The Role of Technology in the Prevention and Intervention of Youth Suicide:
A Literature Review

by

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A Project submitted to the
School of Graduate and Postdoctoral Studies in partial
fulfillment of the requirements for the degree of

Masters of Education

Faculty of Education
Ontario Tech University
Oshawa, Ontario, Canada
August 2022

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University of Ontario Institute of Technology (Ontario Tech University)

PROJECT REVIEW INFORMATION

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Masters of Education in Faculty of Education

Project title:
      The Role of Technology in the Prevention and Intervention of Youth Suicide:
A Literature Review

The Project was approved on August 19, 2022 by the following review committee:

Review Committee:

Research Supervisor	Dr. Jennifer Laffier
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The above review committee determined that the Project is acceptable in form and content and that a satisfactory knowledge of the field was covered by the work submitted. A copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

ABSTRACT

As a result of the increase in youth mental health problems and suicide risks, there is a significant need to develop effective intervention and prevention programs for youth. An area lacking attention, and the goal of this paper, is to explore the role that technology plays within those programs, especially those for youth. The findings suggest that technology may support interventions further if they increase protective factors and may serve several roles such as increasing education and awareness, building avenues for communication and relationship building, screening individuals at risk, and providing support in times of crisis.

Keywords: suicide; prevention; technology; intervention; youth

AUTHOR'S DECLARATION

I hereby declare that this project consists of original work of which I have authored. This is a true copy of the work, including any required final revisions, as accepted by my committee.

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Alexandra Feder

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Chapter 1: Introduction

Suicide is a global problem that continues to draw attention from experts across the globe. According to the World Health Organization (2014b), around 800 000 people, globally, die by suicide each year with individuals dying by suicide every 40 seconds (World Health Organization [WHO], 2014b). In Canada, suicide is one of the leading causes of death (Kellner, 2021). There are an average of more than 10 deaths by suicide a day (Government of Canada, 2021).

Youth are at high risk for suicide. In 2019, suicide was the fourth leading cause of death among people ages 15-29 (WHO, 2021) and global statistics show that, after traffic accidents, suicide is the second most common cause of death for youth (WHO, 2014a). Youth may experience certain risk factors in life that put them at higher risk of developing mental health problems leading to suicide ideation. The transition from childhood into adulthood poses many challenges as youth navigate social, emotional, and physical changes (Bilsen, 2018). These challenges include, but are not limited to, significant decision-making regarding academics, social relationships, high expectations, insecurities, mental health problems, and forming identity (Bilsen, 2018; Centers for Disease Control and Prevention [CDC], 2021; Kaslow, 2022; Patton et al., 2016).

Recently there is recognition that the strategies put in place to minimize the spread of the global Covid-19 pandemic may be an additional risk factor for youth mental health problems possibly contributing to suicide (Mental Health Commission of Canada [MHCC], 2020; Pruitt et al., 2020). Aspects of the pandemic such as school disruptions, isolation, and the loss of socialization and job opportunities have all negatively impacted youth mental health (Vaillancourt et al., 2021). Additionally, due to social distancing, there has been a significant

increase in mental health concerns (Pruitt et al., 2020). McMaster Children's Hospital reported that there has been an increase of youth in crisis and those admitted for suicide attempts have tripled with contributing factors related to the pandemic (Hamilton Health Sciences, 2021).

In addition to these risk factors for suicide, technology has emerged as a potential risk factor for youth mental health problems and possibly suicide. Technology is a prominent part of the lives of youth (Organization for Economic Co-operation and Development [OECD], 2018), and may bring many benefits such as creativity, self-expression, or socialization (Robertson et al., 2012). However, there are growing concerns that with the growing reliance on technologies such as social media, mobile devices, and the internet, there may be negative effects on youth mental health such as internet addiction, increased feelings of loneliness, depression, and suicidal ideation (Children's Bureau, 2019; OECD, 2018; Reyes-Portillo, 2019; Song et al., 2014).

As a result of the increase in youth mental health problems and suicide risks, developing effective intervention and prevention programs to help reduce the prevalence of youth suicide would be worthwhile. Suicide intervention programs focus on working directly with at-risk individuals to treat suicidal thoughts and behaviour using strategies such as routine screening and assessments to allow professionals to respond appropriately (Substance Abuse and Mental Health Services Administration [SAMHSA], 2020). Prevention Programs focus on reducing the risk of engaging in suicidal behaviours through implementing strategies such as identifying at-risk individuals, providing access to care, creating protective environments, promoting connectedness with others, or building resilience and coping strategies for mental health problems from a young age (CDC, 2021; Suicide Prevention Resource Center [SPRC], n.d.). Programs that currently exist include components such as education and awareness curriculum, screening, or peer leadership (Katz et al., 2013). For example, some focus on building coping

skills, while others focus on developing awareness of signs or symptoms in self or others (Katz et al., 2013).

Intervention or prevention programs can be delivered through hospitals, mental health clinics, community organizations such as churches or community centers or even in schools. Schools are an effective way to reach youth (Miller et al., 2009). Children spending countless hours at school can receive free support as part of the educational programming and can receive multiple layers of support (teachers, programs, guidance counsellors). Some suicide programs are offered through schools (Katz et al., 2013; Miller et al., 2009). This includes programs such as Question, Persuade, Refer (QPR) (QPR Institute, n.d.), CARE (Care, Assess, Respond, Empower (Canadian Best Practices Portal [CBPP], 2016), and Sources of Strength (Sourcesofstrength, n.d.).

Some researchers have focused on the topic of youth suicide programs by conducting literature or systematic reviews. For instance, some studies have already explored the effectiveness of suicide programs for youth. In a review of the literature, Katz et al. (2013) reviewed school-based programs to provide a recommendation on the best-practice program. Out of the reviewed programs, only two programs for youth, Sources of Strength (Sourcesofstrength, n.d.) and the Good Behaviour Game (SPRC, 2017) were successful in reducing suicide attempts, while others were successful in reducing suicidal ideation and improving gatekeeper behaviours (Katz et al., 2013). Gatekeeper training (GKT) provides people in the community with the knowledge and competence to intervene with at-risk individuals and respond in appropriate ways (Jorm et al., 2018).

In another review of the literature, Gijzen et al. (2022) conducted a systematic review of studies to determine if school-based prevention programs that target risk factors of suicide, such

as depression, were as effective as prevention programs targeting the act of suicide. It was found that school-based prevention programs seemed to be more effective in the reduction of suicidal behaviour, rather than ideation (Gijzen et al., 2022). Ideation involves the thought process escalating before the behaviours begin (Angel, 2019).

Although the topic of youth suicide has been covered extensively in the literature and previous research has explored the effectiveness of programs, there are still areas that need attention. One area that lacks attention is the role of technology within suicide programs, including those for youth. With the advancement of technology as well as youths' natural desire to use technologies (Anderson & Jiang, 2018), it is worthwhile to explore the role that technology plays in existing or possible future intervention and prevention programs, especially those that may be available within educational institutions. Although technology use may be a risk factor for suicide (Children's Bureau, 2019; OECD, 2018; Reyes-Portillo, 2019; Song et al., 2014), it may also act as a protective factor (Berryman et al., 2017; Marchant et al., 2017; OECD, 2018; Oh et al., 2014) in the prevention of youth suicide. For example, the BlueIce mobile app, for youth, helps youth manage their emotions and provides youth with more accessible evidence-based support (Grist et al., 2018). As we move forward with new technologies, exploring the wide range of opportunities to support programs for youth may be beneficial in reducing the risk of suicide amongst individuals.

1.1 Research Problem

Utilizing technology in intervention programs for youth is a timely and appropriate integration to consider. Unfortunately, there has been little attention to the role technology can play within suicide intervention programs and initiatives, including those for youth. The few studies that do exist (Christensen et al., 2014; Cohen et al., 2022; Melia et al., 2020; MHCC,

2020) looked at the overall success of a program or tool, usually within a clinical setting, with little attention on the various roles technology may play. For example, Cohen et al. (2022) reviewed existing suicide supports for youth, focusing on crisis services and interviewed youth who used online crisis services. Results show that youth found it difficult to find details on websites in times of distress and emphasized the importance of the role of technology in providing access to interactive crisis support. Other studies explored the use of certain mental health apps to support people experiencing mental health problems (MHCC, 2020). Interestingly, this continues to be a challenge because the research cannot match the speed at which the mental health apps are being developed (Melia et al., 2020). Unfortunately, few mental health apps have been specifically designed for young people (Greenhalgh et al, 2021; Melia et al., 2020), limiting the research available on their effectiveness with youth (Grist et al., 2017). In addition, Melia et al. (2020) conducted a systematic review to examine the effectiveness of available mHealth technology tools (mobile phone apps focused on health and medicine) in reducing suicide. Results showed a mild reduction in depression, psychological distress, and self-harm and an increase in coping self-efficacy (Melia et al., 2020). However, there was no evidence that demonstrated a significant reduction in suicidal ideation and the focus of this study was not on youth, nor educational settings. Christensen et al. (2014), explored web-based interventions for suicide of all ages and suggested that interventions may be effective as long as the focus is specific to suicide instead of the various associated mental health issues.

What is missing in current research is an exploration of the role of technology within suicide programs and what purpose technology plays. In addition, there is little focus on youth programs specifically (Henry, 2020; Melia et al., 2020). For example, is technology utilized within suicide programs and programs for youth? If so, how is the technology used or what

purpose does it serve? Does technology make the programs more effective? When used in youth programs, does technology engage youth more?

This area needs attention for several reasons. There is a growing youth suicide problem in Canada that needs greater attention (Garriguet, 2021; WHO, 2014b). Approaches that appeal to youth, are effective, can be delivered within educational settings, and that incorporate technologies in effective ways should be explored (Crawford, 2021; Katz et al., 2013; Laffier, 2013; 2020). As stated earlier, technology is a part of youth's lives and a natural extension of their social, psychological, and academic environments. If technology plays such a large role in their daily lives, we should consider how it can act as a positive protective factor (Laffier, 2013). Understanding if technology can play a helpful and productive role can help intervention and prevention programs further engage at-risk individuals (WHO, 2014b). Additionally, exploring the role of technology can support research on how to best treat adolescents at risk for suicide (Katz et al., 2013). As suicide is a serious health issue (Crawford, 2021; WHO, 2014b), effective interventions need to exist to prevent suicide from becoming normalized (Kirmayer, 2007).

1.2. Research Purpose

The purpose of this research study is to contribute to the body of research on youth suicide and effective intervention programs and initiatives for youth suicide, especially those that can be delivered within educational or community settings. Suicide amongst youth is a national tragedy and an important public health issue in Canada (Kutcher & Szumilas, 2008). There are increasing rates of youth suicide (Crawford, 2021; Garriguet, 2021; UC Davis Health, 2021) across the globe and continued attention to this issue is needed.

With the rapid increase in technology design and application in the mental health field (MHCC, 2020), along with the increasing importance of technology in the lives of youth (Anderson & Jiang, 2018; OECD, 2018), it is worthwhile to explore the specific role technology

plays in intervention programs. Therefore, this research study aims to explore the role of technology in suicide intervention programs, including those aimed at youth. The main research question for this study is: ***What role does technology play or can it play in the intervention and prevention of youth suicide?*** There were several sub-questions that helped guide this overall exploration. These sub-questions included:

    a. What is the current state of youth suicide including risk and protective factors that influence intervention efforts?

    b. What role does technology play within suicide intervention efforts in general and those specifically aimed at youth?

The first sub-question, examining the current state of youth suicide, helps set the context for the issue of youth suicide. An up-to-date snapshot of youth suicide is needed to understand the current statistics and issues related to youth suicide. This includes an understanding of risk and protective factors for youth suicide. This awareness of risks and protective factors brings awareness to what intervention efforts should be focusing on to support youth. The second question seeks to explore the role that technology plays in suicide prevention and intervention programs, including those for youth. This question aims to understand how technology has or is being used in suicide intervention programs in general, including those for youth, and whether its role helps influence the overall success of programs.

By exploring these questions, valuable enhancements can be made to existing suicide prevention programs. Additionally, this information can support future efforts for youth within educational institutions or help inform educational content. There are several interventions in schools, such as responsible reporting of suicides, suicide awareness curriculum, screening students for mental health problems, and teacher training (Kutcher & Szumilas, 2008). However,

more attention needs to be paid to effective programs and those that engage youth (Hawton et al., 2012, 2015).

CHAPTER 2. METHODOLOGY

This chapter reviews the research methods used to explore the research questions. First, an explanation of the research design is explored along with a rationale. Next, the data sources and collection methods are discussed. This is followed by a review of the data analysis method for this study.

2.1. Research Design

To explore technology's role in youth suicide interventions, a literature review was conducted. Literature reviews explore seminal and current research and provide an in-depth analysis of a subject (Winchester & Salji, 2016). Literature reviews collect, summarize, and synthesize information (Purdue University, 2022) and consolidate what is already known, including any existing gaps that still remain in the literature (Winchester & Salji, 2016). A literature review also helps to determine how further research can contribute to a greater understanding of the topic. A literature review requires several steps (Ontario Tech University, 2022; Purdue University, 2022; Winchester & Salji, 2016). First, the data sources and collection method, including inclusion criteria, are determined. Next, the author of the literature review engages in a review of the selected literature to determine which information bests helps answer the research questions, based on the established inclusion criteria, specific to the focus of the research. This information is written into a synthesis of the findings highlighting key insights, commonalities, controversies, gaps in research and future research directions (Ontario Tech University, 2022). Literature reviews can be helpful for individuals interested in a specific area of research or drawing attention to a question that is yet to be explored (Purdue University, 2022).

2.2. Data Sources and Collection

To answer the research questions of this study a review of the existing research literature was conducted. Data sources for this study were research articles, as well as suicide-based websites and program documents. It was decided that to be included in this literature review the following inclusion criteria had to be met by research articles:

1. Research articles were written within the last 10 years to ensure that data was relevant.

2. Articles focused on suicide in general as well as on youth specifically (as well as mental health problems leading to suicide risk).

3. Articles could be Canadian or international studies

4. Suicide-based reports, handbooks or websites could be used if they provided directed information about the suicide programs.

The original goal was to include only studies that explored youth suicide programs with technology. However, after an initial scan of the literature, it became apparent that little literature existed on youth programs with technology. In addition, this researcher recognized that by exploring other programs (for adults or seniors as well) valuable information on the role of technology in intervention programs and initiatives could still be determined. This insight can contribute to the sub-question of how technology can be used in programs specifically for youth now, or in the future.

To effectively gather evidence on the role of technology in the prevention and intervention of youth suicide, databases from the Ontario Tech University library were used. This large central library database was convenient and effective for the author who is an Ontario Tech Graduate student. Databases within the library system used for this search included

EBSCOhost, OMNI, and PubMed Central. In addition, the author searched outside of the library

database using Google Scholar to search for peer-reviewed articles and journals as well as

various websites.

Keywords used in all searches were *"youth suicide", "youth suicide programs", adolescent*

suicide", "youth suicide interventions", "youth suicide preventions", "suicide", suicide

ideation", "risk and protective factors for suicide", "technology and suicide", and "mental

health technology", "suicide intervention programs", suicide prevention programs, and "suicide

initiatives". Using these keywords and the inclusion criterion a total of 135 articles and websites

were found to include in this literature review. Of the articles specifically focused on

technology's role within suicide programs, approximately 27 articles were related to youth

programs and 20 articles were related to programs for all ages.

Once articles were found online, they were downloaded and saved in online files

according to the research questions. Next, an annotated bibliography was created to record all

articles used for the study. This annotated bibliography included information such as names of

authors, years published, title, population, research methodology and questions, findings, key

highlights, and recommendations.

2.3 Data Analysis

When completing a literature review, it is necessary to analyze the results of multiple

studies to gain a deep understanding of a specific topic and draw conclusions (Popenoe et al.,

2021). In this literature, the data that was reviewed consisted of the results from published

research. To conduct the review of the literature, the annotated bibliography was reviewed

several times to determine the type of information and which research question it answered

(Popenoe et al., 2021). The articles were then organized by research questions. The next step was

to review the articles and code information thematically, to help answer the research questions, keeping the inclusion and exclusion criteria in mind (Popenoe et al., 2021). Information was separated, coded, and entered into a spreadsheet. This information was reviewed again to conduct a synthesis of the information, determining answers, insights, similarities, and controversies. The final step was to write the information out into a literature review organized by common themes that helped illustrate the role of technology in prevention programs, found in the existing literature.

CHAPTER 3: LITERATURE REVIEW FINDINGS

To understand the role that technology has in prevention and intervention efforts of youth

suicide, this literature review explored two main sub-topics in the literature related to the

research questions. First, to answer research question one, the current state of youth suicide

along with risk and protective factors, and common intervention and prevention approaches were

reviewed. Next, to answer research question two, the literature related to technology's role in

suicide programs was reviewed. This information is now presented in this order.

3.1 The Current State of Youth Suicide

Despite efforts to help prevent suicide, rates have remained stable or increased across the

globe (Martinez-Ales et al., 2020). In Canada and the United States, death by suicide is the

second leading cause for youth between the ages of 15 and 24 years of age (American Academy

of Child and Adolescent Psychiatry [AACAP], 2021; Canadian Mental Health Association

[CMHA], 2022; Crawford, 2015; Government of Canada, 2019; Kellner, 2021; Wilks et al.,

2021). There are more than 10 deaths by suicide a day (Government of Canada, 2021). These

numbers are alarming and point to a potential youth crisis. Recent statistics show that youth in

Canada are experiencing higher rates of decreasing mental health (MHCC, 2020). Due to various

health measures that were implemented in an effort to limit the spread of the global COVID-19

pandemic, youth have experienced an abundance of risk factors such as school disruptions,

isolation, loss of socialization, and the loss of job opportunities, negatively impacting the mental

health of many individuals (Vaillancourt et al., 2021). For at-risk individuals, the pandemic

posed additional challenges as they had limited access to the type of support that they received

prior to the pandemic, due to social distancing (Pruitt et al., 2020). The health measures that were

put in place may be a risk factor contributing to youth mental health problems as well as suicide (Pruitt et al., 2020).

3.1.1 Risk and Protective Factors

Our knowledge of risk and protective factors for youth suicide has expanded over the years. Experts understand that there are multiple levels and interconnectedness of suicidal risk factors for youth. Risk factors are conditions that can increase the risk of suicide among youth (Healthy Child Manitoba, 2014), however, the presence of risk factors does not always result in suicidal behaviour (WHO, 2014b). Risk factors can be organized into systemic and societal factors (WHO, 2014b), environmental, and individual health factors (American Foundation for Suicide Prevention, 2022). Knowing the risk and protective factors can be helpful in identifying appropriate interventions (WHO, 2014b).

Systemic and Societal Risk Factors. Although mental health awareness and advocacy has come a long way, there are still systematic and societal barriers that people face, putting them at a higher risk. For example, access to timely health care is imperative in reducing the risk of suicide (Cho et al., 2013). Unfortunately, there are barriers to accessing health care services (Kaslow, 2022) and, in many countries, services are limited (SPRC, n.d.). People from marginalized communities may find extra barriers to accessing health care services (Borenstein, 2020) due to economic inequality (Bor et al., 2017), racism and discrimination (Bailey et al., 2017), and the stigma within their communities (Olson, 2013). For example, in Canada, Indigenous peoples do not have equitable access to health services due to geography, which causes far distances to travel and longer wait times, health system deficiencies impacting the quality of care, and a lack of trust in health care providers (Horrill et al., 2018; Ringer, 2017).

In addition, the social stigma associated with mental health can be a barrier to developing help-seeking behaviour, leading to higher suicide risk (CDC, 2021; Clark, 2017; Kaslow, 2022; Witt et al., 2017). Social stigma stems from biased, stereotyped views of mental health, especially in the areas of cause, the person's level of control, and treatment or recovery processes (Zoppi, 2020). In the media, suicide is often portrayed incorrectly or with stigmatized portrayals (CDC, 2021; WHO, 2014b). The media often focuses on people who died by suicide instead of on suicide attempt survivors (Stage, 2010). Inappropriate reporting of suicide in the media can sensationalize and normalize suicide as an appropriate response to times of adversity, increasing the risk of suicidal behaviour (WHO, 2014b) in comparison with stories that feature other ways to cope (Mueller, 2019). For example, the youth series Thirteen Reasons Why was criticized for depicting suicide as an acceptable way to deal with psychological pain (Bates, 2019; Mueller, 2019). It was found that, following the release of this show, there were increased internet searches about suicide (Ayers et al., 2017) and increased admission to the hospital for self-harm (Cooper et al., 2018), suggesting that the show may have had an impact on its viewers (Mueller, 2019). It is important to understand the impact that the media and technology has on their viewers.

The advancement of technological has emerged as an additional potential risk factor, contributing to youth mental health issues and suicide (OECD, 2018). The Interpersonal Psychological Theory of Suicide (Joiner, 2009) states that three factors need to be present for a suicide. These are thwarted belongingness (the absence of meaningful connections), perceived burdensomeness (the perception of being a burden to others and society), and the acquired capability for suicide (the ability to initiate a suicide attempt) (Joiner, 2009). Aligning with the Interpersonal Theory of Suicide, the increased use of technology and social media may put youth

at risk as there are less meaningful human interactions and an increased sense of isolation (Anderson & Jiang, 2018; Miller, 2022).

Since 2010, there has been an increase in adolescents' usage of social media and electronic devices (Twenge et al., 2018). The internet is used for a variety of reasons, including texting, social media, and connecting to peers (Joshi et al., 2018; OECD, 2018). It has been weaved into the lives of youth and may bring many benefits such as creativity, self-expression, or socialization (Luxton et al., 2012; Robertson et al., 2012). Although technology has improved the quality of life for many around the world, research suggests that the motivation for using social media (Valkenburg & Peter, 2007) and the frequency of use (Andreassen et al., 2016) may have an impact on overall health. There is concern that there may be negative effects on youth mental health such as increased feelings of loneliness, depression, suicidal ideation, and internet addiction (Children's Bureau, 2019; OECD, 2018; Reyes-Portillo, 2019).

Owning a smartphone is common for teens (OECD, 2018). In 2019, the Pew Research Center conducted a national survey across the United States and found that 95% of adolescents have access to an internet-enabled smartphone or own one and 45% of teens are online almost constantly (Anderson & Jiang, 2018). The amount of time that youth spend on social media has increased (Rideout & Robb, 2019) and research shows a correlation between screen time, depressive symptoms, and suicide-related outcomes (Smith et al., 2021; Twenge et al., 2018). This can be due to decreased self-esteem due to unrealistic expectations of body image (Anderson & Jiang, 2018), a sedentary lifestyle, and an interrupted sleep routine (Smith et al., 2021). It can also be a result of a lack of face-to-face connection with their peers, leading to feelings of isolation. A study that was conducted between 2010 and 2015 gathered data from more than 500 000 adolescents and revealed that youth who spent three hours or more a day on a

device were 34% more likely to experience feelings of hopelessness or suicidal ideation (Heid, 2017). Further to this, youth who spent at least five hours a day on a device were 48% more likely to experience at least one suicide-related outcome (Heid, 2017).

The internet provides additional risks such as cyberbullying (Anderson, 2018; Kao, 2021) and the promotion of suicide (Memon et al., 2018). When online, youth are often more aggressive than they would be offline (Kao, 2021) due to the anonymity that the internet provides and the inability to see the impact of their actions (Anderson, 2018; Kao, 2021). Cyberbullying is harmful as messages reach larger audiences and the victims cannot escape (Anderson & Jiang, 2018; Luxton et al., 2012). Websites and other individuals that promote or support suicide can influence youth (Hawton et al., 2012). The increased popularity of attempting suicide through social networking sites (Memon et al., 2018) and video-sharing websites have led to concerns around normalizing self-injurious behaviours (Rossi & DeSilva, 2020) and suicidal contagion, increasing suicidal behaviour (Biddle et al., 2016).

Environmental Risk Factors. The community that an individual belongs to can increase the risk of suicide (Center for Addiction and Mental Health [CAMH], 2020). Youth may be exposed to traumatic events depending on the geographic location. For example, youth may encounter war and natural disasters (WHO, 2014b) as well as discrimination, isolation, abuse, and violent relationships (Government of Canada, 2016a; WHO, 2014b). The prevalence of suicide in a community and a lack of access to health care can also increase the risk of suicide (CDC, 2021).

People in marginalized communities such as refugees, First Nations, and individuals in the LGBTQ communities (Bachman, 2018; Kids Help Phone, 2016; MHCC, 2018; Statistics Canada, 2019; WHO, 2021) are at an increased risk of suicide. In Canada especially, these

vulnerable populations are at a higher risk in comparison to others their age, who are not a part

of these communities (Dyck, 2012). Suicide among the First Nations community is three times

higher than other Canadians, and nine times higher among Inuit communities (Kumar &

Tjepkema, 2019; Statistics Canada, 2019).

In countries with war and natural disasters, individuals may experience trauma and turn

to suicide because of the impacts on their social well-being, health, housing, and financial

security (WHO, 2014b). Further to this, relocation, or periods of transition (Casiano et al., 2013),

of vulnerable groups may also increase the risk of suicide due to feelings of isolation,

discrimination, and resentment (WHO, 2014b).

Along with the many challenges mentioned above, Covid-19 has brought on new

challenges and has significantly changed life for individuals around the world, impacting all

areas of daily living such as education, health care, businesses, and daily interactions (Henderson

et al., 2020). Among those impacted, children are among the most vulnerable and may

experience long-term consequences from Covid-19 (Henderson et al., 2020) and may be a risk

factor for youth mental health problems, possibly contributing to suicide (Henderson et al., 2020;

Pruitt et al., 2020). The pandemic has resulted in 5.7 million children and youth impacted by

education and social disruptions in Canada alone (Statistics Canada, 2021) negatively impacting

both their academic performance (Aurini & Davies, 2021) and their mental health (Kang et al.,

2021). This disruption in school has led to an increase in feelings of anxiety and depression, and

has also caused an increase in behavioural problems in youth (Fegert et al., 2020). This is due to

factors such as a loss of connection with peers and teachers, the fear of health, the loss of family

members, and a change in their daily routine (Vaillancourt et al., 2021). Restrictions put in place

to try and limit exposure to Covid-19 have impacted children as they had to stay home and

continuously adapt to the ever-changing situation (Henderson et al., 2020). This, along with the effects of social isolation, stress, and loss of family and friends are contributing to mental health problems (Pfefferbaum & North, 2020). While this has impacted most Canadian youth, it has had the greatest impact on those with pre-existing mental health problems (Hawke et al., 2021), those in racialized communities (Ezell et al., 2021), and those living in adverse socio-economic conditions (Whitehead et al., 2021).

Individual Risk Factors. Individual risk factors such as mental health and a history of suicide, put youth at risk of suicide. While risk factors can change over time, an adolescent is at an increased risk if they have a history of mental or substance abuse problems, if they exhibit impulsive behaviours, if they experience loss or unexpected and unpleasant life events, a past suicide attempt, family violence of history of suicide, and if they have exposure to the suicidal behaviour or others, either in real life or in the media (CDC, 2021; John Hopkins University, 2022; Kaslow, 2022). Although many people living with mental health issues, such as depression and substance use disorders, do not attempt suicide (CAMH, 2022; WHO, 2014b), experts say that those with mental health issues are at an increased risk (American Foundation for Suicide Prevention [AFSP], 2022) increasing with mental health comorbidities (CAMH, 2018; Miller et al., 2015; Scardera et al., 2020).

Mental health problems, trauma, or negative life experiences may cause youth to experience feelings of isolation and feel disconnected from people in their social circle (WHO, 2014b). Children who do not feel supported by significant people in their life can lead to feelings of isolation (Kaslow, 2022) and, when compounded with other risk factors, pose an increased risk of suicide (WHO, 2014b).

The mental health problem, depression, has a strong correlation to suicide (AFSP, 2022; CAMH, 2022). Depression is a common illness that affects approximately 5% of adults (WHO, 2022) and one in five adolescents (Smith et al., 2021) around the globe (WHO, 2022). Although depression is treatable, most youth do not receive help (Smith et al., 2021) and can leave youth feeling hopeless and helpless, thus struggling to enjoy life (CAMH, 2022; Torres, 2020). Many youths who suffer from depression experience suicidal ideation (AACAP, 2021; Smith et al., 2021).

An individual's level of mental health knowledge may also impact their risk level. Individuals with low mental health literacy may have difficulty identifying when they need help (SPRC, n.d.). Sometimes low mental health literacy can lead to self-stigma. Self-stigma is the negative attitude that people have about their own mental illness (Borenstein, 2020). Some effects of self-stigma include a sense of reduced hope, decreased self-esteem, strained relationships, and the reduced likelihood that individuals will seek help, or continue with their course of treatment (Borenstein, 2020). A low level of mental health and suicide literacy could be a result of limited exposure to mental health services, awareness campaigns, or at-risk individuals (Al-Shannaq & Aldalaykeh, 2021). It is important to increase levels of mental health and suicide literacy and decrease the stigma toward suicide in youth.

Protective Factors. In times of adversity, having access to supportive resources, a stable living situation, strong friendships, and a supportive family, is helpful when addressing risk factors (Bilsen, 2018). Risk factors can undermine this support while protective factors strengthen an individual's ability to cope (Bilsen, 2018; WHO, 2014b) and mitigate risks of suicide (Kaslow, 2022) by increasing resilience and strengthening feelings of connectedness (Johnson et al., 2011; WHO, 2014b). Protective factors can reduce the likelihood of suicidal

behaviour (Nazeer, 2016; TeacherVision, 2019). It is important that communities, as well as intervention programs, attempt to not only mitigate risks but increase the presence of protective factors (CAMH, 2022).

Strong Relationships and a Sense of Community. A sense of community is crucial in protecting individuals from the risk of suicide. When individuals are in times of crisis and distress, they often turn to people in their social circle such as family members, friends, and significant others for support (Kaslow, 2022; WHO, 2014b). Having strong connections can help mitigate the risk of self-harm and suicide, as it provides the individual with a sense of love and support (Kaslow, 2022). Building, strengthening, and maintaining healthy close relationships between families, friends, and people in the community, can help individuals build resilience and lessen the risk of suicide (Kaslow, 2022; WHO, 2014b). Parents who are willing to seek help for their children can help reduce the risk of suicidal behaviour (Kaslow, 2022).

Schools can help offer youth a sense of community and safe relationships. School connectedness is the belief that school personnel care about students academically and personally and can lead to a decrease in risky behaviours (CDC, 2018; The Ottawa Child and Youth Initiative [OCYI], 2019) and is very important in a student's healthy development (OCYI, 2019). In a study conducted by Marraccini and Brier (2017), results showed that students with a sense of connection to their school were less likely to have suicidal ideation or experience a suicidal attempt. For individuals who have difficulty engaging with their peers, a strong sense of school connectedness is important (CDC, 2018). As school personnel are in contact with youth daily, schools can help develop coping skills and build resilience (American Institutes for Research, 2022; OCYI, 2019).

Teachers play an important role in the prevention of youth suicide (SPRC, 2019). It is important that students have healthy role models and caring adults in their life, and for many students, teachers can play this role (TeacherVision, 2019). By creating a sense of connectedness in the classroom, teachers can connect with their students (Connecticut State Suicide Advisory Board [CTSAB], 2017), foster a positive sense of well-being in their students, and help them interact with each other in meaningful ways (SPRC, 2019). Additionally, as teachers are in daily contact with their students, they can act as gatekeepers who could recognize and act on any unusual behaviour or risk of self-harm (CTSAB, 2017; SPRC, 2019). Since teachers may encounter at-risk youth, it is important that teachers are trained and prepared to support these students (Stickl Haugen et al., 2022) to increase teachers' feelings of self-efficacy.

Coping Strategies. Effective coping strategies help individuals manage challenging situations (Al-Dajani et al., 2022) and protect against the risk of suicide (Sisask et al., 2008). Important coping skills have been identified as problem-solving, emotional regulation, and support seeking (Stone et al., 2018) as these strategies can help equip youth with the tools that they need to adapt in challenging situations (Government of Canada, 2016b; White, 2016). It is important that individuals are aware of various coping strategies that are available to allow them to have more control over their choices and next steps (Bazrafshan et al., 2014).

Examples of coping strategies include journaling, breathing exercises, and creating and using a safety plan (Kids Help Phone, 2022). Having a trusted person to talk to, such as a friend, family member, doctor, or crisis line worker (Al-Dajani et al., 2022; Jones, 2017) and thinking about reasons for living, can help youth in times of distress (Al-Dajani et al., 2022). Help-seeking is a coping strategy that is especially important in the early intervention of suicide, however, many people, males especially, refrain from doing so, increasing the risk of suicide

(WHO, 2014b). Maintaining healthy lifestyle choices such as exercise, sleep, diet, healthy relationships, and the effective management of stress all help protect against the risk of suicide (Davidson et al., 2013, Sarchiapone et al., 2013).

Universal school programs that help teach and develop coping skills would be helpful in the prevention of suicidal thoughts in youth (Khurana & Romer, 2012). Coping strategies do not always come naturally to youth and, as such, many schools teach coping strategies such as mindfulness and emotional regulation skills (Stutey et al., 2021). Research shows that practicing mindfulness has decreased feelings of depression in youth (Dunning et al., 2019) and having confidence in the benefit of coping skills, results in lower suicidal ideation in youth (Al-Dajani et al., 2022). In a study that looked at coping skills and the association with youth suicidal ideation, it was found that youth who received professional support had lower suicidal urges after the encounter (Al-Dajani et al., 2022).

Technology as a Protective Factor. Although there are risks, research suggests that technology offers positive benefits and can provide its users with protective factors (Berryman et al., 2017; Marchant et al., 2017; OECD, 2018; Oh et al., 2014; Skinner & McFaull, 2012). There are many barriers to accessing mental health services and technology might help to address existing barriers such as stigma, geography, and limited access to health care professionals (Berrouiguet et al., 2018; Kreuze et al., 2017) by providing a safe space to access support. For individuals working with health care professionals, technology may be used in conjunction with face-to-face care, during times in between sessions (Hermes et al., 2019). Technology can help predict and respond to at-risk individuals (Armey, 2022).

Technology can be used to create community. Social media offers users ways to connect with others with similar experiences, providing individuals with a sense of community

(Anderson & Jiang, 2018; Stout, 2018). For those that have trouble connecting with others in person, technology can provide a sense of connection (Miller, 2022; Stout, 2018). Social Media has been linked to decreased levels of loneliness and increased feelings of belonging, life satisfaction, and perceived access to social support (Reyes-Portillo, 2019).

Online support groups and social media sites for suicide prevention can provide resources and support and act as a prevention aid for those with suicidal ideation (Anderson & Jiang, 2018; Skinner & McFaull, 2012). The most commonly used platforms are YouTube, Instagram, and Snapchat (Anderson & Jiang, 2018) where youth may also try new social skills and receive support which may be otherwise difficult to receive in a face-to-face setting (Daine et al., 2013). Social media can be used to spread positive and supportive messages (Stout, 2018).

Technology can also be used in the identification of at-risk individuals. Aside from self-administered screening tools, and live access to support, technology can help trusted adults identify at-risk individuals by accessing posts or messages on social media that may otherwise be unknown, leading to appropriate intervention in times of crisis (Stout, 2018).

3.2 Intervention Approaches for Suicide

Early prevention and intervention are important and can help ensure that people are accessing the appropriate resources (WHO, 2014b). Intervention programs should always be based on research and, although it is known that suicide is the result of many factors, more recent research focuses on a single risk factor rather than the effect of multiple risk factors, combined (Franklin et al., 2017). Suicidal thoughts and behaviours often first occur during adolescence (Esposito-Smythers et al., 2014) however, these thoughts are not often accompanied by help-

seeking behaviour due to the stigma around mental health and low levels of mental health literacy (SPRC, n.d.).

Prevention and intervention strategies can be universal, selective, or indicated (WHO, 2014b). Universal prevention strategies aim to target the entire population (WHO, 2014b). Examples of universal prevention strategies include restricting access to lethal means and firearms, health policies that control the access to painkillers, and putting physical barriers in places where jumping is likely to occur (Zalsman et al., 2016). Responsible media reporting is another important strategy as it can lessen the amount of glamorized or sensationalized suicide (Government of Canada, 2016b; Sisask et al., 2012), which is associated with higher rates of suicide among youth (Sisask et al., 2012). To help combat this, many countries have implemented guidelines around the coverage of suicide in the media (CAMH, 2020). Public education and awareness and school-based programs also help prevent suicide as, for at-risk individuals, it can increase hope, mental health literacy, and awareness around suicide, helping to reduce suicidal ideation in youth (Oliver et al., 2010). Selective prevention strategies aim to target groups of at-risk individuals (WHO, 2014b). For example, at-risk groups may include indigenous persons, those with depression, and youth. As stated earlier youth have high rates of suicide completions and attempts in Canada (MHCC, 2014). One selective prevention strategy that has proven to be successful is the use of physician education to help physicians recognize and treat depression, reducing the number of suicides that occur (Zalsman et al., 2016). Another important strategy is the use of suicide screening, specifically in schools and primary care settings, as they help to identify at-risk individuals and provide additional assessment and treatment, as needed (Zalsman et al., 2016). Gatekeeper training is another prevention strategy that involves training professionals and community members in at-risk populations (Zalsman et

al., 2016). By providing this training, people will be able to identify warning signs and respond appropriately by referring them to mental health professionals (Zalsman et al., 2016). Indicated prevention strategies aim to target individuals already identified as a high risk for suicide (WHO, 2014b). A commonly used strategy is the risk assessment which examines risk factors, warning signs, protective factors, and other information (CAMH, 2018) which helps provide information about the person's suicide risk and develop a catered plan specific to the individual (CAMH, 2020). Maintaining contact with at-risk individuals has shown to be somewhat effective but more research is needed (CAMH, 2020). Medication is also an indicated prevention strategy (CAMH, 2020).

Although these types of suicide prevention strategies can be implemented on their own, comprehensive, and integrated strategies are most effective (Public Health Agency of Canada [PHAC], 2016). Implementing multi-level strategies nationally helps reduce suicide rates, specifically among seniors and youth (Matsubayashi & Ueda, 2011).

3.2.1 School-Based Interventions and Initiatives

There are many school-based suicide prevention programs aimed at youth that exist (Katz et al., 2013). In a review of the literature, Katz et al. (2013) uncovered 16 school-based programs that incorporated common elements of prevention programs such as suicide awareness curricula, screening, general skills training, gatekeeper, and peer leadership training. Out of the 16 programs, Katz et al. (2013) found that only two were successful in reducing suicide attempts, while others were successful in reducing suicidal ideation and improving gatekeeper behaviours.

School-based programs can be universal, using curricula that are implemented schoolwide, or indicated, targeting and working closely with at-risk individuals (Miller et al., 2009). Many experts see schools as one of the most effective ways to reach youth since that is

where they spend most of their time (Miller et al., 2009). Gatekeeper training is a common element in prevention programs. This involves training professionals, school staff, and community members in at-risk populations to identify warning signs in others and respond appropriately, referring them to mental health professionals (Zalsman et al., 2016).

There were several examples of suicide intervention programs used in schools in the literature. Signs of Suicide (SOS) is an evidence-based universal program for youth which focuses on implementing curricula. It promotes the idea of suicide as being directly related to mental illness instead of being a normal response to stress (Katz et al., 2013; Volungis, 2020) and that seeking help is beneficial (Volungis, 2020). The program aims to reduce youth suicide by educating others to recognize the signs of suicide and depression in both themselves and those around them (Schilling et al., 2015; Singer et al., 2019). The SOS program incorporates videos and classroom materials to implement in the classroom to increase awareness around mental health, depression, and suicide, improve attitudes and efficacy around intervening, recognize signs in others and encourage them to seek help and inform an adult (Schilling et al., 2015; Volungis, 2020). Katz et al. (2013) found that this program had various short-term effects such as a reduction in suicide attempts and increased knowledge, however, this program did not decrease suicidal ideation or have an impact on the desire to seek help if needed. The program is implemented in classrooms after school staff undergo training about the program and how to effectively provide supportive environments for their students (Volungis, 2020). The Signs of Suicide program has demonstrated a reduction in suicide attempts but is not designed to address underlying causes of attempts, resulting in no reduction in ideation (Katz et al., 2013). More research on the effectiveness in various communities is needed (Katz et al., 2013).

Another program named Question, Persuade, Refer (QPR), is a universal program that trains people in the school community, such as students and teachers, to recognize risk factors in their peers or students and get help for someone in crisis. This program has influenced knowledge and awareness, however, not all trained staff feel comfortable approaching at-risk students (Katz et al., 2013). Additionally, this program did not seem to encourage at-risk individuals to use additional mental health services (Katz et al., 2013).

The TeenScreen self-reporting tool for youth is used in schools and other care settings to help identify those at-risk (Katz et al., 2013). Students who use this tool indicate how they are feeling and, if certain risk factors are selected, are interviewed to determine if they should seek help (Scott et al., 2009). It was found that this tool was helpful in identifying at-risk individuals and increasing knowledge and attitudes around suicide, however, this tool is time-sensitive and can miss students if they are not at-risk at the time of use (Katz et al., 2013). It is also dependent on the referral to additional services (Katz et al., 2013).

The Sources of Strength is a universal program for youth that helps strengthen protective factors and reduce the chance that individuals will turn to suicide (Sources of Strength, n.d.). As part of this program, students are selected and trained as peer leaders (SPRC, 2011). By increasing their awareness, students sent out positive messaging about suicide to the student body to foster coping skills and communication between youth and trusted adults (SPRC, 2011). Peer leaders are able to recognize at-risk youth in the school and help their peers seek the assistance of a trusted adult (SPRC, 2011; Wyman et al., 2010).

In a study conducted by Wyman et al. (2010), 18 schools implemented this program. It was found that trained peer leaders were four times as likely to refer a suicidal friend to an adult, compared to untrained peers. The Sources of Strength program made help-seeking seem more

acceptable as well as reduced suicide among the school population (Wyman et al., 2010). Sources of Strength is the only program that has demonstrated the ability to improve gatekeep behaviour, attitudes, and knowledge about suicide.

The Good Behavior Game (GBG) is a universal program for students in early elementary school. It is classroom-based and uses teamwork and behaviour management to help children develop intrinsic self-regulation (Katz et al., 2013; SPRC, 2017). A positive and supportive classroom environment is created through teamwork as students work towards meeting standards of behaviour developed by their teacher (Katz et al., 2013; SPRC, 2017). This program has positively impacted key risk factors, such as substance use in youth (Wilcox et al., 2008).

3.3 The Various Roles of Technology

A main aim of this research study was to explore the role of technology in suicide intervention and prevention programs and initiatives, including those for youth. The desire was to understand how technology was used in programs, what function it played within the programs, and how it contributed to the aims and success of programs, including addressing the risk and protective factors, especially those that youth experience. In this section, the literature pertaining to technology's role in suicide interventions is reviewed. The review included programs aimed at all ages as well as youth specifically to determine the existing role of technology in all programs and how they were used specifically within youth programs. Overall, this review of the literature determined that there are several existing suicide intervention initiatives specifically using technology (n= 12), of which seven were youth-specific programs. The type of technologies and their roles varied in programs. We will now explore this summary of findings more in-depth.

Overview of the Current Usage of Technology

Historically, suicide prevention was in the form of mailings, brochures, billboards, radio, television campaigns, phone calls (Luxton et al., 2011) and medication as at-risk individuals often had underlying conditions, such as depression (Vahabzadeh et al., 2016). With the recent shift in the technological landscape for young people (Anderson & Jiang, 2018), digital suicide prevention and intervention programs may be an attractive alternative with lots of potential (Reyes-Portillo, 2019). At-risk individuals, such as youth, are more inclined to seek help from digital interventions than face-to-face treatment (Wilks et al., 2021) as they bring many benefits such as accessibility (Greenhalgh et al., 2021; Kuosmanen et al., 2018) anonymity, convenience (Tingley et al., 2020), and the ability to objectively assess individuals (Vahabzadeh et al., 2016).

The use of digital interventions has become more popular. Currently, there are over 15000 mHealth apps available worldwide with approximately 5000 targeted at mental health (Greenhalgh et al., 2021). With the prevalence of technology in the lives of adolescents, it seems logical to merge technology and interventions. Research shows that 92% of teenagers report going online daily (Perry et al., 2016) and approximately 64% of teens reported that they already use apps to help with their mental health (Rideout & Robb, 2019). Although the main reason for adolescent technology usage is social media (Anderson & Jiang, 2018), adolescents see other benefits of technology (Stallard et al., 2018) such as providing alternate ways to access support (Grist et al., 2018; Reyes-Portillo, 2019) while reducing the stigma around help-seeking behaviour (Weare, 2015). Currently, many mHealth apps have been used in conjunction with health services (East & Havard, 2015), however, few have been specifically designed for young people (Melia et al., 2020), limiting the research available on the effectiveness of these apps, specifically for youth (Grist et al., 2017).

The literature revealed various elements that were common in intervention efforts. These themes could be helpful in suggesting how technology may serve very different roles within intervention efforts. These main roles included (1) education and awareness, (2) communication and relationship building, (3) screening, and (4) support in times of crisis. The most common role technology played was education and awareness. Although distinct roles were uncovered, it was evident that technology often served multiple roles and purposes within programs. These four roles will now be explained with examples. In addition, how the technology role fits within youth programs will be discussed.

3.3.1. Education and Awareness

Educating individuals and increasing awareness around suicide is a common element of existing prevention programs. Many programs use education and awareness programs to increase knowledge about youth suicide (Healthy Child Manitoba, 2014). It is important to ensure that the timing of education programs is appropriate, specifically that other types of programs, including training for staff, come before the delivery of education programs and that programs are not implemented at times of heightened suicide risk in the school or community (Healthy Child Manitoba, 2014). As students are around their peers more than school staff, it is important to include students in the development of suicide programs as well as training them to support their peers while being cautious not to trigger other individuals who may be at risk (Healthy Child Manitoba, 2014).

Curriculum and Gatekeeper Training helps students become more familiar with symptoms of suicide, enabling them to recognize these in themselves and their peers (Katz et al., 2013). The ability to recognize risk factors, and at-risk individuals, and possessing the ability to respond effectively can play a pivotal role in suicide prevention and intervention. Research has

shown that youth who experience suicidal ideation are more likely to tell their peers, as they are with their friends more frequently than they are with mental health professionals (Coyle, 2014). Some programs with an education focus use technology in the form of video and texts for training and interactive websites to help increase knowledge around the topic of suicide.

An example of an educational program is Signs of Suicide (SOS) program. It is an evidence-based universal program for youth which focuses on a school-wide implemented curriculum and promotes the idea of suicide as being directly related to mental illness instead of being a normal response to stress (Katz et al., 2013). This program aims to increase awareness around mental health, depression, and suicide and recognize warning signs in themselves and others and to inform an adult (Schilling et al., 2015; Singer et al., 2019). In a systematic review of school-based suicide prevention programs, Katz et al. (2013) found that this program had various short-term effects such as a reduction in suicide attempts and increased knowledge, however, this program did not decrease suicidal ideation or have an impact on the desire to seek help if needed. The program itself is implemented in classrooms after school staff undergo training and should be coupled with ongoing support regarding implementation and suicide response (Volungis, 2020). The Signs of Suicide program has demonstrated a reduction in suicide attempts but is not designed to address underlying causes of attempts, resulting in no reduction in ideation (Katz et al., 2013). More research on the effectiveness in various communities is needed (Katz et al., 2013).

The 8 Lives online suicide prevention program, for all ages, uses text and video to increase knowledge and awareness in its users, reduce the stigma around suicide, and increase expectations around self-efficacy of coping skills and resilience in stressful situations (Dreier et al., 2021). This program provides online reports about lived experiences of suicide, fact sheets,

cognitive-behavioural exercises, and worksheets (Dreier et al., 2021). After creating their profiles, users are given access to videos of lived experiences tailored to their individual suicide experiences, as indicated in their profiles (Dreier et al., 2021). The program includes resources for users with suicidal thoughts, those with suicidal attempts, those who have experienced a loss by suicide, those who have a concern for a close suicidal person, and generally interested people (Dreier et al., 2021). During the program, individuals have access to external professional support services via online links and telephone numbers of national and regional services, crisis lines, and locations of emergency mental health services (Dreier et al., 2021). Additionally, participants can be in indirect contact, through videos, with people affected by suicidality (either self-affected or affected as a close person) to learn about various authentic experiences of suicide while focusing on hope and the ability to overcome a crisis. The program intends to raise awareness of suicide and empower participants to talk about the topic of suicide within their community, including people that they are close with and mental health professionals (Dreier et al., 2021).

3.3.2. Communication and Relationship Building

Another common role in youth programs was the purpose of communication and relationship building. For youth specifically, having strong connections with others is important due to their developmental needs of belonging and fitting in with their peers (Leibovich et al., 2018). The ability to communicate, share stories, and find others who are like-minded is another important element that could be included in suicide prevention programs. As individuals are often more willing to share their stories online (Coyle, 2014), technology can help build community and support at-risk individuals (Anderson & Jiang, 2018).

Social networking sites and social media are used to share experiences, support others, and are sometimes used to remember and acknowledge those who have died by suicide (Thorn et al., 2020). Among American teenagers, YouTube, Instagram and Snapchat are the most popular forms of Social Media (Anderson & Jiang, 2018). The impact of using social media varies for youth as some users view it as positive, and others, as negative (Anderson & Jiang, 2018). Social networking sites are used for entertainment, but more importantly, to maintain and develop connections with others who share similar interests or experiences (Anderson & Jiang, 2018). As a result, users can feel a decreased sense of loneliness, increased feelings of belonging, life satisfaction, and perceived access to social support (Anderson & Jiang, 2018; Reyes-Portillo, 2019). Individuals can also use social media to gain access to news and information (Anderson & Jiang, 2018), and form online support groups, potentially acting as a prevention aid for those with suicidal ideation (Skinner & McFaull, 2012).

Websites have been used by individuals looking for support. Websites that share individual stories and personal accounts can help reduce stigmatization (Corrigan, 2011). Livethrougthis.org (Stage, 2010) is an organization that aims to change public awareness and attitudes about suicide, reduce discrimination against suicide attempt survivors, provide a community for those experiencing suicidality or who have experienced loss due to suicide, and to provide education about suicide or be used as a teaching tool (Stage, 2010). Users of all ages can find a gallery of portraits and read stories of suicide attempt survivors helping to break stereotypes and show that suicide has the potential to affect everyone (Stage, 2010), reducing feelings of stigma and isolation, increasing a sense of belonging.

3.3.3. Screening

Screening tools can help identify youth who are at risk of suicide and help promote help-seeking behaviour (Healthy Child Manitoba, 2014). Another important role of technology is its ability to screen individuals who may be at risk. This role was found in nine youth programs reviewed for this study.

An existing barrier to help-seeking behaviour is the difficulty that youth have in recognizing and identifying their symptoms (Christensen et al., 2011). Research supports the importance of implementing screening programs in health care settings as approximately 80% of people who die by suicide are in contact with their care provider within the final year prior to their death, and nearly 44% of individuals are in contact with their provider within a month of their death (Stene-Larson & Reneflot, 2019).

Screening is important, specifically in schools and primary care settings, as they help to identify at-risk individuals and specifically look for risk factors such as depression, past suicidal behaviour, and addiction (Katz et al., 2013). Screening tools provide additional assessment and treatment as needed (Zalsman et al., 2016) however, they are only effective if referral services are available (Katz et al., 2013). In addition to screening, risk assessments examine various factors, such as risk and protective factors and warning signs (CAMH, 2018) and can help develop an individualized plan based on a person's suicide risk (CAMH, 2020).

Screening tools can also be used to identify at-risk individuals through internet searches. A primary indicator of an at-risk teen is if they had searched the internet or social media about suicide (Kids Help Phone; 2016). Social media and search engines, such as Google and Yahoo, have the capability of monitoring information and conversations had by their users (Christensen et al., 2014; Luxton et al., 2012). When keyword searches that suggest suicidal ideation or intent

are detected, these websites have the capability to provide messages and resources, such as videos and links, to help support those users (Christensen et al., 2014; Luxton et al., 2012).

Additionally, computerized speech analysis and facial recognition can help identify vulnerable individuals by finding differences in the way that they speak (Larsen et al., 2015; Vahabzadeh et al., 2016) and how their facial expressions change in response to various videos (Vannoy et al., 2016). With this capability, technology can help develop a way to assess suicidality in individuals who may be reluctant to express their thoughts, feelings, and eventual plans (Vannoy et al, 2016).

Youth suicide prevention programs called CARE (Care, Assess, Respond, Empower) and CAST (Coping and Support Training), help identify high-risk youth through computer-assisted assessments, followed by counselling (Katz et al., 2013). These programs provide safe and supportive environments and promote positive coping methods and help-seeking behaviour with an aim of decreasing risk factors that lead to suicidal behaviours (Katz et al., 2013; CBPP, 2016). When individuals are identified through CARE, they participate in CAST to help improve mood management, academic achievement, and decrease substance use (Katz et al., 2013). Studies show that these programs are effective in decreasing depressive symptoms, suicide risk behaviours, feelings of hopelessness, anger and family distress and help increase self-esteem (Katz et al., 2013).

3.3.4. Support in Times of Crisis

Individuals can experience distress outside of conventional business hours, emphasizing the importance of accessible healthcare at all times (Cohen et al., 2022). Research shows that suicidal thoughts are episodic and, although they are short in duration, can come on quickly and unexpectedly (Kleiman & Nock, 2018; Stanley & Brown, 2012). Accessible health care is

essential in the prevention of suicide (Clark, 2017). The role of technology to provide support in times of crisis was found in three youth programs reviewed for this study.

Websites are accessible at any time (Anderson & Jiang, 2018) and provide users with resources for treatment, self-help, ways to help others, and access to mental health care services (Luxton et al., 2011). Discussion boards, blogs, and self-assessment tests found on various websites often provide their users with instant feedback, recommendations, resources, support and education, and provide self-assessments to help users identify signs and symptoms and when they should seek help (Luxton et al., 2011).

Mobile applications can provide youth with more accessible evidence-based support. One example is the BlueIce mobile app for youth which was created in response to the limited amount of self-harm prevention apps available (Greenhalgh et al., 2021). With the aim to reduce suicidal behaviours and support users (Greenhalgh et al., 2021), this app was co-designed with youth who have experienced self-harm (Greenhalgh et al., 2021; Stallard et al., 2016). BlueIce helps users manage their emotions, access support at all times (Grist et al., 2018), and is designed to be used as often as needed (Melia et al., 2020). This app is meant to be used alongside face-to-face interventions (Greenhalgh et al., 2021) and uses technology to provide users with strategies based on theoretical approaches including Dialectical Behaviour Therapy (DBT), Cognitive Behavioural Therapy (CBT), mindfulness and behavioural activation (Grist et al., 2018). The app, consisting of a mood diary, mood-lifting activities, and automatic routing depending on the user, helps users access the resources necessary, such as emergency contacts (Greenhalgh et al., 2021; Grist et al., 2018). In a study conducted by Grist et al. (2018), many participants used it daily to track their feelings and many found it reassuring that they could turn to this tool for

instant support. For most participants in the study, engagement seemed to decline due to a reduction in suicidal ideation (Grist et al., 2018; Melia et al., 2020).

        The Safety Planning Intervention (SPI), designed by Stanley and Brown (2012) provides individuals with a tailored plan, specific coping strategies, and sources of support that can be used in times of distress, with the intent of reducing the risk of suicide (Stanley & Brown, 2012). Its goal is to increase self-help and help-seeking behaviours and support those that are not willing or, do not have access, to mental health services (Melvin et al., 2019). BeyondNow is a smartphone application, based on SPI, that was developed to provide at-risk individuals, of all ages, a resource to create, access, and share with others, a personalized safety plan (Melvin et al., 2019). This app allows users to document their warning signs, reasons to live, coping strategies, limit access to lethal means, as well as input important contacts (Melvin et al., 2019). Individuals, after creating their safety plan, are able to view this plan in times of distress (Melvin et al., 2019). This app was co-created with individuals with lived experiences and mental health professionals (Melvin et al., 2019). Upon release of this app, it was downloaded more than 40,000 times (Melvin et al., 2019), suggesting the high acceptability of this app by its users. Individuals who used another all ages safety planning app, called MYPLAN, provided positive feedback around the ease of accessibility of their safety plan (Melvin et al., 2019). The LifeLine app (The Life Line Canada Foundation, 2022) is a suicide prevention and awareness app that provides access to users, of all ages, who are suffering a crisis or have experienced a loss due to suicide. This app connects its users to help and crisis centers across Canada as well as provides educational materials and strategies to help prevent suicide (The Life Line Canada Foundation, 2022).

Websites can provide users with relief in times of distress as they can connect users with assistance and provide resources that may be helpful in times of distress. For example, The Trevor Project organization aims to create a more inclusive space for LGBTQ youth who are at an increased risk of suicide. Through this website, users can access crisis lines and be connected with trained counsellors at any time through chat, text message, or by phone calls. This website also offers calming exercises for those who need assistance but are reluctant to talk (The Trevor Project, n.d.).

Another website, mindyourmind.ca is a website that works with youth to promote wellness, reduce the stigma around mental health and provide support to its users through the community (mindyourmind, 2022). This website focuses on providing youth with resources and information about mental health and helps youth access assistance in times of crisis (mindyourmind, 2022).

3.4 Technology's Contribution to the Success of Programs

This literature review uncovered many ways technology may contribute to the success of the program. First, was technology's overall ability to engage youth due to their natural desire to use technologies. According to the Pew Research Center, 95% of adolescents have access to an internet-enabled smartphone or own one and 45% of teens are online almost constantly (Anderson & Jiang, 2018). Youth enjoy using technologies and the integration of technology can enhance attention and learning for them (Teen Rehab, 2021).

Second, technology may support program success by drawing youth in due to their natural desire for connection and communication. Youth, specifically those at-risk, seem to turn to technology for connection and support or to help develop coping strategies (Daine et al., 2013). As noted in some of the prevention programs, technology can help build connections

(Miller, 2022; Stout, 2018) through online support groups, identify at-risk individuals (Katz et al., 2013), and spread supportive messages (Stout, 2018).

A third way technology supported program success was by reaching more people. It can help address limitations and break down existing barriers to conventional methods of mental health care (Armey, 2022). One example of this is offering alternative ways to access support (Clark, 2017) to individuals who are not willing or able to access face-to-face interventions in times of crisis (Armey, 2022).

Lastly, it seems that technology can help prevention strategies be more successful if they assist in reducing risk factors or, conversely, build on protective factors and resilience (CAMH, 2022; Seligman et al., 2009; White & Waters, 2015). For instance, can the technology support the development of protective factors or mitigate risk factors? For example, mobile applications such as BlueIce use technology to provide accessible support and manage user emotions. In this case, the use of technology was successful as the engagement seemed to decline due to a reduction in suicidal ideation (Grist et al., 2018; Melia et al., 2020).

It is important to note, that although technology can support the success of programs, there can pose various risks and challenges to its users. Although technology was used within programs to build relationships, it was also noted as a factor in negative relationships. Often, at-risk youth spend a lot of time on the internet (Daine et al., 2013), which may contribute to feelings of isolation, loneliness, and mental health concerns (Children's Bureau, 2019). The internet has the potential to normalize self-injurious behaviours as, often, the media's portrayal of suicide is inaccurate (Daine et al., 2013; WHO, 2014b). Social media sites may increase the prevalence of cyber-bullying (Daine et al., 2013) provide access to others thinking of suicide, and increase feelings of hopelessness, leading to suicide ideation (Anderson & Jiang, 2018).

These risk factors should include the thoughtful implementation of technology in suicide prevention programs.

Chapter 4. Discussion and Conclusions

This chapter presents an analysis and interpretation of the findings of this research study. First, the analysis and interpretation of the findings for each research question are discussed. Next, the research implications, including educational implications, are reviewed. After this, the limitations of this study are discussed. Finally, recommendations and future research directions are highlighted.

4.1. Analysis and Interpretation of findings

A review of the literature has determined that youth suicide continues to be a prominent health issue in Canada (Government of Canada, 2021) and across the globe (Kõlves & De Leo, 2016; WHO, 2021). Although there is more awareness and concern around youth suicide (AACAP, 2021; CMHA, 2022; Government of Canada, 2019), including risk and protective factors, this literature review suggests that, despite prevention efforts, the rates of suicide have not decreased (Martinez-Ales et al., 2020). This may be due to increased risk factors, potentially resulting from the health measures put in place to limit the spread of Covid-19 (Vaillancourt et al., 2021). Recent statistics show that youth in Canada are experiencing higher rates of declining mental health (MHCC, 2020).

Newer research suggests that suicidal behaviour is influenced by many interconnected risk factors (WHO, 2014b) and not just one or two. The recent research also highlights new risk factors that the youth of today face. This includes technology (Children's Bureau, 2019; OECD, 2018; Reyes-Portillo, 2019), efforts to limit the spread of Covid-19 (Vaillancourt et al., 2021), and social media (Twenge et al., 2018; Smith et al., 2021). While technology has the potential to

increase suicidal ideation (Children's Bureau, 2019; OECD, 2018; Reyes-Portillo, 2019; Song et al., 2014) through "Pro-suicide" websites (Biddle et al., 2016; Durkee et al., 2011), for example, it would not be wise to ignore the benefits that technology can offer, in regard to suicide prevention strategies. When incorporating effective elements into a program, it is essential to understand the risk and protective factors of suicide (WHO, 2014b) so the technologies implemented can help support protective factors.

The positive use of technology (Luxton et al., 2012; Skinner & McFaull, 2012) can help enhance protective factors such as fostering strong relationships and a sense of community (WHO, 2014b) and help develop effective coping strategies for well-being (Sisask et al., 2008). Technology offers users ways to build community by bringing individuals, with similar experiences, together (Anderson & Jiang, 2018). This helps to mitigate the risk of self-harm and suicide by providing the individual with a sense of love and support, contributing to high levels of resiliency (Kaslow, 2022; WHO, 2014b). It also offers support through online support groups and social media sites for suicide prevention (Anderson & Jiang, 2018; Skinner & McFaull, 2012). This review found that the identification of symptoms, accessible support, education, and building support are important to at-risk youth.

Many types of technology can help predict and respond to suicide risk (Armey, 2022) which is especially beneficial for youth who have trouble recognizing and identifying their symptoms (Christensen et al., 2011). To help combat this, prevention strategies should implement suicide screening tools to help identify at-risk individuals and provide additional assessment and treatment, as needed (Zalsman et al., 2016). This is important in schools and primary care settings (Zalsman et al., 2016). Assessing the risk of suicide in a patient can be subjective (Vahabzadeh et al., 2016) and the risk of suicide can fluctuate based on life events

(Vahabzadeh et al., 2016). By incorporating screening into prevention programs, individuals could identify when they are at risk and seek help.

Across Canada, adolescents have expressed their difficulty navigating and accessing the healthcare system and, as a result, are having difficulty coping in times of distress (CBC News, 2016). Accessible support at any time is important as evidence shows that suicidal thoughts are unpredictable and can happen quickly and unexpectedly (Kleiman & Nock, 2018; Stanley & Brown, 2012). Even more important is providing individuals with access to support before becoming suicidal and for people at imminent risk or experiencing a crisis (CAMH, 2022). Evidence suggests that crisis lines can help reduce suicide-related distress and behaviour (Hoffberg et al., 2019) further supporting the benefit of accessible support at any time. While crisis lines are beneficial, further research is needed to determine their effectiveness in the prevention of suicide (CAMH, 2022; Zalsman et al., 2016).

Research has shown that distressed teenagers are more likely to discuss their problems with their peers (Healthy Child Manitoba, 2014) as they are with their friends more frequently than they are with mental health professionals (Coyle, 2014). Schools and teachers can play a critical role in the prevention of suicide. Programs offered in schools should have clear learning objectives (Surgenor et al., 2016) and should incorporate training for staff and students to help them become more familiar and recognize signs in themselves and their peers (Katz et al., 2013). In the early years, students can learn about bullying prevention, creating a positive school climate, and developing strong problem-solving skills and in the older grades, students can explore curricula that address suicidal behaviours (Wisconsin Department of Public Instruction, n.d.). Programs that are offered in the classroom, such as the SOS program, have reduced suicide rates and have increased knowledge around suicide, its warning signs, and how to cope

(Wisconsin Department of Public Instruction, n.d.). Schools can also provide a feeling of school connectedness (CDC, 2018; OCYI, 2019) which can also help decrease suicidal ideation and attempts (Marraccini & Brier, 2017). Even more effective is the delivery of information by specialists (Cross et al., 2011; Wasserman et al., 2015; White et al., 2012) to assure students that it is being treated as a serious issue and to be able to answer questions and provide them with support (Surgenor et al., 2016). Teachers play a crucial role in the prevention of youth suicide (SPRC, 2019) as they are seen as role models for many students (TeacherVision, 2019). They also act as gatekeepers who can recognize and support students at risk (CTSAB, 2017; SPRC, 2019). Gatekeeper training is essential (Stickl Haugen et al., 2022) to help increase teacher efficacy. Since schools have the potential to help prevent suicide (Gijzen et al., 2022; Miller et al., 2009), it would be beneficial to incorporate prevention programs into classrooms to increase the awareness of suicide and address existing stigmatization. It is important to note that having awareness and education is not enough as a stand-alone measure when preventing the risk of suicidal behaviour (Surgenor et al., 2016).

Prevention programs should build on protective factors and focus on enabling youth to be resilient in the face of adversity (CAMH, 2022; Seligman et al., 2009; White & Waters, 2015). Research shows that there is a vast amount of suicide prevention strategies that focus on preventing the act of suicide (CAMH, 2022). Many individuals who experience suicidal thoughts and attempts also experience distress, calling for the need for prevention strategies that focus on earlier components of suicide (CAMH, 2022). The Centers for Disease Control and Prevention published a technical package with policy, programs, and practices (Stone et al., 2017). Many of the prevention approaches focus on the development of protective factors and the mitigation of risk factors (Stone et al., 2017). For example, the strategies included in the package aim to

prevent the risk of suicide by focusing on protective factors such as strengthening access and delivery and care, promoting connectedness, identifying people at risk, and teaching coping skills (Stone et al., 2017).

Using technology in suicide prevention programs can encourage users to connect in healthy ways and provide alternative ways to access support that they may have trouble accessing offline due to concerns around stigma or the reluctance to seek help (Stout, 2018). It can help identify at-risk individuals, through administered screening tools or tools that detect changes in speech, text, or facial expressions. Technology can be used in prevention programs to educate others and increase awareness, create avenues for communication and build relationships, identify those at-risk through screening, and provide support in times of crisis. Although these roles are independent of each other, many programs incorporate a combination of these roles in their programs to best support and meet the needs of the at-risk users.

4.2. Limitations

This review has some limitations. This paper was completed for the requirements of a Master's in Education project/paper. Although the literature review was extensively done it would be worthwhile for a larger scale study to be conducted, examining more programs, and potentially a cross case comparison of those programs with technology. There was limited research about current programs that use technology to specifically address youth suicide, risk and protective factors, and best understand how to treat adolescents at risk of suicide (Katz et al., 2013) so some of the studies looked at all ages. School based programs seem to have a lot of research and data analysis for evidence based methods. Interestingly, many programs that are school-based do not use a lot of technology. Without the contribution of school-based programs that use technology, it limited the availability of data of successful programs, making it hard to

generalize best practices (Katz et al., 2013) to use in future programs. More time spent in this area could be beneficial in further assessing how technology might address risk and protective factors and contribute to the success of a prevention program.

4.3. Research Implications and Future Research Directions

The aim of this literature review was to explore how technology can play a role in suicide interventions for youth. The findings suggest a number of important research and educational implications. Research suggests that existing programs have limitations and should be re-evaluated regularly (Surgenor et al., 2016) preferably by clinicians (Wilks et al., 2021). Additionally, more research is needed to further understand how to improve the implementation of these interventions (Weare, 2015). As there are many risk factors that influence suicidal ideation, programs should not be restrictive and limited to or over-emphasize, one issue (Surgenor et al., 2016). Existing research on prevention programs seems to focus on single risk factors rather than the effect of multiple risk factors combined (Franklin et al., 2017).

Concerns around the use of prevention programs exist. For example, teachers worry about the risk of normalizing suicidal behaviour if it is discussed in the classroom. By following research, participating in training, and implementing curricula, teachers will be able to open up the discussion in positive ways (Wisconsin Department of Public Instruction, n.d.). Teacher efficacy is another concern. Gatekeeper training can help address this concern, however, further research is needed to assess the effectiveness of this training (CAMH, 2022).

Privacy and confidentiality of these apps as individuals are often required to input their information to use these programs (Luxton et al., 2011). Additionally, the preferences of users may change as technology is constantly evolving (Luxton et al., 2011) which may lower user

engagement. It is important to stay up-to-date with research to help inform the creation of effective prevention programs.

Technology can provide mental health care services to at-risk individuals, regardless of their geographic location, however, something to consider is that users may have limited access to the internet (Luxton et al., 2011), hindering their ability to access timely support in times of need.

Programs should be trauma-informed (CAMH, 2022), flexible, and responsive to individual issues (Surgenor et al., 2016) and ensure that they are culturally relevant (Luxton et al., 2011). Programs should reflect the needs of the schools and students and should be accommodated to suit each environment (Singer et al., 2019). To effectively help youth in various communities, more research on specific strategies is needed (CAMH, 2022). To ensure that programs reflect cultural values, strategies that are created for various communities should be created in collaboration with the community to ensure that the lived experiences of individuals in that community are reflected in the strategy (CAMH, 2022). There are many opportunities for further development of applications and more research would be beneficial to determine how applications can be used by clinicians (Wilks et al., 2021). Through this research, it was found that technology has the potential to aid in suicide prevention and intervention through building awareness through education, building community and fostering relationships, screening at-risk individuals, and providing individuals with support in times of crisis. As technology has become a prevalent and necessary component in the lives of individuals, its usage has helped increased accessibility to services and resources, helping to mitigate the risk of suicide amongst individuals. As suicide is a sensitive topic, further research is needed to help determine how technology can best be used in the prevention of youth suicide

in various communities (CAMH, 2022) while considering the roles that technology can play in the prevention and intervention of youth suicide.

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