 1320.

Foebel, A. D., Hirdes, J. P., Heckman, G. A., Kergoat, M. J., Patten, S., & Marrie, R. A. (2013). Diagnostic data for neurological conditions in interRAI assessments in home care, nursing home and mental health care settings: a validity study. *BMC Health Services Research,* 13(1), 457.

Ford, J. D., & Gomez, J. M. (2015). The relationship of psychological trauma and dissociative and posttraumatic stress disorders to non-suicidal self-injury and suicidality: A review. *Journal of Trauma & Dissociation*: *The Official Journal of the International Society for the Study of Dissociation (ISSD)*, 16(3), 232–271.

Förstl, H. (2008). The will to live instead of euthanasia. Neurodegenerative diseases as seen by the sufferers themselves. *Deutsches Arzteblatt International, 105*, 395-396.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., & Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviours: A meta-analysis of 50 years of research. *Psychological Bulletin*, 143,187–232. [http://dx.doi.org/10.1037/bul0000084]

Franko, D. L. & Keel, P. K. (2006). Suicidality in eating disorders: occurrence, correlates, and clinical implications. *Clinical Psychology Review*, 26:769–782.

Gibbons, C., Dubois, S., Ross, S., Parker, B., Morris, K., Lim, T., & Bédard, M. (2008). Using the resident assessment instrument-mental health (RAI-MH) to determine levels of care for individuals with serious mental illness. *The Journal of Behavioral Health Services & Research*, *35*(1), 60-70.

Glass, J. K., & Reed, S. E. (1993). To live or die: A look at elderly suicide. *Educational Gerontology*, 19, 767-778.

Gleaves, D. H. (1996). The sociocognitive model of dissociative identity disorder: a re-examination of the evidence. *Psychological Bulletin*, 120, 42–59.

Goldblatt, M. J. (2000). Physical illness and suicide. In R. Maris, A. Berman, & M. Silverman (Eds.), *Comprehensive textbook of suicidology* (pp. 342-356). New York: The Guilford Press.

Greenwald, R. (2007). EMDR: Within a phase model of trauma-informed treatment. New York: Routledge.

Hassan, R. (1995). Suicide explained. Melbourne: Melbourne University Press.

Hardy, L. (2014). Suicidal Ideation: Admissions Criteria and Treatment Options, Healthy Place. Retrieved on 2020, December 17 from https://www.healthyplace.com/blogs/mentalhealthtreatmentcircle/2014/10/suicidal-ideation-admissions-criteria-and-treatment-options

Harris, E. C. & Barraclough, B. (1997) Suicide as an outcome of mental disorders. *British Journal of Psychiatry*, 170, 205–228.

Harris, E. C. & Barraclough, B. (1998). Excess mortality of mental disorder. *British Journal of Psychiatry*, 173, 11−53.

Haw, C., Harwood, D., Hawton, K. (2009). Dementia and suicidal behaviour: A review of the literature. *International Psychogeriatrics,* 21, 440-453.

Hawton, K. (2000). Sex and suicide. Gender differences in suicidal behaviour. *British Journal of Psychiatry*, 177, 484-5.

Hawton, K., Sutton, L., Haw, C., Sinclair, J., & Deeks, J. J. (2005). Schizophrenia and suicide: Systematic review of risk factors. *British Journal of Psychiatry*, 187, 9–20.

Hawton, K., & van Heeringen K. (2009). Suicide. *Lancet*, 373(9672),1372–81.

Hawton, K., Bergen, H., Cooper, J., Turnbull, P., Waters, K., Ness, J., & Kapur, N. (2015). Suicide following self-harm: findings from the Multicentre Study of Self-harm in England, 2000-2012. *Journal of Affective Disorders.*

Hawton, K. (2018). Sex and suicide: gender differences in suicidal behaviour. *British Journal of Psychiatry*, 177(6), 484–5.

Hawgood, J., & De Leo, D. (2008). Anxiety disorders and suicidal behaviour: An update. *Current Opinion in Psychiatry, 21*, 51-64.

Heisel, M. J. (2006). Suicide and its prevention among older adults. *Canadian Journal of Psychiatry, 51*, 143-154.

Henriksson, M. M., Isometsa, E. T., Kuoppasalmi, K. I., Heikkinen, M. E., Marttunen, M. J., Lonnqvst, J. K. (1996). Panic disorder in completed suicide. *Journal of Clinical Psychiatry*, 57, 275–280.

Herman, J. L. (1992). Complex PTSD: A syndrome in survivors of prolonged and repeated trauma. *Journal of Traumatic Stress*, 5, 377–391.

Hermansen, S. W. (2008). Evaluating Predictive Models: Computing and Interpreting the c Statistic. *Data Mining and Predictive Modelling,* 143.

Herzog, D. B., Dorer, D. J., Keel, P. K., Selwyn, S. E., Ekeblad, E. R., & Flores, A. T. (1999). Recovery and relapse in anorexia and bulimia nervosa: A 7.5-year follow-up study. *Journal of the American Academy of Child Adolescent Psychiatry*, 38, 829−837.

Hinkley, B. D., & Jaremko, M. E. (1994). Effects of pain duration on psychosocial adjustment in orthopedic patients: The importance of early diagnosis and treatment of pain. *Journal of Pain Symptom Management*, 9, 175-185.

Hirdes, J. P., Fries, B. E., Morris, J. N., Steel, K., Mor, V., Frijters, D., & Smith, T. (1999). Integrated health information systems based on the RAI/MDS series of instruments. *Healthcare management forum*, 12(4), 30-40.

Hirdes, J. P., Marhaba, M., Smith, T. F., Clyburn, L., Mitchell, L., & Lemick, R. A, et al (2000). Development of the resident assessment instrument–mental health (RAI-MH). *Hospital Quarterly*. 4(2) 44–51.

Hirdes, J, P., Trevor F. S., Rabinowitz, T., Yamauchi, K., Pérez, E., Telegdi, N. C., & Prendergast, P., et al. (2002) The resident assessment instrument-mental health (RAI-MH): Inter-rater reliability and convergent validity. *The journal of behavioral health services & research*, 29(4), 419-432.

Hirdes, J., Ljunggren, G., Morris, J., Frijters, D., Finne Soveri, H., & Gray, L., et al. (2008). Reliability of the interRAI suite of assessment instruments: a 12-country study of an integrated health information system. *BMC Health Services Research*, (8) 277–288.

Hirdes, J. P., van Everdingen, C., Ferris, J., Franco-Martin, M., Fries, B. E., Heikkilä, J., & Perlman, C. M. (2020). The interRAI suite of mental health assessment instruments: An integrated system for the continuum of care. *Frontiers in psychiatry*, 10, 926.

Hjorthøj, C. R., Madsen, T., Agerbo, E., & Nordentoft, M. (2014). Risk of suicide according to level of psychiatric treatment: A nationwide nested case-control study. *Social Psychiatry and Psychiatric Epidemiology*, 49, 1357–1365.

Holderness, C. C., Brooks-Gunn, J., & Warren, M. P. (1994). Co-morbidity of eating disorders and substance abuse review of the literature. *International Journal of Eating Disorders*, 16, 1−34.

Hor K., & Taylor, M. (2010) Suicide and schizophrenia: a systematic review of rates and risk factors. Journal of Psychopharmacology. 24(11) 81-90.
*Halady, S. W. (2013). Attempted suicide, LGBT identity, and heightened scrutiny. *American Journal of Bioethics*, 13, 20–2.

Hovey, J. D. (2000). Acculturative Stress, Depression, and Suicidal Ideation in Mexican Immigrants. *Cultural Diversity & Ethnic Minority Psychology*, 6(2), 134-151.

Hunt, I. M., Kapur, N., Webb, R., Robinson, J., Burns, J., & Turbull, P., et al. (2007). Suicide in current psychiatric in-patients: a case-control study: the National Confidential Inquiry into suicide and homicide. *Psychological Medicine*, 37(6), 831–837.

Ialomiteanu, et al (2016). CAMH Monitor eReport: Substance use, mental health and well-being among Ontario adults, 1977-2015. CAMH Research Document Series no. 45. Toronto: Centre for Addiction and Mental Health.

Iliceto, P., Pompili, M., & Candilera, G. et al., (2012). Suicide Risk and Psychopathology in Immigrants: A Multi-Group Confirmatory Factor Analysis. *Social Psychiatry and Psychiatric Epidemiology*, 48, 1105-1114.

Ilgen, M. A., Zivin, K., & McCammon, R. J., et al (2008). Pain and suicidal thoughts, plans and attempts in the United States. *General Hospital Psychiatry*, 30(6), 521–7.

Ilgen, M. A., Kleinberg, F., & Ignacio, R. V., et al. (2013). Noncancer pain conditions and risk of suicide. *JAMA Psychiatry*. 70(7), 692–7.

Ingram, R. E. & Luxton, D. D. (2005). Vulnerability-Stress Models. Development of Psychopathology: A Vulnerability-Stress Perspective. Sage.

Jacobs, D. (1999). Harvard Medical School guide to suicide assessment and intervention. San Francisco: Jossey-Bass.

Jakobsen, I. S. & Christiansen, E. (2011). Young people's risk of suicide attempts in relation to parental death: A population-based register study. *Journal of Child Psychology and Psychiatry*, 52(2), 176–183.

Johansson, L. M., Sundquist, J., Johansson, S. E., Bergman, B., Qvist, J., & Träskman-Bendz, L. (1997). Suicide among foreign-born minorities and Native Swedes: an epidemiological follow-up study of a defined population. *Social Science Medicine* 44(2), 181-7.

Joiner, T. (2002). The trajectory of suicidal behavior over time. *Suicide and Life-Threatening Behaviour*, 32, 33–41.

Joiner, T. E. (2005). Why people die by suicide. Cambridge: Harvard University Press.

Jones, K., Perlman, C. M., Hirdes, J. P., & Scott, T. (2010) Screening cognitive performance with the Resident Assessment Instrument for Mental Health (RAI-MH) Cognitive Performance Scale. (2010). *Canadian Journal of Psychiatry, 55*(11), 736-740.

Juurlink, D. N., Herrmann, N., Szalai, J. P., Kopp, A., & Redelmeier, D. A. (2004). Medical illness and the risk of suicide in the elderly. *Archives of Internal Medicine*, 164, 1179-1183.

Kachur, S. P., Potter, L. B., James, S.P., & Powell, K. E. (1995). Suicide in the United States 1980–1992 Atlanta: Centers for Disease Control and Prevention, National Centre for Injury Prevention and Control.

Keel, P. K., Dorer, D. J., Eddy, K. T., Franko, D., Charatan, D. L., & Herzog, D. B. (2003). Predictors of mortality in eating disorders. *Archives of General Psychiatry*, 60, 179–83.

Kenagy, G. & Bostwick, W. (2005) Health and social service needs of transgender people in Chicago. *International Journal of Transgenderism*, 8(2–3):57–66.

Kennedy, G., Metz, H., & Lowinger, R. (1996). Epidemiology and inferences regarding etiology of late-life suicide. *Suicide and depression in late life. Critical issues in treatment, research, and public policy*, 3-22. New York, NY: John Wiley & Sons, Inc.

Kessler, R. C., Aguilar-Gaxiola, S., Alonso, J., Benjet, C., Bromet, E. J., Cardoso, G., & Koenen, K. C. (2017). Trauma and PTSD in the WHO world mental health surveys. *European Journal of Psychotraumatology*, 8(5), 1353-383.

Khan, A., Leventhal, R. M., Khan, S., & Brown, W. A. (2002). Suicide risk in patients with anxiety disorders: a meta-analysis of the FDA database. *Journal of Affective Disorders*, 68, 183–90.

Kilpatrick, D. G., Resnick, H. S., Milanak, M. E., Miller, M. W., Keyes, K. M., & Friedman, M. J. (2013). National estimates of exposure to traumatic events and PTSD prevalence using DSM-IV and DSM-5 criteria. *Journal of Traumatic Stress*, 26(5), 537–547.

King, S. A. (2018). Opioids, Suicide, Mental Disorders, and Pain. Psychiatric Times, 35, 11. Available from: https: //www.psychiatrictimes.com/psychopharmacology/opioids-suicide-mental-disorders-and-pain

Klassen, J. A., Hamza, C. A., & Stewart, S. L. (2017). An examination of correlates for adolescent engagement in non-suicidal self- injury, suicidal self-injury, and substance use. *Journal of Research on Adolescents*, 28, 342–353.

Kluft, R. P. (1985). The Childhood Antecedents of Multiple Personality Disorder. American Psychiatric Press, Washington, DC.

Kposowa, A. J., Breault, K. D., & Singh, G. K. (1995). White male suicide in the United States: a multivariate individual-level analysis. *Social Forces*, 74, 315–23.

Kposowa, J. A. (2001). Unemployment and suicide: a cohort analysis of social factors predicting suicide in the US National Longitudinal Mortality Study. *Journal of Psychological Medicine*, 32, 127-138.

Krug, E. G., Dahlberg, L. L., Mercy, J. A., Zwi, A., & Lozano, R. (2002). World report on violence and health. Geneva: World Health Organization. Available from: http://www.who.int/violence_injury_prevention/violence/world_report/en/.

Krysinska, K. & Lester, D. (2010). Post-traumatic stress disorder and suicide risk: A systematic review. *Archives of Suicide Research: Official Journal of the International Academy for Suicide Research*, 14(1), 1–23.

Latham, A. E. & Prigerson, H. G. (2004). Suicidality and bereavement: Complicated grief as psychiatric disorder presenting greatest risk for suicidality. *Suicide and Life-Threatening Behaviour, 34*, 350-362.

Landmark, K., Cernovsky, Z. Z., & Merskey, H. (1987). Correlates of suicide attempts and ideation in schizophrenia. *British Journal of Psychiatry*, 151, 18-20.

Lau, C., Stewart, S. L., Saklofske, D. H., Tremblay, P. F., & Hirdes, J. (2018). Psychometric evaluation of the interRAI Child and Youth Mental Health Disruptive/Aggression Behaviour Scale (DABS) and Hyperactive/Distraction Scale (HDS). *Child Psychiatry and Human Developmen*t, 49, 279–289.

Lau, C., Stewart, S, L., Saklofske, D. H., & Hirdes, J. (2019). Scale development and psychometric properties of internalizing symptoms: the interRAI Child and Youth Mental Health internalizing subscale. *Psychiatry Research*, 278, 235–241.

Lebrun-Harris, L. A., Baggett, T. P., & Jenkins, D. M., et al. (2012). Health Status and Health Care Experiences among Homeless Patients in Federally Supported Health Centres: Findings from the 2009 Patient Survey. *Health Services Research*, 48(3), 992-1017.

Lewis, S. & Roberts, A. R. (2001). Crisis assessment tools: the good, the bad, and the available. *Brief Treatment and Crisis Intervention*, 1, 17–28.

Li, L. W. & Conwell, Y. (2010). Pain and self-injury ideation in elderly men and women receiving home care. *Journal of the American Geriatric Society, 58,* 2160-2165.

Lim, W. S., Rubin, E. H., Coast, M., & Morris, J. C. (2005). Early-stage Alzheimer Disease represents increased suicidal risk in relation to later stages. *Alzheimer Disease Association Disorder, 19*, 214-219.

Liu, X, C., Chen, H., Lie, Z, Z., & Wang, J. Y. (2017). Prevalence of suicidal behaviour and associated factors in a large sample of Chinese adolescents. *Epidemiology & Psychiatric Sciences*, 28(3) 280-289.

Lombardi, E. L. (2001). Enhancing transgender health care. *American Journal of Public Health*, 91(6), 869–872.

Lonnqvist, J. K. (2000). Psychiatric aspects of suicidal behaviour: depression. In the International Handbook of Suicide and Attempted Suicide, 107–20. Chichester: Wiley Interscience.

Lorant, V., Kunst, A. E., Huisman, M., Costa. G., & Mackenbach, J. (2005). Socio- economic inequalities in suicide: a European comparative study. *British Journal of Psychiatry*, 187(1), 49–54.

Lupien, S.J., McEwen, B.S., Gunnar, R.M., & Heim, C. (2009). The effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews: Neuroscience*, 10, 434-445.

Lyons, J. S., Stutesman, J., Neme, J., Vessey, J. T., O'Mahoney, M. T., & Camper, H. J. (1997). Predicting psychiatric emergency admissions and hospital outcome. *Medical Care,* 35(8), 792–800.

Mann, J. J., Waternaux, C., Haas, G. L., & Malone, K. M. (1999). Toward a clinical model of suicidal behaviour in psychiatric patients. *American Journal of Psychiatry*, 156, 181–189.

Mann, J. J. (2002). A current perspective of suicide and attempted suicide. *Annuls of Internal Medicine,* 136, 302–311.

Mann, J. J. (2003). Neurobiology of suicidal behaviour. *Nature Reviews: Neuroscience,* 4, 819–828.

Mann, J. J., Apter, A., Bertolote, J., Beautrais, A., Currier, D., & Haas, A., et al (2005). Suicide prevention strategies: a systematic review. *JAMA*, 294, 2064–2074.

Mann, J.J., & Haghgighi, F. (2010). Genes and environment: multiple pathways to psychopathology. *Biological Psychiatry,* 68, 403–404.

Mann, J. J. (2012). Neurobiological aspects of suicide. Retrieved from: http://www.omh.state.ny.us/omhweb/savinglives/volume2/neurobiological.html.

McDuffie, E., & Brown, G. (2010). 70 US veterans with gender identity disturbances: a descriptive study. *International Journal of Transgenderism,* 12(1), 21–30.

McIntosh, J. L., Santos, J. F., & Hubbard, R. W. (1994). Elderly suicide research, theory and treatment. Washington, DC: American Psychological Association.

Margo, G. M. & Finkel J. A. (1990). Early dementia as a risk factor for suicide. *Hospital and Community Psychiatry, 6*, 676-678.

Martin, L., Hirdes, J. P., Morris, J. N., Montague, P., Rabinowitz, T., & Fries, B. E. (2009). Validating the mental health assessment protocols (MHAPs) in the resident assessment instrument mental health (RAI-MH). *Journal of Psychiatric and Mental Health Nursing*, 16(7), 646-653.

Marty, M. A., Segal, D. L., Coolidge, F. L., & Klebe, K. J. (2012). Analysis of the psychometric properties of the Interpersonal Needs Questionnaire (INQ) among community-dwelling older adults. *Journal of Clinical Psychology, 68*, 1008-1018.

Mathy, R. (2002). Transgender identity and suicidality in a nonclinical sample: sexual orientation, psychiatric history, and compulsive behaviours. *Journal of Psychology and Human Sexuality,* 14(4), 47–65.

Maurizio, P., Paola, V., & Sandra, C., et al. (2012). Do stroke patients have an increased risk of developing suicidal ideation or dying by suicide? An overview of the current literature. *CNS Neuroscience and Therapeutics*, 8(9), 711–21.

Midgley, N. (2002). Child dissociation and its 'roots' in adulthood. In: Attachment, Trauma and Multiplicity: Working with Dissociative Identity Disorder. Brunner Routledge, Hove.

Miller, A., Esposito-Smythers, C., Weismoore, J., & Renshaw, K. (2013). The relation between child maltreatment and adolescent suicidal behavior: A systematic review and critical examination of the literature. *Clinical Child and Family Psychology Review*, 16, 146–172.

Mościcki, E. K. (2001). Epidemiology of completed and attempted suicide: toward a framework for prevention. *Clinical Neuroscience Research,* 5, 310–23.

Morrell, S. L., Taylor, R. J. & Kerr, C. B. (1998). Unemployment and young people's health. *Medical Journal of Australia,* 168, 236–240.

Morris, J. N., Carpenter, I., Berg, K., & Jones, R. N. (2000). Outcome measures for use with home care clients. *Canadian Journal of Aging,* 19, 87–105.

Monroe, S. M. & Hadjiyannakis, H. (2002). The social environment and depression: focusing on severe life stress. Handbook of Depression. New York: Guilford Press.

Mulder, C. L., Koopmans, G. T., & Lyons, J. S. (2005). Determinants of indicated versus actual level of care in psychiatric emergency services. *Psychiatric Services*, 56(4), 452–457.

Navaneelan, T. (2012). Study: suicide rates, an overview, 1950 to 2009. Statistics Canada Catalogue no. 82–624-X (p 1–2). Accessed at: https ://www.statcan.gc.ca/pub/82-624-x/2012001s/article/11696 -eng.htm.

Neufeld, E., Perlman, C. M., & Hirdes, J. P. (2012). Predicting inpatient aggression using the interRAI Risk of Harm to Others clinical assessment protocol. *Journal of Behavioral Health Services & Research*, 39(4), 472-480.

Neufeld, E., Hirdes, J. P., Perlman, C. M., & Rabinowitz, T. (2015a). Risk and protective factors associated with intentional self-harm among older community-residing home care clients in Ontario, Canada. *International journal of geriatric psychiatry*, 30(10), 1032-1040.

Neufeld, E., Hirdes, J. P., Perlman, C. M., & Rabinowitz, T. (2015b). A longitudinal examination of rural status and suicide risk. *Healthcare management forum*, 28(4), 129-133.

Niederkrotenthaler, T., Floderus, B., Alexanderson, K., Rasmussen, F., & Mittendorfer-Rutz, E. (2012). Exposure to parental mortality and markers of morbidity, and the European Journal of Psychotraumatology 9 risks of attempted and completed suicide in offspring: An analysis of sensitive life periods. *Journal of Epidemiology and Community Health*, 66(3), 233–239.

Nielsen, S., Moller-Madsen, S., Isager, T., Jorgensen, J., Pagsberg, K., & Theander, S. (1998). Standardized mortality in eating disorders—A quantitative summary of previously published and new evidence. *Journal of Psychosomatic Research*, 44, 413−434.

Nordentoft, M., Mortensen, P. B., & Pedersen, C. B. (2011). Absolute risk of suicide after first hospital contact in mental disorder. *Archives of General Psychiatry*, 68(10), 1058–1064.

Nordentoft, M., Wahlbeck, K., Hällgren, J., Westman, J., Ösby, U., Alinaghizadeh, H., Gissler, M., & Laursen, T. M. (2013). Excess Mortality, Causes of Death and Life Expectancy in 270,770 Patients with Recent Onset of Mental Disorders in Denmark, Finland and Sweden. *PLOS One*, *8*, e55176.

Noyes, Jr. R. (1991). Suicide and panic disorder: a review. *Journal of Affective Disorders*, 22, 1–11.

O'Brien, K. M. & Vincent, N. K. (2003). Psychiatric comorbidity in anorexia and bulimia nervosa: Nature, prevalence, and causal relationships. *Clinical Psychology Review*, 23, 57−74.

O'Connor, R. C. & Nock, M. K. (2014). The psychology of suicidal behaviour. *Lancet Psychiatry*, 1(1), 73–85.

Oquendo, M. A. Friedman, J. H., Grunebaum, M. F., Burke, A., Silver, J.M., & Mann, J. J. (2004). Suicidal behavior and mild traumatic brain injury in major depression. *Journal of Nervous Mental Disease*, 192, 430–434.

Oquendo, M. A., Currier, D., & Mann, J. J. (2006). Prospective studies of suicidal behaviour in major depressive and bipolar disorders: what is the evidence for predictive risk factors? *Acta Psychiatrica Scandinavica*, 114, 151–158.

Osgood, N. (1992). Suicide in Later Life: Recognizing the Warning Signs. New York: Lexington Books.

Ozer, E. J., Best, S. R., Lipsey, T. L., & Weiss, D. S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychological Bulletin*, 129(1), 52–73.

Palmer, B. A., Pankratz, V. S., & Bostwick, J. M. (2005). The lifetime risk of suicide in schizophrenia: A re-examination. *Archives of General Psychiatry*, 62, 247-253.

Panagioti, M., Gooding, P. A., Triantafyllou, K., & Tarrier, N. (2015). Suicidality and posttraumatic stress disorder (PTSD) in adolescents: A systematic review and meta- analysis. *Social Psychiatry and Psychiatric Epidemiology*, 50(4), 525–537.

Patterson, A. A. & Holden, R. R. (2012). Psychache and suicide ideation among men who are homeless: A test of Shneidmans model. *Suicide & Life-Threatening Behaviour*, 42(2), 147.

Paul, J. P., J. Catania, L., & Pollack, et al. (2002). Suicide attempts among gay and bisexual men: Lifetime prevalence and antecedents. *American Journal of Public Health*, 92(8), 1338–1345.

Perlman, C. M., Neufeld, E., Martin, L., Goy, M., & Hirdes, J. P. (2011). Suicide risk assessment inventory: A resource guide for Canadian health care organizations. Toronto, ON: Ontario Hospital Association and Canadian Patient Safety Institute.

Perlman, C. M., Hirdes, J. P., Barbaree, H., Fries, B. E., McKillop, I., Morris, J. N., & Rabinowitz, T. (2013). Development of mental health quality indicators (MHQIs) for inpatient psychiatry based on the interRAI mental health assessment. *BMC Health Services Research*, 13(1), 15.

Perry, I. J., Corcoran, P., Fitzgerald, A. P., Keeley, H. S., Reulbach, U., & Arensman, E. (2012). The incidence and repetition of hospital-treated deliberate self-harm: findings from the world's first national registry. PLOS One 7(2), 31663.

Phillips, C. D., Patnaik, A., Moudouni, D. K., Naiser, E., Dyer, J. A., & Hawes, C., et al (2012). Summarizing activity limitations in children with chronic illnesses living in the community: a measurement study of scales using supplemented interRAI items. *BMC Health Service Research*, 12, 1–10.

Phillips, C. D. & Hawes, C. (2015). The interRAI pediatric home care (PEDS HC) assessment: evaluating the long-term community-based service and support needs of children facing special healthcare challenges. *Health Service Insights*, 8, 17–24.

Phillips, J. A. & Hempstead, K. (2017). Differences in U.S. Suicide Rates by Educational Attainment, 2000-2014. *American Journal of Preventative Medicine,* 53(4), 123-130.

Piatkowska, S. J. (2020) Poverty, inequality, and suicide rates: A Cross-National Assessment of the Durkheim Theory and the Stream Analogy of Lethal Violence. *The Sociological Quarterly*, 1-26.

Placidi, G. P. A., Oquendo, M. A., Malone, K. M., Brodsky, B., Ellis, S. P., & Mann, J. J. (2000). Anxiety in major depression: relationship to suicide attempts. *American Journal of Psychiatry*, 157, 1614–18.

Planansky, K. & Johnson, R. (1971). The occurrence and characteristics of suicidal preoccupation and acts in schizophrenia. *Acta Psychiatric Scand*. 47, 473-83.

Pompili, M. et al. (2010). Suicidal behaviour and alcohol abuse. *International Journal of Environmental Research and Public Health,* 7, 1392-1431.

Pompili, M., Innamorati, M., Vichi, M., Masocco, M., Vanacore, N., Lester, D., Serafini, G., Tatarelli, R., De Leo, D., & Girardi, P. (2011). Inequalities and impact of socioeconomic-cultural factors in suicide rates across Italy. *Crisis,* 32, 178–185.

Ponizovsky, A. M. & Ritsner, M. S. (1999). Suicide Ideation among Recent Immigrants to Israel from the Former Soviet Union: An Epidemiological Survey of Prevalence and Risk Factors. *Suicide and Life-Threatening Behavior*, 29(4), 376-392.

Powell, J., Geddes, J., & Hawton, K., et al. (2000). Suicide in psychiatric hospital in-patients. Risk factors and their predictive power. *British Journal of Psychiatry*, 176, 266-272.

Preti, A., Camboni, M. V., & Miotto, P. (2011). Eating disorders and suicide. The handbook of behavior, diet and nutrition. New York: Springer.

Preuss, U. W., Schuckit, M. A., Smith, T. L., Danko, G. P., & Buckman, K., et al. (2002). Comparison of 3190 alcohol-dependent individuals with and without suicide attempts. *Alcoholism: Clinical and Experimental Research,* 26, 471–77.

Prigerson, H. G., Desai, R. A., Lui-Mares, W., & Roseheck, R. A. (2003). Suicidal ideation and suicide attempts in homeless mentally ill persons. *Social Psychiatry and Psychiatric Epidemiology,* 38, 213–19.

Prinstein, M. J. (2008). Introduction to the special section on suicide and non-suicidal self-injury: A review of unique challenges and important directions for self-injury science. *Journal of Consulting and Clinical Psychology, 76,* 1-8.

Putnam, F. W., Guroff, J. J., Barban, L., & Post, R. M. (1986). The clinical phenomenology of multiple personality disorder: A review of 100 recent cases. *Journal of Clinical Psychiatry*, 47, 285–293.

Putnam, F. W. (1989). Diagnosis and Treatment of Multiple Personality Disorder. Guilford Press, New York.

Qin, P. & Nordentoft. M. (2005). Suicide risk in relation to psychiatric hospitalization evidence based on longitudinal registers. *Archives of General Psychiatry*, 62, 427-432.

Qin, P. (2011). The impact of psychiatric illness on suicide: Differences by diagnosis of disorders and by sex and age of subjects. *Journal of Psychiatric Research*, 45, 1445-1452.

Rabinowitz, J., Massad, A., & Fennig, S. (1995). Factors influencing disposition decisions for patients seen in a psychiatric emergency service. *Psychiatric Service*, 46(7), 712–718.

Ratkowska, K. A. & De Leo, D. (2013). Suicide in Immigrants: An Overview. *Open Journal of Medical Psychology*, 2, 124-133.

Ray, N. (2006). Lesbian, gay, bisexual and transgender youth: An epi- demic of homelessness. New York, NY: National Gay and Lesbian Task Force Policy Institute and the National Coalition for the Homeless.

Resnick, H. L. P. (1980). Suicide. Comprehensive Textbook of Psychiatry, ed 3. Bal1imore.

Ribeiro, J. D. & Joiner, T. E. (2009). The interpersonal-psychological theory of suicidal behaviour: Current status and future directions. *Journal of Clinical Psychology, 65*, 1291-1299.

Rosenvinge, J. H., Martinussen, M., & Ostensen, E. (2000). The comorbidity of eating disorders and personality disorders: A meta-analytic review of studies published between 1983 and 1998. *Eating and Weight Disorders*, 5, 52−61.

Rosenberg, L. (2011). Addressing trauma in mental health and substance use treatment. *The Journal of Behavioural Health Services & Research, 38*(4), 428-431.

Rowe, J. L., Conwell, T., Schulberg, H. G., & Bruce, M. (2006). Social support and suicidal ideation in older adults using home healthcare services. *American Journal of Geriatric Psychiatry*, 14, 758-766.

Roy, A., Mazonson, A., & Pickar, D. (1984). Attempted suicide in schizophrenia. *British Journal of Psychiatry*, 144, 303-6.

Rubenowitz, E., Waern, M., Wilelmson, K., & Allbeck, P. (2001). Life events and psychosocial factors in elderly suicides: a case-control study. *Psychological Medicine*, 31, 1193-1202.

Rubio, A., Vestner, A. L., Stewart, J. M., Forbes, N. T., Conwell, Y., & Cox, C. (2001). Suicide and alzheimer's pathology in the elderly: a case-control study. *Society of Biological Psychiatry, 49*, 137-145.

Rudd, M. D., Berman, A. L., Joiner, T. E., Nock, M. K., Silverman, M. M., Mandrusiak, M., Orden, K., & Witte, T. (2006). Warning signs for suicide: theory, research, and clinical applications. *Suicide and Life-Threatening Behaviour*, 36, 255–262.

Rudd, M. D. (2008). Suicide warning signs in clinical practice. *Current Psychiatry Reports*, 10, 87-90.

Ryan, C., Nielssen, O., Paton, M., Large, M. (2010). Clinical decisions in psychiatry should not be based on risk assessment. *Australasian Psychiatry*. 18, 398–403.

Sachs-Ericsson, N. J., Stanley, I. A., Sheffler, J. L., Selby, E., & Joiner, T. E. (2017). Non-violent and violent forms of childhood abuse in the prediction of suicide attempts: Direct or indirect effects through psychiatric disorders. *Journal of Affective Disorders*, 215, 15–22.

Saha, S., Chant, D., & McGrath, J. (2007). A systematic review of mortality in schizophrenia: Is the differential mortality gap worsening over time? *Archives of General Psychiatry*, 64, 1123–1131.

Sapolsky, R. M., Krey, L.C., & McEwen, B. S. (1986). The neuroendocrinology of stress and aging: the glucocorticoid cascade hypothesis. *Endocrinology Review,* 7, 284–301.

Sartorius, N., Jablensky, A., Korten, A., Ernberg, G., Anker, M., Cooper, J. E., & Day, R. (1986). Early manifestations and first-contact incidence of schizophrenia in different cultures. A preliminary report on the initial evaluation phase of the WHO Collaborative Study on determinants of outcome of severe mental disorders. *Psychological Medicine*, 16, 909–928.

Schmidt, N. B., Woolaway-Bickel, K., & Bates, M. (2000). Suicide and panic disorder: integration of the literature and new findings. In Suicide Science: Expanding the Boundaries. Boston: Kluwer Academy.

Serafini, G., Muzio, C., Piccinini, G., Flouri, E., Ferrigno, G., Pompili, M., Girardi, P., & Amore, M. (2015). Life adversities and suicidal behavior in young individuals: A systematic review. *European Child and Adolescent Psychiatry*, 24, 1423–1446.

Seyfried, L. S., Kales, H. C., Ignacio, R. B., Conwell, Y., & Valenstein, M. (2011). Predictors of suicide in patients with dementia. *Alzheimer's and Dementia,* 7, 567-573.

Shah, A.K. & De, T. (1998). Suicide and the elderly. *International Journal of Psychiatry and Clinical Practice*, 3-17.

Sher, L. & Kahn, R. S. (2019). Suicide in Schizophrenia: An Educational Overview. *Medicina*, 55, 361.

Shneidman, E. (1996). The suicidal mind. New York: Oxford University Press.

Shneidman, E. (1998). Further reflections on suicide and psychache. *Suicide and Life-Threatening Behaviour, 28,* 245-250.

Signorini A, De Filippo, E., Panico, S., De Caprio, C., Pasanisi, F., & Contaldo, F. (2007). Long-term mortality in anorexia nervosa: a report after an 8-year follow-up and a review of the most recent literature. *European Journal of Clinical Nutrition*, 61, 119–122.

Silverman, M. M., Berman, A. L., Sanddal, N. D., O'Carroll, P. W., & Joiner, T. E. (2007a). Rebuilding the tower of babel: A revised nomenclature for the study of suicide and suicide-related behaviours. Part 1: Background, rationale, and methodology. *Suicide and Life-Threatening Behaviour,* 37, 248-263.

Silverman, M. M., Berman, A. L., Sanddal, N. D., O'Carroll, P. W., & Joiner, T. E. (2007b). Rebuilding the tower of babel: A revised nomenclature for the study of suicide and suicide-related behaviours. Part 2: Suicide-related ideations, communications, and behaviours. *Suicide and Life-Threatening Behaviour,* 37, 264-277.

Sinason, V. (2002). Attachment, Trauma and Multiplicity: Working with Dissociative Identity Disorder. Brunner Routledge, Hove.

Sinclair, J. M. A., Hawton, K., & Gray, A. (2010). Six-year follow-up of a clinical sample of self-harm patients. *Journal of Affective Disorders,* 121(3), 247–252.

Smetanin, et al. (2011). The life and economic impact of major mental illnesses in Canada: 2011-2041. Prepared for the Mental Health Commission of Canada. Toronto: RiskAnalytica.

Smith, J. C., Mercy, J. A., & Conn, J. M. (1988). Marital status and the risk of suicide. *American Journal of Public Health,*78, 78–80.

Spiegal, D. (1984). Multiple personality as a post-traumatic stress disorder. *Psychiatric Clinics of North America*, 7, 101–110.

Statistics Canada, (2016). Immigration and ethnocultural diversity: Key results from the 2016 census. Accessed at: https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025b-eng.htm?indid=14428-1&indgeo=0

Statistics Canada, (2018). Deaths and age-specific mortality rates, by selected grouped causes, Canada, 2016. Table: 13-10-0392-01

Statistics Canada, (2019). Suicide in Canada: Key Statistics. Accessed at: https://www.canada.ca/en/public-health/services/publications/healthy-living/suicide-canada-key-statistics-infographic.html

Stansfeld, S. A., Clark, C., Smuk, M., Power, C., Davidson, T., & Rodgers, B. (2017). Childhood adversity and midlife suicidal ideation. *Psychological Medicine*, 47(2), 327–340.

Stein, D. J., Chiu, W. T., Hwang, I., Kessler, R. C., Sampson, N., Alonso, J., & Shea, B. J. (2010). Cross- national analysis of the associations between traumatic events and suicidal behavior: Findings from the WHO world mental health surveys. *PLOS One*, 5(5), e10574.

Stenager, E. N. & Stenager, E. (1992). Suicide and patients with neurological disease. Methodologic problems. *Archives of Neurology*, 49, 1296-1303.

Stenager, E. N., Madsen, C., Stenager, E., & Boldson, J. (1998). Suicide in patients with stroke: epidemiological study. *British Medical Journal*, 316, 1206.

Stewart, S. L., Currie, M., Arbeau, K., Leschied, A., & Kerry, A. (2015). Assessment and planning for community and custodial services: the application of interRAI assessment in the youth justice system. In: R Corrado, A Leschied (eds) Serious and violent young offenders and youth criminal justice: a Canadian perspective, SFU Publications, Vancouver.

Stewart, S. L., Poss, J. W., Thornley, E., & Hirdes, J. P. (2019). Resource intensity for children and youth: the development of an algorithm to identify high service users in children's mental health. *Health Service Insights*, 12, 1-11.

Sullivan, P. F. (1995). Mortality in anorexia nervosa. *American Journal of Psychiatry*, 152, 1073−1074.

Sullivan, P. F. (2002). Course and outcome of anorexia nervosa and bulimia nervosa. Eating disorders and obesity: A comprehensive handbook (2nd ed). New York: The Guilford Press.

Thompson, M. P., Kingree, J. B., & Lamis, D. (2019). Associations of adverse childhood experiences and suicidal behaviours in adulthood in a U.S. nationally representative sample. *Child Care and Health Development*, 45(1), 121-128.

Thordardottir, E. B., Valdimarsdottir, U. A., Hansdottir, I., Resnick, H., Shipherd, J. C., & Gudmundsdottir, B. (2015). Posttraumatic stress and other health consequences of catastrophic avalanches: A 16-year follow-up of survivors. *Journal of Anxiety Disorders*, 32, 103–111.

Turecki, G, & Brent, D. A. (2016). Suicide and suicidal behaviour. *Lancet*, 387(10024), 1227–39.

Unick, G. J., Kessell, E., Woodard, E.K., Leary, M., Dilley, J.W., & Shumway, M. (2011). Factors affecting psychiatric inpatient hospitalization from a psychiatric emergency service. General Hospital Psychiatry, 33(6), 618–625.

van der Kolk, B. A., Pelcovitz, D., Roth, S., Mandel, F. S., McFarlane, A., & Herman, J.L. (1996). Dissociation, somatization, and affect dysregulation: The complexity of adaptation to trauma. *American Journal of Psychiatry*,153, 83–93.

van Heeringen, C., Marusic, A. (2003) Understanding the suicidal brain. *British Journal of Psychiatry.* 183:282-4. doi: 10.1192/bjp.183.4.282.

van Heeringen, K. & Hawton, K. (2009). Suicide. *Lancet*, 373, 1372-81.

van Heeringen, K. (2012). The neurobiological basis of suicide: stress-diathesis model of suicidal behaviour. CRC Press: Taylor & Francis.

van Heeringen, K, & Mann, J. J. (2014). The neurobiology of suicide. *Lancet Psychiatry*, 1(1), 63–72.

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, 117, 575-600.

Varese, F., Smeets, F., Drukker, M., Lieverse, R., Lataster, T., Viechtbauer, W., Read, J., van Os, J., & Bentall, R. P. (2012). Childhood adversities increase the risk of psychosis: A meta-analysis of patient-control, prospective-and cross-sectional cohort studies. *Schizophrenia Bulletin*, 38, 661–671.

Verona, E., Patrick, C.J., & Joiner, T.E. (2001). Psychopathy, antisocial personality, and suicide risk. *Journal of Abnormal Psychology.* 110, 462–70.

Verona, E., Sachs-Ericsson, N., & Joiner, T. (2004). Analysis of suicide attempts in connection to externalizing psychopathology in an epidemiological sample. *American Journal of Psychiatry*, 161, 444–51.

Vijayakumar, L., Nagaraj, K., Pirkis, J., & Whiteford, H. (2005). Suicide in developing countries: frequency, distribution and association with socioeconomic indicators. *Crisis*. 26(3), 104–111.

Waern, M., Rubenowitz, E., Runeson, B., Skoog, I., Wilhelmson, K., & Allebeck, P. (2002). Burden of illness and suicide in elderly people: Case-control study. *British Medical Journal*, 324, 1–4.

Wahlbeck, K., Westman, J., Nordentoft, M., Gissler, M., & Laursen, T. M. (2011). Outcomes of Nordic mental health systems: Life expectancy of patients with mental disorders. *British Journal of Psychiatry*, 199, 453–458.

Way, B. B., & Banks, S. (2001). Clinical factors related to admission and release decisions in psychiatric emergency services. Psychiatric Services, 52(2), 214–218.

White, J. (2003). Suicide-related research in Canada: a descriptive overview. Ottawa, ON: Public Health Agency of Canada.

Wilson, S. H. & Walker, G. M. (1993). Unemployment and health: a review. *Public Health,* 107, 153–162.

World Health Organization. (2012). Public health action for the prevention of suicide: A framework. Geneva, Switzerland: Author.

World Health Organization. (2018). World Health Statistics data visualizations dashboard: Suicide. Accessed at: http://apps.who.int/gho/data/node.sdg.3-4-viz-2?lang=en

Xavier, J., Bobbin, M., Singer, B., & Budd, E. (2005). A needs assessment of transgendered people of colour living in Washington, DC. *International Journal of Transgenderism,* 8(2–3), 31–47.

Xu, K. B. & Li, W. Q. (2013). An ethical stakeholder approach to crisis communication: a case study of Foxconn's 2010 employee suicide crisis. *Journal of Business Ethics*, 117, 371–86.

Yen, S., Shea, M. T., Pagano, M., Sanislow, C. A., Grilo, C. M., McGlashan, T. H., & Morey, L. C. (2003). Axis I and axis II disorders as predictors of prospective suicide attempts: Findings from the collaborative longitudinal personality disorders study. *Journal of Abnormal Psychology,* 112, 375–381.

Yip, P. S. F., Chi, I., Chiu, H., Chi Wai, K., Conwell, Y., & Caine, E. (2003). A prevalence study of suicide ideation among older adults in Hong Kong SAR. *International Journal of Geriatric Psychiatry*, 18, 1056-1062.

Yip, P. S. F., & Liu, K. Y. (2006). The ecological fallacy and the gender ratio of suicide in China. *British Journal of Psychiatry,* 189, 465-466.

Zaheer, J., Links, P. S., & Liu E. (2008). Assessment and emergency management of suicidality in personality disorders. *Psychiatric Clinics of North America*, 31, 527-543.

Zuckerman, M. (1999). Vulnerability to psychopathology: a biosocial model. Washington, DC: *American Psychological Association.*

# Appendices

## Clinical Assessment Protocols (CAPs)

The **Trauma CAP** informs clinicians about an individual's history and experience of traumatic life events. This CAP includes triggers for immediate safety concerns and reducing the impact of prior traumatic life events. The following items from the RAI-MH are used to determine trigger levels: (1) intense fear, (2) serious accident, (3) death of a family member, (4) lived in war zone, (5) witnessed severe accident, (6) victim of crime, (7) victim of sexual assault, (8) victim of physical assault, (9) victim of emotional abuse, (10) fearful of family member, (11) concerns for safety, (12) family history of abuse.

The **Social Relationships CAP** informs clinicians about an individual's experiences of social isolation. This CAP includes triggers for reducing social isolation and family dysfunction and improving close friendships and family functioning. The following items from the RAI-MH are used to determine trigger levels: (1) withdrawal, (2) reduced social interactions, (3) social activities, (4) visit with family member, (5) other interaction with family member, (6) family overwhelmed by person's illness, (7) dysfunctional family relationship, (8) presence of confidant, (9) conflict-laden relationship

The **Interpersonal Conflict CAP** informs clinicians about an individual's dysfunctional interpersonal relationships and behaviours. This CAP includes triggers for reducing widespread conflict and reducing conflict within specific relationships. The following items from the RAI- MH are used to determine trigger levels: (1) anger, (2) conflict with staff/others, (3) conflict with family/friends, (4) staff report frustration in dealing with person.

The **Personal Finances CAP** informs clinicians about an individual's current financial situation. This CAP includes triggers for trouble due to economic hardship, and inability to manage finances. The following items from the RAI-MH are used to determine trigger levels: (1) competent to manage property, (2) finance – capacity, (3) economic trade-offs, (4) loss of income. The Personal Finances CAP triggers two groups of interest: (1) those who are experiencing economic hardship because of a major loss of income or poverty; and (2) those who are not experiencing hardship but who have been assessed to be incapable of managing property, including finances, or who require limited to total assistance to manage their finances.

The **Education and Employment CAP** informs clinicians about an individual's participation in school and/or employment. This CAP includes triggers for reducing the risk of unemployment or dropping out of school and supporting employment or educational participation. The following items

and scales from the RAI-MH are used to determine trigger levels: (1) insight into mental health, (2) failed education program, (3) employment status, (4) increase in absenteeism, (5) poor productivity, (6) intent to quit work, (7) persistent unemployment, (8) age, (9) ADL scale, (10) ABS scale, (11) CPS scale, (12) PSSL scale. Level 1 of the Education and Employment CAP is triggered to identify those who are at risk of losing employment or dropping out of school, characterized by (1) an increase in lateness or absenteeism over the last 6 months, (2) poor productivity or disruptiveness at work or school, (3) an expressed intent to quit work or school, and (4) a persistent unemployment or fluctuating work history over the last 2 years. Level 2 of the CAP is triggered to identify those who are in need of support for employment, educational participation, or involvement of volunteer activities, characterized by (1) persons of any age who are unemployed but seeking employment, (2) persons aged 15 to 65 years who are unemployed and are not seeking employment but who have minimal impairment in ADL and cognitive function, few indications of positive symptoms, full insight into their mental health condition, and minimal indications of behavioral problems, and (3) persons aged 10 to 30 who have recently dropped out of or failed school.

The **substance use CAP** informs clinicians about an individual's past and current history of substance abuse. This CAP includes triggers for current problematic substance abuse, and history of problematic substance abuse. The following items from the RAI-MH are used to determine trigger levels: (1) intentional misuse of medications, (2) number of alcoholic drinks in last 14 days, (3) inhalant use, (3) hallucinogen use, (4) cocaine use, (5) stimulant use, (6) opiate use, (7) cannabis use, (8) injection drug use, (9) told to cut down use, (10) bothered by criticism about alcohol/drug use, (11) guilt about drinking/drug use, (12) starts morning with alcohol/drugs, (13) social environment encourages use.

The **pain CAP** informs clinicians about an individual's current level of experienced pain. This CAP includes triggers for medium priority level and high priority level. The pain scale is used to determine the trigger level for this CAP, which itself incorporates items on pain frequency and pain intensity.

## Scales

The **Severity of Self-Harm (SoS)** is a clinical algorithm that is designed to assess an individual's risk for harming themselves. The SoS is calculated based on both individual items in the RAI-MH, as well as three other scales (one of which is based on the Emergency Screener for Psychiatry [ESP]). The scale ranges from 0-6, with higher scores representing increased risk for harming oneself. The following criteria for SoS are: (1) most recent self-injurious attempt, (2) intent of any self-injurious attempt was to kill themselves, (3) family/others concerned about person's risk for self-injury, (4) suicide plan, (5) score on the Depression Severity Index, (6) score on the Cognitive Performance Scale, (7) score on the ESP version of the PSS – Short.

The **Cognitive Performance Scale (CPS)** is a clinical scale that is generated to determine an individual's level of cognitive impairment. The scale ranges from 0-6, with higher scores signifying greater cognitive impairment. The CPS is calculated based on the following items in the RAI-MH: (1) short term memory, (2) cognitive skills for daily decision making, (3) making self-understood, (4) ADL self-performance (eating).

The **Risk of Harm to Others Scale (RHO)** is a clinical algorithm generated to determine the level of risk of harm an individual presents to others. The scale ranges from 0 to 6, with higher scores indicating increased risk of harm to others. The RHO is calculated based on the following items in the RAI-MH: (1) history of violence or extreme behaviour, (2) insight into mental health, (3) delusions, (4) difficulty sleeping, (5) score on the Positive Symptoms Scale – long, (6) score on the Aggressive Behaviour Scale, (7) score on the Violence Summary Scale.

The **Self-Care Index (SCI)** is a clinical algorithm based on psychiatric symptoms that is designed to assess an individual's inability to care for self. The scale ranges from 0-6, with higher scores representing decreased ability to care for self. The SCI is calculated based on the following items in the RAI-MH: (1) daily decision making, (2) insight into mental health, (3) decreased energy, (4) abnormal thought process, (5) making self-understood, (6) Score on the PSS Short, (7) Poor hygiene, (8) Score on the ESP version of the Mania scale, (9) anhedonia.

The **Social Withdrawal Scale (SWS)** is generated to determine an individual's level of withdrawal from social activities. The scale ranges from 0-12, with higher scores indicating greater social withdrawal. Social withdrawal is calculated based on the following items in the RAI-MH: (1) anhedonia, (2) withdrawal, (3) lack of motivation, (4) reduced social interaction.

The **Depressive Severity Index (DSI)** The DSI is a clinical scale that is generated to determine an individual's level of depressive symptoms. The scale ranges from 0 to 15, with higher scores signifying more depressive symptoms. The DSI is calculated based on the following items in the RAI-MH: (1) sad/pained facial expression (2) negative statements, (3) self-deprecation, (4) guilt/shame, (5) hopelessness.

The **Depression Rating Scale (DRS)** is a clinical scale that is generated to determine the level of an individual's negative mood. The scale ranges from 0 to 14, with higher scores indicative of more severe depression. The DRS is calculated based on the following items in the RAI-MH: (1) negative statements, (2) persistent anger, (3) unrealistic fears, (4) repetitive health complaints, (5) repetitive anxious complaints, (6) sad/worried facial expression, (7) Crying or tearfulness.

The **Positive Symptom Scale - Short (PSSS)** is a clinical scale that is generated to determine an individual's level of positive psychotic symptoms. The scale ranges from 0-12, with higher scores signifying more positive symptoms. The PSSS is calculated based on the following items in the RAI-MH: (1) hallucinations, (2) command hallucinations, (3) delusions, (4) abnormal thought process, (5) inflated self-worth, (6) hyperarousal, (7) pressured speech, (8) abnormal/unusual movements.

The **Mania Scale (MANIA)** is generated to determine an individual's level of manic symptoms. The scale ranges from 0-20, with higher scores signifying more manic symptoms. The mania scale is calculated based on the following items in the RAI-MH: (1) inflated self-worth, (2) hyperarousal, (3) irritability, (4) increased sociability/hypersexuality (5) pressured speech, (6) labile affect, (7) sleep problems due to hypomania

The **instrumental Activities of Daily Living (IADL**) is a clinical scale that is generated to determine an individual's level of functional capacity for more complex daily living. The IADL is calculated based on the following items in the RAI-MH: (1) meal preparation, (2) managing finances, (3) managing medications, (4) transportation, and (5) phone use. The scale ranges from 0-30, with higher scores signifying greater dependence on a variety of IADLs.

The **Activities of Daily Living (ADL)** hierarchy is a clinical scale that is generated to determine an individual's level of functional capacity for more basic daily living. The ADL is calculated based on the following items in the RAI-MH: (1) personal hygiene, (2) locomotion (walking/wheeling), (3) toilet use, and (4) eating. The scale ranges from 0-6, with higher scores signifying greater dependence on a variety of ADLs.