

Social Media and Adolescent Suicide: Exploring Risks, Benefits, and Opportunities for Prevention

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Abstract

During the same time period that suicide rose to the 2nd leading cause of death among adolescents, the proportion of youth who use social media multiple times per day has doubled, and now encompasses 70% of US adolescents. These are concerning trends, because maladaptive use of social media is associated with adverse mental health effects with particularly concerning ramifications for adolescent suicidal risk. While this linkage to suicidal risk remains evident, adolescents report notable benefits to use of social media, including the provision of social support and connectedness. This dissertation focuses on three critical gaps in the literature aimed to explore the association between adolescent suicidal risk and social media use.

First, since the most recently conducted systematic reviews on this topic ended their searches, the literature is estimated to have doubled in size. To address this gap, the first paper presents the results of a literature review which provides an update of social media-related risk and protective factors for adolescent suicide through May 20th, 2018.

Second, effective methods to monitor at-risk adolescents' use of social media are needed. The dissertation paper offers the results from a formative study that aims to develop an acceptable approach to social media monitoring for suicidal youth. The results of a mixed methods study are presented that explore the social media experiences of suicidal adolescents and their parents.

Third, longitudinal studies evaluating the relationship between adolescent suicide and social media use have measured a limited scope of risk and protective factors and have focused on youth within the general population. The third paper presents the iterative development of an ecological momentary assessment tool that aims to measure a range of risk and protective factors for adolescent suicide associated with distressing social media experiences.

This dissertation offers public health significance through formative investigation aimed to expand our understanding of social media's influence on youth suicidal risk and explore avenues for prevention. It does so through a current evaluation of the literature, a measure that could provide insights on proximal suicidal risk, and suggestions for an acceptable monitoring approach for youth at risk of suicide.

Table of Contents

Preface.....	x
1.0 Introduction.....	1
1.1 Trends in Adolescent Suicide-Related Morbidity and Morality	2
1.2 Trends in Adolescent Social Media Use.....	6
1.3 Associations of Adolescent Suicide and Social Media Use.....	8
1.4 Ethical Considerations of Social Media Research with Suicidal Youth	10
1.5 Research Gaps	12
1.6 Public Health Significance	15
2.0 Review of the Relationship Between Social Media Use and Deliberate Self-Harm	
Among Youth	17
2.1 Introduction	18
2.2 Methods	20
2.3 Results.....	22
2.4 Discussion	30
2.5 Tables and Figures	37
3.0 Understanding and Responding to Adolescent Suicidal Risk Within Online	
Spaces: Exploring the Context and Feasibility of Automated Digital Media	
Monitoring.....	57
3.1 Introduction	58
3.2 Methods	61
3.3 Results.....	65

3.4 Discussion	76
3.5 Tables and Figures	81
4.0 Development of an Ecological Momentary Assessment Tool of Distressing Social Media Use Among Suicidal Youth.....	90
4.1 Introduction	91
4.2 Methods	93
4.3 Results.....	97
4.4 Discussion	107
4.5 Tables.....	110
5.0 Final Discussion and Future Directions.....	119
5.1 Summary of the Main Findings.....	119
5.2 Future Directions.....	120
5.3 Considerations for Research and Practice	123
5.4 Dissertation Conclusions.....	125
Appendix A Search Strategy.....	126
Appendix B Teen and Parent Surveys	127
Appendix C Interview Guides.....	138
Appendix D Initial Draft of the Ecological Momentary Assessment Measure	141
Appendix E Final Ecological Momentary Assessment Measure	145
Bibliography	152

List of Tables

Table 1 Risk and Protective Factors Identified within Previous Systematic Reviews	38
Table 2 Initial Literature Review Search	38
Table 3 Description of Included Studies.....	38
Table 4 Social Media Data Collectionand Deliberate Self-Harm Focus	39
Table 5 Summary and Characteristics of Included Studies that Examined Deliberate Self-Harm and the Potential for Risk (n=26).....	42
Table 6 Summary and Characteristics of Included Studies that Examined Deliberate Self-Harm and the Potential for Protection (n=13).....	52
Table 7 Teen Sample Characteristics.....	82
Table 8 Selected Quotes: Teens’ Digital Media Use and Experiences.....	83
Table 9 Parent Sample Characteristics	85
Table 10 Selected Quotes: Parents’ Experiences in Digital Media Monitoring	86
Table 11 Selected Quotes: Teens’ and Parents’ Perceptions of Automated Digital Media Monitoring	88
Table 12 Risk Factors of Social Media Use for Adolescent Suicide.....	110
Table 13 Protective Factors of Social Media use for Adolescent Suicide.....	110
Table 14 Summary of the Initial Draft of the Ecological Momentary Assessment Measure	110
Table 15 Expert Interviews Themes: Measure Development.....	111
Table 16 Expert Interview Themes: Protocol Development.....	112
Table 17 Cognitive Interview Themes: Measure Development	112

List of Figures

Figure 1 Flow of Information through the Evidence Review Process.....	37
Figure 2 Proposed Strategy for Automated Digital Media Monitoring.....	81

Preface

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1.0 Introduction

Today's adolescents spend upwards of 8.5 hours on digital devices each day with social media being a leading factor in time spent online.^{1, 2} This massive uptake of digital technologies has changed the way adolescents learn, play, and interact in a fashion that is emphatically different than any other time in history.² This has drawn a myriad of questions on the impact of digital technologies on adolescent health. Will this culture in which adolescents engage in seemingly endless hours with digital media impede adolescents' ability to cope? In the case of youth suicide, social media has been implicated in the creation of a disconnected social environment in which youth's ability to cope with social interactions has diminished, placing youth at risk for suicide. However, further research is needed to establish the relationship between social media use and adolescent suicide. What are the implications of social media to create vulnerability or perhaps in some cases protect against adolescent suicide? Further, if social media does implicate adolescents' suicidal risk, how can prevention experts, providers, and concerned parents protect their digital environments? This dissertation aims to approach these critical questions.

Section One offers a background in the pursuit of these research questions. First, recent national and local trends of adolescent suicide are reviewed, including population subgroups that are disproportionately impacted. Second, trends in the use of social media are summarized. Third, cross-sectional and longitudinal studies are reviewed which offer insights into the association between adolescent suicide and use of social media. Fourth, ethical implications of study within this research domain are discussed. Finally, gaps in knowledge are presented which shape research presented in the three dissertation papers.

1.1 Trends in Adolescent Suicide-Related Morbidity and Morality

This section addresses national, state, and county-level trends in adolescent suicide, suicide attempts, and suicidal ideation. The Centers for Disease Control and Prevention³ offers the following definitions of these terms. Suicide refers to death due to self-inflicted injury with the intention of killing oneself. A suicide attempt is defined as a non-fatal potentially self-injurious act committed with at least some wish to die. Suicidal ideation refers to thinking about, considering or planning to kill oneself. Suicidal thoughts have variable levels of intention to kill oneself and may involve consideration of specific methods or plans or be non-specific in nature.⁴ Suicidal ideation and behavior are distinct from non-suicidal self-injury (NSSI). NSSI ideation refers to an urge to engage in intentional self-harm behavior, and NSSI behavior refers to the actual act of engaging in self-harm, both of which are done with the intention of harming oneself, not killing oneself.⁵

National Trends. Adolescent suicide has recently risen to the second-leading cause of death in youth ages 10-24 in the United States (8.7 deaths per 100,000).^{6, 7} Across all ages, the suicide rate has risen 24% since 1999 with females aged 10-14 having experienced the largest percent increase in suicides (an over 200% increase) over this time period.⁷ This rise in youth suicides is occurring at the same time that all-cause mortality in adolescence is declining, indicating that there is something particular about suicide that is resistant to current public health efforts to reduce adolescent mortality.

Morbidity is also a chief concern with adolescence being a high-risk period for suicidal thought and behavior. In 2017, the Youth Risk Behavior Survey (YRBS) reported in the past year 17.2% of U.S. teenagers seriously considered attempting suicide, 13.6% made a plan of how they would attempt suicide, and 7.4% followed through with a suicide attempt.⁸ Rates of suicidal

behavior among adolescents have increased over the past decade.⁹ Furthermore, the rise in death by suicide is also associated with use of more lethal methods in attempts. This is particularly true in the case of suffocation, which rose from 27% of suicide deaths in 1999 to 45% in 2014, a spike that is most prominent among adolescent girls.⁷

State and Local Trends. Similar to national figures, suicide is the second-leading cause of death among adolescents in Pennsylvania, as well as within Allegheny County, and its contiguous counties.¹⁰⁻¹² The age-adjusted rate of suicides among 10-24 year-olds in Pennsylvania was 10.22 per 100,000 in 2017, compared to 6.55 per 100,000 in 2007, a 64% increase within a decade.¹³ Likewise, the overall suicide rate within Allegheny County was recently estimated to have increased by 66% between 2010 and 2017 by the county's medical examiner's office.¹⁴

Furthermore, suicide-related morbidity is a concern both locally within Allegheny County and across the state of Pennsylvania. In the 2017 YRBS survey,¹⁵ 7.4% of Pennsylvanian adolescents reported past-year suicide attempts, compared to 5.7% in 2009. Serious ideation was also on an upswing with 15.1% of Pennsylvanian youth seriously considering attempting suicide and 12.2% who planned to attempt suicide in the past year, compared to 13.5% and 9.6% respectively in 2009. In particular, the rate of past-year suicide attempts increased by 23%, and the rate of attempts increased by 21% between 2009 and 2017 ($p=.01$ and $p=.02$, respectively). As an indicator of the burden of suicidal behavior in Allegheny County, 16% of injury-related hospitalizations among youth aged 15-24 within the county were self-inflicted and were associated with a median cost of \$13,724 per hospitalization.¹⁶

Economic Burden. Suicide mortality and morbidity is costly, both nationally and locally. The national cost of suicide attempts and suicides is estimated to be up to \$93.5 billion dollars, the majority of which is represented by costs calculated by lost productivity.¹⁷ With each death costing

nearly \$1.3 million dollars in medical and work loss costs, suicide accounts for approximately a quarter of the total fatal injury costs in the United States.¹⁸ In Pennsylvania, medical and lifetime work loss costs associated with suicide and suicide attempts were estimated to be over \$1.8 billion in 2010, corresponding to 37,335 years of potential life loss.¹⁹

Gender. Suicide rates are three times higher among adolescent males compared to females, and approximately twice as many females report serious suicidal ideation and behavior than males.^{8, 20} Males are thought to have multiple risk factors that make them vulnerable to suicide death including: impulsive and aggressive behaviors, comorbid mood and alcohol abuse disorders, and more lethal attempts, particularly with firearms.²⁶⁻²⁸ By contrast, females have greater vulnerability to overall psychopathology, especially depression, which is a strong predictor of suicide attempts, greater exposure to risk factors such as sexual abuse, and greater sensitivity to interpersonal conflict and isolation from peers, all of which are predictors of suicidal behavior.^{26, 29} However, the gender gap in suicide fatalities in adolescence is narrowing. Particularly among youth ages 10-14, suicides have increased by 200% among girls since 1999, while the rate among males has increased by 37%.²⁰

Gender and Sexual Minorities. Gender and sexual minority youth are at significantly higher risk of suicide attempt than heterosexual and cisgender youth (youth whose gender identity matches the sex they were assigned at birth). A recent meta-analysis found that lesbian, gay and bisexual (LGB) youth had over twice the odds of making a suicide attempt compared to heterosexual youth, explained in part by disparities in depression and substance abuse.^{21, 22} The National Transgender Discrimination Survey showed that suicide attempts are elevated among transgender youth, finding 45% of transgendered young adults ages 18-24 reported a history of suicide attempt, which is vastly higher than the national average.²³ Disparities among LGBT youth

are thought to be heavily impacted by stigma with rates of suicide rising substantially among youth experiencing high amounts of stigma at individual and structural levels (marked by the absence of LGBT-friendly laws and policies), when explored through national survey and mortality data.^{24, 25}

Race and Ethnicity. Differences were observed in the prevalence of suicide attempt among racial and ethnic groups on the 2017 Youth Risk Behavior Survey.¹⁵ Reports of past year suicide attempts were lowest among White and Asian youth (6.1% and 5.7% of youth, respectively) and were highest among youth who were multi-racial, Black, and Hispanic (10.8%, 9.8%, and 8.2% of youth, respectively). Among suicidal deaths, American Indian/Alaskan Native (AI/AN) youth are impacted by a myriad of risk factors including residence in predominantly rural areas that are isolated from health resources, high rates of unemployment, alcohol and substance misuse, physical and sexual abuse, and gun availability. These factors result in AI/AN youth experiencing higher rates of suicide than any other racial or ethnic group.²⁶ The population prevalence is 42.3 suicides per 100,000 in AI/AN ages 10-24, compared to the overall adolescent suicide rate of 8.7 per 100,000.²⁷ AI/AN young men are particularly at risk. The Centers for Disease Control and Prevention reports that AI/AN young men (ages 18-24) are twice as likely to die by suicide than any other gender and racial/ethnic comparison group.²⁸

Urbanicity and Rurality. In the United States, suicides have increased disproportionately among rural and less urban areas over the past 15 years, with nearly double the rate of suicide of urban areas (11.9 vs. 6.5 deaths by suicide/100,000).²⁹ Not just rural areas, but also less urbanized areas (small to medium-sized metro areas, micropolitans, and non-core county groups) are also at heightened risk.³⁰ Small to mid-size metro areas are hypothesized to be less protected from the rise in suicide rates in the same way that larger metro areas have been, primarily due to lack of

access and availability of qualified mental health providers as well as high rates of loneliness in less urbanized areas.³¹

1.2 Trends in Adolescent Social Media Use

The upward trend in adolescent suicide and suicidal behavior over the past decade has cooccurred with the rise in mass use of smartphones. The iPhone's release in 2007 marked a pivotal point in which U.S. smartphone usage surpassed 50%. Since that time, smartphone use has skyrocketed.³² Today, 95% of teens have access to smartphones, and nearly half of teens report being online on a near constant basis.³³ Rates of social media use have similarly spiked. As of 2015, 90% of youth used social media, compared to just 12% in 2005.³² Further, 70% of teens report checking their social media accounts multiple times per day, over half of whom check multiple times per hour.²

Teens use a variety of forms of social media, which has been defined as not only social networking sites (e.g. Facebook or Twitter) but also collaborative projects (e.g. wikis), blogs, content communities (e.g. YouTube), and virtual game worlds and virtual social worlds (e.g. World of Warcraft or Second Life).³⁴ In the Pew Research Center's 2018 poll,³³ teens reported the highest use of YouTube, Instagram, and Snapchat (85%, 72%, and 69% of youth, respectively). This lineup of platforms was similar to the sites that were used most frequently -- Snapchat, YouTube, and Instagram (reported among 35%, 32%, and 15% of youth, respectively). Facebook, which in previous polls was the most frequently used platform has observed a precipitous drop in use among teens. In 2018, 51% of teens (from 75% in 2015)³² reported using Facebook with only 10% of teens reporting they used this site frequently. In reference to videogames, 84% of teens

say they have access to a game console, and 90% say they play video games on any device (game console, computer, or cellphone).

Some differences were observed in teens' use of and access to social media platforms on the Pew Research Center's poll.³³ Teens from families with lower incomes express greater interest in Facebook. Girls expressed greater interest in Snapchat; whereas boys were more interested in YouTube. Further, boys were more frequently videogame users than girls. Nearly all males (97%) reported playing videogames, although videogame play among girls is also quite frequent (83% of girls). Regarding access to social media, teens from lower income families had less access to a computer or game console in their homes; however, differences were not observed in access to a smartphone as a function of income.

Regardless of platform, now more than ever, teens prefer digital communication to in-person communication. The number of teens who prefer communicating offline reduced by half between 2012 to 2018 per Common Sense Media's 2018 survey.² Further, this report showed that while many teens engage in some form of self-regulation of their devices, e.g. putting phones away at key times like when going to sleep (reported among 56% of youth as all or most of the time), nearly half of teens also reported difficulty powering off their devices. For example, 44% of teens said social media distracts them from interacting with friends.

The importance of social media use in teens' daily lives is highest among vulnerable teens. In Common Sense Media's survey,² teens who had low levels of social-emotional well-being placed significantly higher importance on the role of social media in their daily lives, nearly half (46%) of whom reported social media was extremely or very important to them (compared to 32% of those who reported high well-being scores). Teens with low well-being scores were more likely to report negative experiences on social media such as feeling bad that no one commented or liked

their post, feeling left out or excluded on social media, and disturbingly, more than a third (35%) reported being cyberbullied compared to just 5% of youth who reported high well-being scores. However, teens with low levels of well-being were also more likely to report that social media had a positive impact on their daily lives than high well-being teens. Among the lower well-being youth, nearly a third reported that social media made them feel less depressed (29%), 22% said social media made them feel better about themselves, and 39% felt that the use of social media reduced feelings of loneliness.

1.3 Associations of Adolescent Suicide and Social Media Use

Negative Consequences of Social Media Use. Use of social media has been correlated with adolescent suicidal thoughts and behaviors, as well with common risk factors for suicide such as self-harm, depression, anxiety, and sleep disturbance.³⁵⁻³⁸ Correlational studies have focused on the amount of adolescents' social media use. Heavy social media use, which is a common term within social media literature that describes use in high frequency or long duration, has been correlated with both high levels of psychological distress and suicidal ideation among youth (for the latter, adjusted relative risk = 5.93, [95% CI 2.38–14.75]) when use of online social networks is reported on a daily basis for two hours or longer.³⁹ Additionally, heavy use of videogames (5 hours or more of daily use) has been associated with a higher prevalence of suicidal behavior among adolescents.⁴⁰ These associations are noteworthy, because many adolescents are heavy users of social media. A quarter of high school students in Ontario have reported social network site use of 2+ hours daily and a fifth of US high school students have reported videogame use for 5+ hours daily.^{39, 40}

Beyond heavy use of social media, problematic use has also been implicated for heightening risk for suicidal behavior among adolescents. Problematic social media use refers to an inability to control use that results in negative consequences in daily life.⁴¹ As an example of this, Merelle and team found that both problematic social network site users and problematic videogame users had higher risk of suicidal ideation than non-problematic users (OR=2.28, 95% CI (1.96-2.65), $p<.01$ and OR=1.79, 95% CI (1.59-2.01), $p<.01$, respectively).⁴²

Moving beyond cross-sectional studies, Hökby and colleagues surveyed 2,286 adolescents from state schools in Europe and the United Kingdom on internet behaviors and mental health variables over a 4-month period.⁴³ They found that time spent online relative to time spent on other activities had a lasting impact on the mental health of adolescents. In particular, they showed that consequences of internet use, most notably sleep loss and indicators of problematic use (withdrawal/negative mood when the internet could not be accessed), significantly predicted poor mental health outcomes over their study period. In their paper, they argue that interventions aimed to reduce the negative mental health effects of online activity among adolescents could target negative consequences of internet use, rather than amount or frequency of internet use.

Consistent with the focus on identification of negative consequences of the adolescents' digital media use, other researchers have aimed to identify factors associated with the use of social media that implicate adolescent suicidal risk. While many potential risk factors have been identified, leading risk factors include experiences of cyberbullying,⁴⁴ sleep disturbance,³⁸ exposure to others' self-harm content,⁴⁵ and propagation of suicidal content within tightly knit virtual communities.⁴⁶ These factors are discussed in greater detail in Papers 1 and 2.

Positive Consequences of Social Media Use. Use of social media among adolescents in the general population offers a number of benefits, including serving as an avenue for self-expression,

discovery of new information, and enhancing identity and interconnectedness.⁴⁷ Likewise, high-risk adolescents find ways to express themselves on social media in ways that enhance their feelings of acceptance, support, and connectedness to others and offer benefits such as suggestions for help seeking.^{35, 48} In some instances, the provision of support has shown particular benefit. Murray and team found that participation in an online group dedicated to the reduction of self-injury resulted in 41.8% of its users indicating a reduction in self-harm behavior.⁴⁹ Further, Frison and colleagues⁵⁰ showed in a brief longitudinal study of Flemish and Belgian high school students that peer support (provided online or offline) was a moderator in the relationship between peer victimization on Facebook and well-being, indicating the protective potential of supportive peers. Social support and connectedness, the leading protective factors for adolescent suicide associated with the use of social media, are elaborated upon in Papers 1 and 2.

1.4 Ethical Considerations of Social Media Research with Suicidal Youth

There are several ethical challenges associated with the study of social media among youth at risk of suicide, both stemming from the newness of the field of social media research as well as the risky nature of studying youth at suicidal risk in general. First, there is a general consensus among researchers and key stakeholders from suicide prevention groups that the ethical implications of using social media data for research as well as suicide prevention interventions are not clearly defined.^{51, 52} Researchers gather social media data to analyze patterns of content, emotional expression, and social interaction to understand and predict health outcomes, often in a way that is similar to data mining of electronic medical records. However, the assumptions of users of social media producing digital content is very different from the assumptions of patients

producing medical information within their health record. Patients are provided with privacy disclosures, made aware of their rights, and know their private health information is protected by the Health Insurance Portability and Accountability Act (HIPAA). By contrast, information shared on social media can be sensitive in nature and with no clear or explicit assumption of privacy.

Though social networking sites provide privacy agreements to users upon sign-up, they are notorious for providing this detail in lengthy, legal documents that are out of the literacy and developmental reach of most adolescents.⁵³ By the nature of their developmental stage and generation, Millennial adolescents are thought to have a sense of bravado toward online privacy. For example, adolescents may feel they will avoid negative consequences associated with the release of their digital content that they have heard others experience, such as not getting a job due to employers seeing pictures of drinking or drug use on social media.^{54, 55} This is particularly true of photos shared online, which are considered both highly identifiable and easily accessible.⁵⁶ Even when youth have the foresight to put privacy settings in place, due to frequent software updates that alter privacy menus and options, discretion cannot be guaranteed.⁵⁶ All of these privacy concerns matter when collecting data either about or directly from social networking sites, particularly publicly available data that is often gathered without informed consent.

At the same time, the potential to gain scientific insights about suicide risk from adolescent's social media data is striking, and there is a clear argument for the ethics of conducting this research to improve their health and safety. As such, it is important to identify ways to mitigate risk, so that this research can be feasibly and ethically conducted. First, when collecting any type of health information, there is no suggestion that the rules and regulations surrounding HIPAA should be relaxed.⁵⁵ This includes the need for private collection, storage, and handling of participant's data, and depending on the potential risk to subjects, this may include the need to

engage in informed consent.⁵⁷ When consent is necessary, participants should be provided with a full list of risks and benefits, including the boundaries of privacy and confidentiality, e.g. if there is potential that researchers investigating social media interactions may also view friends' digital content and if so how that would be addressed.

Some additional concerns come into play in the study of youth affected by suicidal thoughts or behaviors. Suicidal youth are doubly vulnerable both by nature of their suicide risk and because they are children. Due to this vulnerability, any direct assessment of suicidal youth requires adequate informed consent. In most cases, this involves consent from a parent or legal guardian as well as assent from the youth.⁵⁸ In the case of suicidal youth, the consent should clearly delineate procedures to assure confidentiality while weighing the balance of privacy and the need to respond in cases of imminent risk.⁵⁹

Furthermore, the research procedures themselves should be evaluated for their potential to distress suicidal youth. In reference to surveys or interviews of suicidal youth, studies have shown that there are no iatrogenic effects, i.e. the potential for increased risk of self-harm events, in asking youth questions about suicidality or self-harm. Several studies have shown a lack of iatrogenic effects,^{60, 61} including with collection of intensive longitudinal studies.^{62, 63}

1.5 Research Gaps

In 2012, a highly cited paper by Luxton and colleagues⁶⁴ published in the American Journal of Public Health established priorities for public health professionals to address growing concerns toward social media's impact on vulnerability toward suicide. First, they acknowledged that a focus on adolescents and young adults is intuitive, because suicide is a leading cause of death in

this age group and youth are more likely to encounter suicide-related online content.⁶⁵ Second, they called for further research to explain the degree and extent of social media's harmful and beneficial influences. In terms of research priorities, they recognized that studies are needed which address causal mechanisms. Further, they recommended investigating subgroups which might be most vulnerable to suicide-promoting influences on social media. Third, they suggested considerations for public health approaches to suicide prevention social media. Among these considerations, they advocated for the contemplation of legal and ethical issues associated with monitoring and filtering online content. Furthermore, they recognized that emerging data from the rapidly evolving study of social media's influence on suicidal behavior is necessary to inform public health-based approaches to suicide prevention. Consistent with these public health priorities, this dissertation aims to address four critical research gaps.

Gap 1: The fast pace of publication on the implications of social media use on adolescent suicide has made amassing the known risk and protective factors challenging. While it is true in all fields that the literature is constantly changing, the need to keep current with the high volume of articles published within an emerging field of study is particularly important. It is imperative that the development of prevention guidelines, treatment protocols, and other interventions aimed to reduce suicidal risk associated with adolescent use of social media are guided by an up-to-date account of the factors which implicate risk. Nonetheless, literature reviews within this topic area are no longer current. Since the time of the most recent systematic reviews were completed, the literature is estimated to have doubled in size (See Paper 1 for further details). Since that time, there is no review available that has used systematic methods to cull the known risk and protective factors for adolescent suicide. Furthermore, there has been little focus on population subgroups

that may be more vulnerable to the negative influences of social media within literature reviews focused on the suicidal risk of adolescents.

Gap 2: The experiences of acutely suicidal youth in using social media and their parents in monitoring their children's use of social media are not known. While risk and protective factors for adolescent suicide have been identified within the literature, the voices of currently suicidal adolescents in expressing their social media experiences remains absent. Because youth who are currently experiencing suicidal thoughts or behaviors are at high risk of suicide,⁶⁶ understanding the social media experiences that contribute to heightened distress is of extreme importance. Asking adolescents' perspectives on the risky and protective aspects of their social media use can be a launching point for future study. Additionally, gaining an understanding of the ways in which parents monitor their suicidal adolescents' use of social media, could offer important information for clinical care teams treating suicidal adolescents. Further, once successful parental monitoring experiences are identified, their effectiveness could be tested in order to determine optimal methods of monitoring that balance risks and benefits to suicidal youth.

Gap 3: There are currently no effective methods for monitoring the social media content of adolescents at-risk of suicide. While there are many parental control technologies available on the market, none have been shown to be effective in preventing harm in high-risk youth. Further, there are no effective strategies for monitoring that engage clinicians in preventing youth from harm, which could be of high value in reducing risk among suicidal youth who are engaged in care with a mental health provider. Technology is available that has the capacity to access and process social media data in real-time (See Paper 2 for further details).⁶⁷ However, the use of technology such as this has not yet been implemented within a clinical context. An ascertainment of the attitudes of parents and adolescents about involving clinicians in monitoring suicidal youth's use

of social media is needed in order to develop a feasible method of monitoring that engages clinicians to respond to risky incidents of teen's social media use and thus collaborate with teens and their families.

Gap 4: Factors that implicate proximal suicidal risk among adolescents are not known.

Few longitudinal studies have been conducted to understand the temporal relationship between social media use and suicidal risk, and to date none have focused on the factors associated with near-term risk. Study of momentary changes in risk and protective factors among suicidal youth could provide vital insights into targets for prevention and intervention efforts. However, no tools for doing so exist and the feasibility of measuring momentary changes in suicidal risk associated with social media experiences has not been established.

1.6 Public Health Significance

In addressing these research gaps, this dissertation will have the combined impact of shedding light on the harmful and beneficial aspects of social media use for youth at risk of suicide and identifying an acceptable means of protecting youth from harmful online experiences. The development of a means of measuring momentary changes in suicidal risk that could aid in identifying real-time distressing or supporting exposures to social media use is critical to advance research in this topic. The identification of these changes could offer insights into the mechanisms by which suicidal youth are impacted by stressful and supportive social media experiences, which could offer important insights for treatment providers and prevention experts alike. Further, the distillation of ways in which social media offers risk and protection for adolescent suicide, based

on an up-to-date account of the literature, is critical to the development of evidence-based interventions and policies.

This work not only leverages literature review and measurement development toward the goal of understanding harms and benefits of social media use, but also harnesses the insights of acutely suicidal adolescents and their parents to expand our understanding. Given the vulnerability of this population, bringing a voice to the teens themselves is an essential part of the significance of this dissertation. Further, youth and parent stakeholder's guidance in informing a feasible means of real-time monitoring of suicidal adolescents' social media content has tremendous potential to aid clinicians in protecting adolescents from harm.

2.0 Review of the Relationship Between Social Media Use and Deliberate Self-Harm Among Youth

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2.1 Introduction

Suicide is the 2nd leading cause of death among youth ages 10-24 in the U.S.^{7, 66, 68} and the reduction in this leading cause of adolescent mortality is a national imperative.⁶⁹ The rise in youth suicides is occurring contemporaneously with a significant uptick in social media use. Currently 70% of U.S. adolescents use social media multiple times per day-- double the proportion from 2012 to 2018.⁷⁰ This is concerning, because maladaptive and frequent use of social media may have adverse mental health effects on young people, especially regarding risk of suicide.^{43, 71} Recent research has shown a link between social media use risk of deliberate self-harm (DSH), which includes non-suicidal self-harm ideation, non-suicidal self-harm behavior, suicidal ideation, and suicidal behavior.^{36, 72, 73} Because each of the components of DSH independently contribute toward heightened risk of death by suicide,^{66, 74, 75} the amelioration of risk across the DSH spectrum is of significant importance. While the linkage between social media use and suicidal risk is evident, adolescents also report notable benefits to using social media and experts have shown enthusiasm regarding the potential for social media platforms as a vehicle for prevention.^{76, 77}

Few literature reviews have attempted to identify DSH risk and protective factors among youth within the context of social media use. The two most recent systematic reviews that evaluated social media's impact on adolescents' suicidal outcomes were led by Marchant³⁶ and by Dyson.³⁵ A summary of the risk and protective factors identified within these reviews is shown in **Table 1**. At the time of these reviews, exposure to and expression of DSH content via social media was associated with the glorification and normalization of self-harm behavior, as well as a host of maladaptive behaviors that increased risk of future DSH. Furthermore, addictive internet use was observed among self-injuring adolescents. Social isolation was a

concern, while at the same time the potential for social media to reduce isolation and contribute toward feelings of social connectedness and support were discussed as potential benefits. These benefits were thought to support a fertile ground for online help-seeking and social media-based preventive interventions, notably through moderated online environments and awareness campaigns.

These two reviews did not summarize potential impacts on subgroups known to be at increased risk for suicide to identify the potential for disparities in DSH among adolescent social media users. However, other reviews have pointed to the potential for vulnerability within certain subgroups, particularly regarding cyberbullying. In a meta-analysis by Kowalski & team,⁴⁴ cyberbullying was strongly associated with suicidal ideation, and this relationship was moderated by age and country of origin. Youth in middle school (compared to high school or elementary school) and from individualistic societies were at highest risk in their analysis. Additional reviews have identified that cyberbullying victimization is highest among younger children, girls, and sexual minority youth.^{78, 79} While research into potential disparities remains limited outside of the domain of cyberbullying, one study by Booker and colleagues⁸⁰ of young adolescents who took part in five waves of the UK Household Panel Study presents the possibility of heightened risk among girls. In their longitudinal sample of nearly 10,000 youth ages 10-15, they found that girls had higher levels of socio-emotional difficulties over time as their social media interaction increased, whereas boys did not. The potential for social media use to impact DSH risk among girls and other vulnerable groups remains underexplored and requires further research.

While Marchant and Dyson's reviews were well-designed and offer important contributions, the rapid increase in studies within this content area and the need to consider

vulnerable subgroups suggests the need for additional review. The Marchant and Dyson systematic reviews ended on June 24th, 2014 and January 26th, 2015, respectively. An initial keyword search conducted to evaluate the need for this review indicated that the literature has more than doubled in size since 2015 (see **Table 2**). This review offers an updated account since the time the last systematic reviews were conducted of the known social media-related risk and protective factors for adolescent suicide among studies that included a DSH outcome.

2.2 Methods

Search Strategy. The search strategy was guided by evidence-based practices in the health review literature.⁸¹ Through consultation with a research librarian, the first author searched Scopus for articles published from June 25th, 2014 to May 20th, 2018. Additional literature was identified via recommendations from experts in social media and youth suicide, as well as searching the Association for Computing Machinery's digital library of conference materials to ensure the adequate inclusion of literature from computer science disciplines. Inclusion of computer science publications was deemed important, because there is an emerging literature focused on using methods typical within computer science, e.g. machine learning, to explore phenomena on social media, including suicidality. No study design restrictions were applied to the search. See **Appendix A** for a listing of the search terms.

Study Selection. Two independent reviewers screened titles and abstracts for eligibility. When eligibility could not be determined by the titles and abstracts alone, the full text of articles was obtained and independently evaluated by two reviewers. Interrater agreement for the eligibility determination was $\kappa = .752$ and $.837$ for abstract/title and full-text review respectively.

Discrepancies were resolved through consensus meetings. The inclusion criteria for this review were studies that: evaluated use of social media platforms; had a focus on DSH; studied early to late adolescence; and were conducted in English. DSH was defined as non-suicidal self-harm ideation or behavior and suicidal self-harm ideation or behavior (including lethal suicidal behavior). Social media was conceptualized using Kaplan and Haenlein's definition, which includes social networking sites in addition to collaborative projects (e.g. wikis), blogs, content communities (e.g. YouTube) as well as virtual game worlds and virtual social worlds.³⁴ Studies that did not directly focus on social media (e.g. those that involved text messaging or covered all internet use) were excluded. The timeframe for early to late adolescence was defined by Sawyer and team's⁸² definition as 10-24 years. Several articles spanned a wide range of adolescent ages. Those spanning a wide range of years that predominantly fell within the 10-24 age range were included if the upper range was not above 30 years (e.g. 15-30 years).

Data Extraction. Data were extracted in a standardized fashion through Microsoft Excel. Extracted data included lead author, year and country of publication, sample size and composition, study aims, key findings including those among vulnerable subgroups, social media data collection, and DSH outcomes identified.

Quality Assessment. Quality assessment was performed using the Mixed Methods Appraisal Tool (MMAT), which allows for critical evaluation of quantitative, qualitative, and mixed methods studies.^{83, 84} The MMAT generates overall quality scores for qualitative, non-randomized and randomized quantitative, and mixed method studies. These overall quality scores are a combination of quality criteria designed to assess the appropriateness of sampling, measurement, rates of data completion, and a number of factors aimed to determine the potential for bias. The full criteria for the MMAT are available at:

<http://mixedmethodsappraisaltoolpublic.pbworks.com>. Two reviewers independently coded eligible studies using the MMAT criteria and resolved disagreements through consensus.

Data Analysis. Due to the range of research questions, methods, and outcomes assessed, pooling of results was not possible. Therefore, the results of study findings were described in narrative form. The analysis focused on studies scoring 75% or higher on the MMAT (meeting at least 3 of 4 criteria demonstrating high quality studies). Descriptive statistics were calculated using SPSS, Version 25.0.⁸⁵

2.3 Results

Review Process. A total of 536 articles were identified, 381 were screened, the full texts of 217 articles were reviewed for eligibility, and 36 articles were eligible, 22 of which were rated as high quality and included in the narrative review. The most common reasons for exclusion included the lack of a youth study population, no emphasis on social media, and lack of a deliberate self-harm outcome. **Figure 1** provides a description of the review process.

Quality Review Process. Quality was variable among the 36 eligible articles. Scores ranged from 0% (0 out of 4 criteria met) to 100% (4 out of 4 criteria met). Articles reporting on qualitative studies had the highest quality ratings (8 out of 10 studies had a score of 75% or higher) followed by non-randomized quantitative studies (11 out of 19 studies had a score of 75% or higher). The lowest quality ratings were assigned to mixed methods studies with observed scores of 75% or higher in 3 out of 6 and the one randomized control trial had a score of a 50%. In total, 22 articles met the quality threshold necessary for inclusion, which was defined as a score of 75% or higher.

Description of the Included Articles. Of the 22 articles that were included (see **Table 3**), most used non-randomized quantitative methods (cross-sectional or descriptive studies) or qualitative methods. Two of the articles used a longitudinal study design. Sample sizes varied significantly with articles reporting on qualitative and case studies having the fewest participants and those amassing publicly available data from social media platforms having the largest samples. The articles had equal representation of early adolescents (ages 10-18) and late adolescents/young adults (ages 19-30).

Social Media Data Collection. **Table 4** describes the methods used for collecting social media data in the included articles. Four articles used validated questionnaires, 5 used questionnaires that were developed by the authors (4 of which reported internal consistency reliability, $\alpha = .69$ to $.88$), 9 used data gathered directly from social media content (2 of which gathered visual data and 7 of which gathered text-based data), 2 used qualitative interviews, and 2 used medical or death records.

Deliberate Self-Harm Focus. Also included in **Table 4** is the DSH focus among the included studies. Suicidal content (suicidal ideation, behavior, or death) was assessed most frequently, among 14 articles, 2 of which addressed death by suicide. Non-suicidal self-injury thoughts or behavior was the focus of 5 of the included articles. An additional 3 articles focused on multiple domains of DSH. Finally, one qualitative study concentrated on prevention of DSH broadly had a non-specific DSH focus.

Social Media-Related Risk Factors of Deliberate Self Harm

Of the 36 included articles, 26 evaluated the potential DSH risk factors, which are described in **Table 5**. Of those 26 articles, 16 were rated as high quality and thematically

summarized. Among the articles evaluated, three primary domains emerged: (1) heavy and problematic social media use, (2) cyberbullying and cybervictimization, and (3) disclosure and proliferation of DSH content.

Heavy and Problematic Use. Three high quality articles reported associations between heavy social media use (reported as use in either high frequency, e.g. times social media was checked per day, or volume, e.g. number of hours social media was consumed per day) and suicidal risk, and a fourth described the impact of problematic use. Problematic social media use is broadly conceptualized as an inability to control one's use of social media which leads to negative consequences in daily life.⁴¹ Two articles showed social media use in high volume to be both commonplace and associated with the suicidal risk of young people.^{39, 40} Daily use of social networking sites (e.g. Facebook, Twitter, Instagram, etc.) of two hours or more was observed in 25% of high school students in Ontario and was associated with a five-fold increased odds of suicidal ideation, compared to youth who used social media for under 2 hours daily (aOR = 5.93, CI = 2.38–14.75) while adjusting for grade, sex, subjective socioeconomic status, and parental level of education.³⁹ Further, use of videogames and other nonacademic computer use (computer/videogame play not related to homework, e.g. on an Xbox, PlayStation, or other online device) of five hours or greater was observed in nearly 20% of U.S. high school students, and approximately a third of adolescents who were heavy videogame users reported suicidal behavior in the past year.⁴⁰ The prevalence of suicidal behavior was particularly high among girls, among whom the proportion of youth who reported past-year suicidal behavior was 37.8%.⁴⁰ Greater frequency of online activities (chatting, participating in social media communities, or boards) was also shown to increase the odds of suicidal ideation in a Korean sample, particularly among youth who were victims of cyberbullying or experiencing academic stress.⁸⁶ In regard to problematic

use, Merelle and team⁴² studied the impact of addictive social media and video game use among over 20,000 early adolescents in The Netherlands. They defined addictive use as “loss of control, preoccupation, withdrawal symptoms, coping, social problems, and problems fulfilling responsibilities in school.”⁴² They showed that both problematic video-game users and problematic non-videogame social media users had higher risk of suicidal ideation than non-addictive users (OR=2.28, 95% CI (1.96-2.65), $p<.01$ and OR=1.79, 95% CI (1.59-2.01), $p<.01$, respectively).⁴²

Cyberbullying. Five articles reviewed the impact of cyberbullying on the suicidal risk of young people. Two of these articles reported cyberbullying victimization as a mediating factor in the relationship between heavy use of social media and suicidal ideation and behavior.^{40, 87} Three additional articles evaluated the independent association between history of cyberbullying/cybervictimization and DSH in population-based and clinical samples. Within a large-scale study of Chinese high school students, Chen and team⁸⁸ showed internet victimization was correlated with both non-suicidal and suicidal self-harm ideation (aOR = 1.228-1.914, $p<.001$, $n = 18,341$) while adjusting for demographics, parental socioeconomic status, and family structure. Of note, non-internet victimization was also correlated to these DSH outcomes. Using a longitudinal dataset of 2,000 Korean adolescents, Kim and colleagues⁸⁶ found that youth who were cyberbullied, compared to those with no history of cyberbullying, were at higher risk of reporting suicidal thinking (OR = 1.77, 95% CI: 1.22-2.59, $p<.05$). Another included paper⁸⁹ explored the role of cyberbullying among adolescents who presented to an urban northeastern U.S. pediatric emergency department, showing a higher prevalence of suicidal ideation among adolescents who reported cyberbullying within the past year, compared to those who did not.

Vulnerability to cyberbullying was observed among certain subgroups. Specifically, male gender, sexual minority status, and familial adversity (those experiencing parental discord, the death of a parent, and those from families with low socioeconomic status) contributed to heightened risk of being victims of cyberbullying.^{88, 89}

Communication of Deliberate Self-Harm Content on Social Media. The frequent disclosure and rapid proliferation of DSH content was a predominant theme in the literature, addressed in nine of the articles reviewed. Two high quality articles led by Cavazos-Rehg⁹⁰ and Columbo⁴⁶ highlight the extent to which self-harm and suicidal content is spread online. Colombo and team⁴⁶ compared the online social networks of suicidal Twitter users compared to suicidal cases of youth ages 11-18 who were identified through traditional forms of media. They found that mutual linkages, i.e. reciprocity of follower and following relationships, between suicidal users was especially high (up to 73% compared to 42% among general users). The average shortest path of retweets of suicidal content among their sample of 3,535 youth were similar to networks of over 3 million nodes, which they argue suggests a high level of propagation of suicidal content. They indicate these findings suggest tighter linkages exists within networks of suicidal users, making the potential for contagion higher. Cavazos-Rehg and colleagues⁹⁰ further demonstrated the propagation of suicidal content online by following 17 Tumblr accounts that had highly popular posts pertaining to depression and DSH. They found that the posts generated from these accounts were re-blogged or liked a median number of 1.6 million times.

Several authors⁹¹⁻⁹⁴ aimed to understand the context of the rapid propagation of suicidal content on social media through analysis of textual content. One approach was data mining of content from a South Korean social networking site.⁹¹ Through this approach, expressions of stress over maintaining grades had the strongest association to DSH communications, partially mediated

by expression of depressed mood. Another approach was an inductive thematic analysis of Twitter messages, which revealed themes of celebrity influence on self-harm behavior, receipt of peer support (or lack thereof), expression of distorted body image, and personal stories of self-harm.⁹²

Other authors spoke of the influence of images, rather than textual references, to impact suicidal risk. In an article by Jacob and team, adolescents indicated that images on social media were the primary reason they practiced self-harm via the internet.⁹⁴ Youth explained that photos and videos invoked a physical reaction and inspired ritualistic practices of self-harm.⁹⁴ Further, a study of self-harm images found a positive relationship between reinforcement and wound grade, where self-harm images showing greater wound severity elicited the most responses.⁹³

Finally, Keipi,⁹⁵ Rodway,⁹⁶ and Poonai⁹⁷ each led papers that investigated severe forms of DSH online content. Keipi and colleagues⁹⁵ studied self-harm and suicide advocating social media groups. They found that vulnerable youth, defined by having a poor level of subjective wellbeing and those experiencing peer victimization, were most likely to be exposed to DSH-advocating sites. Taking another approach, Rodway and team⁹⁶ conducted a consecutive case series study that investigated the presence of DSH disclosure on social media as an antecedent to suicidal death. This study showed that internet use related to suicide (including searches of suicidal methods, posting suicidal ideas on social media, and online bullying) was recorded in 23% of deaths among adolescents in their sample. Poonai and team⁹⁷ investigated the impact of a high profile suicide death announcement made on social media to subsequent suicide-related diagnoses within emergency rooms; however, in this case no significant relationship was observed.

Social Media-Related Protective Factors of Deliberate Self-Harm and Opportunities for Prevention

A total of 13 articles were reviewed that demonstrated the protective and preventive potential of social media to DSH among youth, 9 of which were rated of high quality and thematically reviewed. These articles are described in **Table 6**. The 9 articles reviewed highlighted the potential of social media to offer social support through naturally occurring communication and prevention efforts, and the use of social media data to identify suicidal risk.

Naturally Occurring Social Support and Connectedness. Four articles reviewed social connectedness and the provision of social support within naturally occurring social media communication of youth engaging in DSH. Three articles investigated peer interactions with youth who posted DSH content on social media.^{90, 93, 98} While a portion of interactions in response to DSH disclosure were either hostile or offered harmful advice, each of these studies showed the presence of empathetic responses, offering emotional and informational support. As examples of this, nearly half of posts responding to Tumblr users posting DSH content were coded as demonstrating emotionally supportive content,⁹⁰ and the majority of responses to live broadcasts of suicide attempts involved audience members acting to prevent suicide through contact with prevention services.⁹⁸ The impact of supportive communication by celebrities to their followers was shown as well in a paper by Hilton and team,⁹² which investigated communication surrounding self-harm behavior generated through Twitter. Celebrities online influence was described as a source of support with teens finding celebrities stories of overcoming struggles with self-harm behavior to be inspiring. However, harmful influences of celebrity comments were also observed, some of which involved the encouragement of self-harm behavior.

Hobbs and colleagues⁹⁹ provide an example of the impact of a youth's suicidal death on the online connectedness of surviving friends on social networking sites. They found that friendship interactions increased sharply after the death of a friend and that friendships were less likely to fade over time than a comparison group that did not have a friend who died by suicide.

Social Support Provided through Prevention Efforts. Three articles demonstrate the provision of social support through prevention efforts. The first article by Seko and team¹⁰⁰ analyzed content posted on SelfInjury.net, a messaging board that offered an online space for youth to discuss self-harm ideation and behavior in a moderated environment. While youth cited examples of self-harm urges being curbed as a result of their interactions on this site, they noted other cases in which self-harm urges were triggered. Gal and colleagues¹⁰¹ offered another example through analysis of YouTube videos made in response to the “It Gets Better” campaign, which aimed to uplift and empower LGBTQ youth. This campaign highlights the potential for support to be offered to combat the heightened risk of suicide within the LGBTQ community through social media-based memes; however, the authors critique the inadequate inclusion of LGBTQ individuals from marginalized groups, e.g. non-Caucasian, non-Christian, non-disabled, non-American youth.

An additional paper by Gritton and team¹⁰² provides the perspective of American Indian and Alaskan Native (AI/AN) youth engaging in prevention efforts. Youth within their sample noted feeling responsible for responding to DSH content disclosed on social media by others within their network. This responsibility left a heavy burden, described as a “cycle of viewer distress” characterized by stress and worry following perceived failures in response to peers’ concerning posts on social media. They recommended AI/AN-specific media-based resources such as “We R Native,”¹⁰³ to address DSH prevention through social media.

Identification of DSH Risk. Two papers showed the potential for social media data to be used for the identification of DSH risk. Sueki and colleagues¹⁰⁴ explored the connection between text from suicide-related tweets to lifetime suicidality, showing the specific wording “want to die” and “want to commit suicide” were significantly related to suicidal ideation and behavior. Subsequently, Wood and team⁶⁷ discussed the novel use of machine learning to classify social media users who have attempted suicide. They estimated their classifier correctly identified 70% of users who attempted suicide and recommend use of this approach within clinical settings to flag patients at risk of a future suicide attempt.

2.4 Discussion

This review, an update to two previous systematic reviews,^{35, 36} explored the relationship between social media use and DSH among youth over a period in which the literature on this topic is estimated to have doubled in size (June 25th, 2014 – May 20th, 2018). The volume of new studies published, has allowed for an up-to-date examination of risk and protective factors associated with adolescents’ use of social media within studies that focused on DSH. While one other recent review offers an update on this topic,¹⁰⁵ this is the only paper that has used systematic search methods and incorporated a rigorous quality review, which are important measures for assuring bias is minimized. A total of 36 articles were included by authors from 14 countries. A total of 22 articles were rated as high quality and thematically reviewed, 3 of which included indicators of both risk and protection. Nearly twice as many articles summarized in this review demonstrate the potential for DSH risk (n=16) than those demonstrating the potential for protection or prevention (n=9). Based on these studies, the potential for DSH risk is significant, while the

benefits of social media, particularly regarding opportunities for prevention, merit further investigation.

The results of this review demonstrate a higher proportion of articles that indicate risks of social media use than previous reviews, which showed relatively equal numbers of articles demonstrating risks and benefits. Of the articles included in the narrative review, 59% reported risk factors, 27% reported protective factors, and 14% reported both risk and protective factors. High quality studies demonstrate that risk is exacerbated by heavy and problematic use of social media.^{39, 40} While the finding that heavy use of social media is correlated to suicidal risk was previously known,⁷² the studies highlighted in this review are the first to demonstrate this correlation in population-based samples and to denote indicators of heavy use (2 hours daily of SNS use and 5 hours daily of videogame use).^{39, 40, 42, 86}

In addition to heavy and problematic use of social media, experiences of cyberbullying emerged as significant predictors of DSH.^{40, 86-89} While extant reviews have addressed the prevalence of cyberbullying among youth,^{78, 106, 107} this review highlights the impact of cyberbullying occurring on social media on suicidal outcomes. The longitudinal study by Kim and colleagues⁸⁶ showing the impact of cyberbullying victimization on multiple forms of DSH provides evidence of a risk relationship and is consistent with other studies evaluating peer victimization's impact on well-being.⁷¹ Further, the repeated finding that experiences of cyberbullying are found to mediate the relationship between heavy social media use and DSH appear particularly salient to understanding a potential mechanism by which youth experience harm as a result of cyberbullying.^{40, 108}

The risks associated with communication of DSH content on social media were discussed among more than half of the included studies exploring risk factors. These studies examined the

impact of suicidal and self-harm virtual communities and demonstrate the rapid proliferation of DSH content on social media,^{46, 91-95, 97} which is consistent with another focused review that discusses the potential for contagion across media platforms.⁴⁵ The extent with which DSH content is communicated on social media proximal to suicidal death was explored in a consecutive case series study by Rodway and team.⁹⁶ While the sample size in this study was limited, the identification of suicide-related internet use in nearly a quarter of youth suicides highlights the potential to investigate DSH content expressed on social media to identify communication patterns that may predict acute suicidal risk.

Protective factors identified within high-quality papers include experiences of social support and connectedness,^{90, 92, 93, 98-102} a repeated finding that was consistent with previous reviews.^{35, 36} Several articles^{90, 93, 98} highlighted that the natural tendency to respond to friends on social media who have disclosed DSH content is more often supportive in nature; nonetheless, a proportion of comments tended to be either harmful or unhelpful. Similarly, within a virtual community aimed to support those with a history of self-harm thoughts and behaviors, many members reported interactions were supportive and acted as a deterrent to self-harm though in some cases exposure to others' DSH content had the unintended byproduct of triggering self-harm urges.¹⁰⁰ Together, these findings highlight the need to train and support youth in effectively offering help in response to online crises and for careful moderation within online spaces that is mindful of the potential burden of DSH disclosure.

Articles included within this review also addressed novel means of detection, including the use of natural language processing and machine learning.^{67, 104} These methods were used to harness the volume of information available on social media to classify and predict suicidal risk. The social media data of youth is likely to be especially rich, because of their abundant use of

social media and propensity toward disclosure of health risk behaviors within this age range.^{70, 109} Further applications could provide tremendous insight into clinical practice by enhancing the capacity of providers to understand the suicidal risk of their youth patients.

In relation to the potential for heightened vulnerability within certain subgroups, the heightened risk of cyberbullying victimization for sexual minority youth, males, and youth facing familial adversity,^{88, 89} suggests the need for targeted policies and prevention programs to reduce the incidence of cyberbullying victimization within these vulnerable groups. Additionally, programs aimed to reduce heavy and problematic videogaming are necessary, particularly among females who report high rates of suicidal behavior.⁴⁰ While the research predominantly explored risk among minority adolescents, there were also indications of protection, specifically a prevention campaign targeting LGBT youth and the acceptance of culturally appropriate social media programs aimed to prevent DSH among AI/AN youth.^{101, 102} These reports speak to the capacity to reach and offer support to two highly vulnerable groups that are at high risk of suicidal behavior and death via social media-based interventions.^{21, 110}

Strengths and Limitations. Limitations exist based upon the narrow scope of the review. First, previously identified high-quality articles within the Marchant and Dyson systematic reviews^{35, 36} were not evaluated within this review. As such, it will be necessary for readers to consult the prior reviews to understand the full extent of the literature to date evaluating risk and protective factors associated with the use of social media among studies focused on DSH. Secondly, this review, as well as the previous systematic reviews by Marchant and Dyson, focus only on studies evaluating DSH. Articles evaluating other outcomes known to be associated with adolescent DSH, such as depression, anxiety, and sleep disturbance, were not included. The findings of this review had significant overlap with a recent systematic review by Seabrook and

colleagues, which evaluated the influence of social media use on adolescent depression and anxiety,³⁷ as well as with recent longitudinal studies evaluating social media's impact on adolescent's mental health.^{43, 71} In particular, common risk factors were observed that included use in high volume, problematic internet use, and cyberbullying, and common protective factors were observed in social support and connectedness. However, these sources identified additional risk factors that were not discussed in this review - experiences of negative upward social comparison within online spaces and social media-related sleep disturbance.^{37, 43} As such, future reviews are needed that address a broad range of outcomes associated with suicidal risk to gain a more fine-grained idea of the pathways on which social media influences adolescent DSH. Third, this review is also limited by the database search exclusively focusing on Scopus. Thus, articles that were not indexed within Scopus or were not identified by expert review may have been missed within this review.

While readers are advised to take note of these limitations, this review also presents important strengths. Within a landscape in which the publications on this topic area are rapidly increasing, there is a need for a tightly focused review to advance the literature for researchers and prevention experts to act nimbly to new scientific findings. Further, it bridges the gap between the need for rapid release of findings with the need for rigor by using systematic search methods and quality review. Thus, this review was necessary, and additional reviews aimed to update the literature should be done frequently.

Additionally, though only one database was searched, the use of Scopus is estimated to offer wide scoping coverage of the literature. Scopus was selected because it is the largest database of peer-reviewed literature including records from EMBASE and MEDLINE (which includes publications from PubMed) from scientific journals, books, and conference proceedings, offering

a comprehensive overview of research in the fields of science, technology, medicine and social sciences.^{72, 111} Subsequently, bias was also minimized through supplementation of resources from conferences focused on the computer sciences and literature suggested by expert review.

Other limitations pertained to the inclusion criteria for the study. First, only articles written in English were included. Secondly, the inclusion of articles focused on cyberbullying was limited, because articles within this topic domain often focused across all forms of internet or phone use, rather than social media-specific cyberbullying. A future review of the impact of cyberbullying across any form of electronic media may be justified to fully capture implications for suicidal youth across all platforms. Additionally, we excluded articles that spanned a wide age range (e.g. until age 35) or with an ambiguous age range. Despite these challenges, this review captures the full spectrum of adolescence, a critical period in the life course during which health risk behaviors and protection within peer social networks impact the trajectories of adult health,^{112, 113} and a time during which social media use and suicide mortality are both very high.^{70, 114}

The body of literature was limited in two critical areas. First, nearly half of the included studies used questionnaires to guide data collection; however, there were few examples where validated measures were used. This is consistent with a recent systematic review that highlighted the need for validated measures of social media engagement.¹¹⁵ Secondly, the use of longitudinal and randomized control trial (RCT) study designs was limited. While the inclusion of articles with population-based samples is promising, longitudinal and RCT studies are necessary to investigate causal mechanisms.

Future Directions. Future research is needed to broaden insights into the direction and causal nature of the associations between social media use and DSH, particularly within the proximal time period to suicidal death, which is critical to the prediction of imminent suicidal risk.

Further, there is a clear need for validated measures of social media use. A recent systematic review offers a review of the available measures within this domain.¹¹⁵ Use of validated measures is critical to rigorous study within this content area. Future research should also focus on protective aspects of use is necessary, given that the recent research has disproportionately focused on risk relationships. Finally, the impact of social media use on vulnerable groups is poorly understood. Study of social media's impact and opportunities for prevention within groups known to be at heightened risk of suicide are vitally important next steps.

Conclusion. The study of the impact of social media use on youth suicide is rapidly evolving to meet the breakneck speed of technological innovation. In this relatively short period of review (2015 - 2018), the correlation between use of social media and youth DSH was tested in population-based studies. Further, the vast amount of data present on social media platforms was used to explore the proliferation of suicidal content. Additionally, new opportunities for the detection of suicidal risk to impact the prevention of youth suicide were identified. Despite this progress, large blind spots remain in the understanding of social media's impact on youth at risk of suicide, including understanding how social media impacts the most vulnerable adolescents. Researchers, clinicians, computer scientists, and prevention experts must ban together to reduce suicidal risk associated with maladaptive use of social media while exploiting benefits of protective online environments for the health and safety of young people.

2.5 Tables and Figures

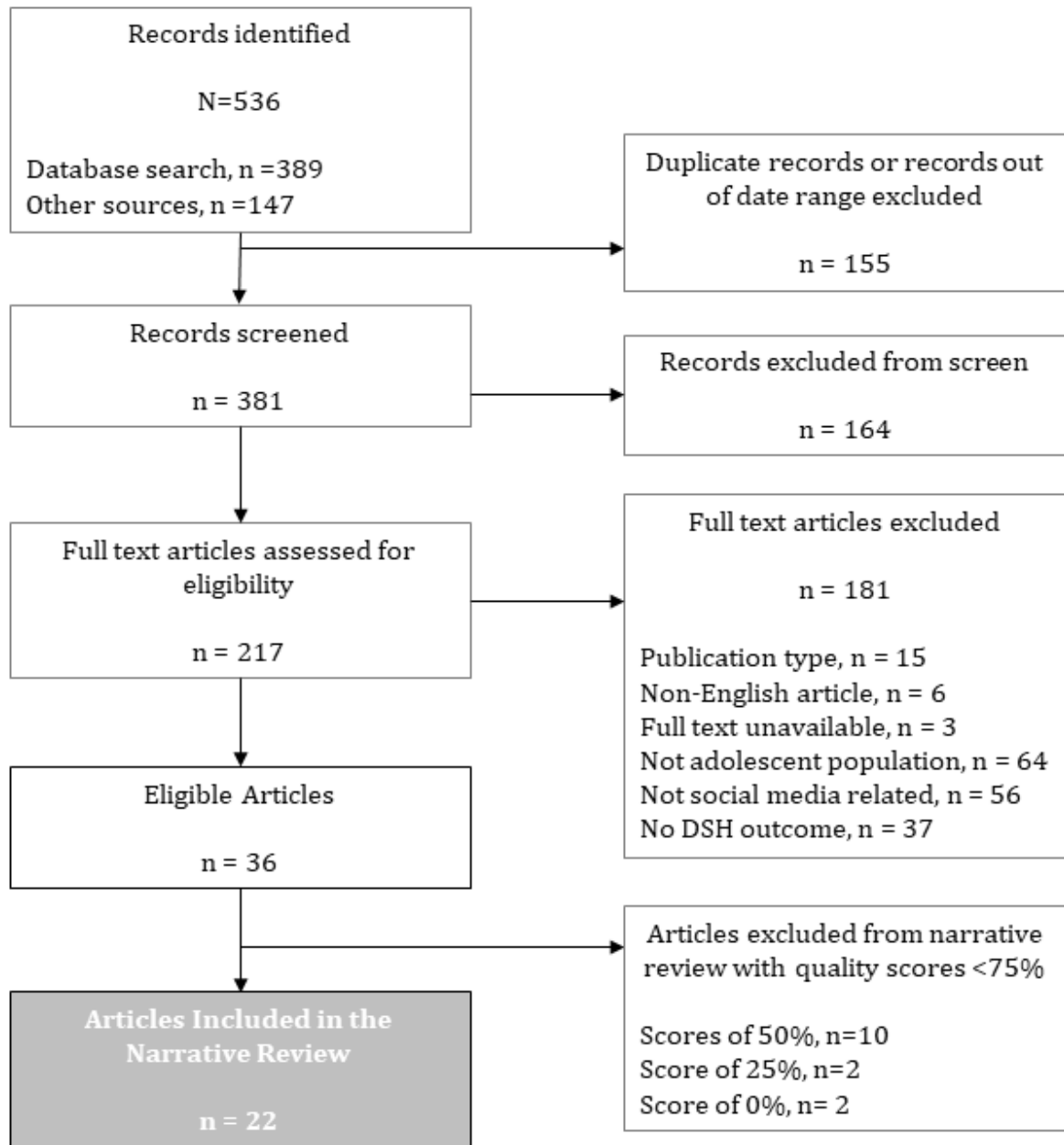


Figure 1 Flow of Information through the Evidence Review Process

Table 1 Risk and Protective Factors Identified within Previous Systematic Reviews

Risk Factors:	Marchant et al, 2017	Dyson et al, 2016
Heavy Use	X	
Problematic Social Media Use	X	
Cyberbullying/ peer victimization	X	
Exposure to Self-harm/ suicidal content	X	X
Social Isolation		X
Protective Factors:	Marchant et al, 2017	Dyson et al, 2016
Social Connectedness	X	X
Social Support	X	X

Table 2 Initial Literature Review Search

Database	Total Number of Results	% Publications from 2015 or Later
Scopus	295	64%
Web of Science	256	71%
PsycInfo	209	57%
Medline	214	65%
PubMed	184	68%
CINAHL	82	71%

Search term: ("social media" OR "social networking sites" OR twitter OR facebook OR instagram OR reddit OR tumblr OR youtube) AND (suicid* OR NSSI OR "self-injury" OR "self-harm" OR cutting OR depression OR depressed) AND (adolescen* OR youth OR child* OR teen* OR pediatric)

Table 3 Description of Included Studies

Study Design		
	<i>N</i>	<i>%</i>
Quantitative - Randomized	1	2.7%
Quantitative- Nonrandomized	19	52.8%
Qualitative	10	27.8%
Mixed Methods	6	16.7%
Sample Characteristics		
	<i>N</i>	<i>%</i>
Age:		
10-18*	20	55.6%
19-30*	21	58.3%
Not reported	1	2.8%
	<i>mean</i>	<i>range</i>
Sample size analyzed	7,945	1 - 99,693

*6 studies age ranges extended from adolescents (10-18) through young adulthood (19-29).

Table 4 Social Media Data Collection and Deliberate Self-Harm Focus

Lead Author, Year, Country	Social Media Data Collection	DSH Focus
Brown, 2017, Germany	photos pulled from instagram with the #ritzen (cutting in German)	Self-harm behavior shown in photos
Chen, 2018, China	"Internet Victimization" coded with the Relational Aggression Scale - 5-items: spreading rumors, keeping the victim from being in a group, telling friends to stop liking the victim, ignoring the victim, & threatening the victim (then asked if it happened on the internet)	Suicidal ideation, Self-harm ideation
Colombo, 2016, England	DSH content collected directly from Twitter	Deliberate self-harm online content, e.g. evidence of possible suicidal intent, flippant references to suicide, reporting news of someone's suicide
Duarte, 2018, United States	Social network modalities used, (e.g. texting, Facebook, Instagram, Twitter) & total # of network platforms used	Suicidal ideation severity
Gal, 2016, Israel	Memes were the focus of qualitative data collection	Prevention of deliberate self-harm
Gritton, 2017, United States	Adolescents' response to friends posting of suicidal content was the focus of qualitative data collection	Deliberate self-harm online content
Hilton, 2017, United Kingdom	Twitter posts pertaining to self-harm	Self-harm ideation/behavior disclosures
Hobbs, 2017, United States	Facebook profiles & contacts	Suicidal death
Jacob, 2017, United Kingdom	Self-harm behavior shown visually; online interactions	Self-harm behavior shown in photos
Keipi, 2017, Finland	Harm-advocating online content - assessed through 4 questions pertaining to suicide, self-hurt, eating disorder, and death sites; SNS activity - 21 options for popular SNSs, video sites, message & image boards, photo-sharing services, and online communication services	Self-harm/Suicide advocating sites

Table 4 Continued

Kim H, 2017, South Korea	Social media was defined by frequency of use one of the following four Internet-based activities: 'chatting online or using online messenger service,' 'using e-mail,' 'participating in online community or club' and 'using an online bulletin board.'	Suicidal ideation
Lee H, 2017, United States	Video gaming ("On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Count time spent on things such as Xbox, PlayStation, an iPod, an iPad or other tablet, a smartphone, YouTube, Facebook or other social networking tools, and the Internet).") Response options: none, 1 hour or less, 1 hour, 2 hours, 3 hours, 4 hours, and 5 or more hours)	Suicidal ideation with and without plan; Suicidal behavior
Ma, 2016, China	Responses to live-broadcasts of suicidal behavior on Weibo	Suicidal behavior & Suicidal death
Merelle, 2017, The Netherlands	Problematic social media use - any type of SNS or instant messengers (e.g. Facebook, Skype, Ping, WhatsApp, Twitter); Any type of video game on devices such as computer, tablet, smartphone, or game console (Problematic videogaming Cronbach's $\alpha = .88$; problematic social media use Cronbach's $\alpha = .82$)	Suicidal ideation
Poonai, 2017, Canada	Response to the release of Amanda Todd's YouTube video death announcement in October, 2012	Suicidal ideation, Suicidal behavior
Rodway, 2015, England	Suicide-related social media & internet use collected from investigations and inquiries by official bodies, e.g. coroner inquest hearings	Suicidal death
Roussel, 2016, United States	Responses associated with the "salt and ice challenge" that went viral on several SNSs	Self-harm behavior
Sampsa-Kanyinga, 2015a, Canada	Hours per day students usually spend on social media website such as Facebook, Twitter, Instagram, Myspace, either posting or browsing (coded dichotomously as internet users or non-users)	Suicidal ideation; Suicidal behavior
Sampsa-Kanyinga, 2015b, Canada	Hours per day students usually spend on social media website such as Facebook, Twitter, Instagram, Myspace, either posting or browsing (coded dichotomously as internet users or non-users)	Suicidal ideation
Seko, 2015, Canada	Posting self-injury content on social media sites	Self-harm ideation/behavior

Table 4 Continued

Song, 2016, South Korea	posts were collected from 163 different social media websites	Deliberate self-harm search terms, e.g. "suicide," "jump to one's death," "drown oneself," "hang oneself" and other forms of suicide
Sueki, 2015, Japan	Experiences on Twitter (4 questions measuring daily tweeting, lifetime suicide-related tweeting, and suicide-related tweeting within a month) and the device used to access the internet	Deliberate self-harm history (self-harm behavior; suicidal ideation; suicidal behavior)
Wood, 2016, United States	Suicidal content expressed on Twitter	Suicidal behavior

Table 5 Summary and Characteristics of Included Studies that Examined Deliberate Self-Harm and the Potential for Risk

(n=26)

Lead Author, Year, Country	Study Population, Age (n)	Aims/ Objectives	Key Findings & Findings Addressing Vulnerable Subgroups (if present)	Risk Factors	MMAT Quality Score
Akkin, 2017, Turkey	Depressed adolescents in outpatient MH care, aged 13-18 (n=55) and healthy control adolescents, aged 13-18 years (n =55)	To evaluate the amount of social media depressed adolescents use and the incidents of disclosure on social networking sites (SNSs)	Depressed adolescents spent significantly higher amounts of time on SNS (social networking sites) than non-depressed adolescents (4-5 hours compared to 1-3 hours) and were more likely to disclose thoughts of suicide on SNSs.	Amount of time spent on social media among depressed adolescents	25
Alpaslan, 2015, Turkey	Adolescents with Major Depressive Disorder, aged 12-18 years (n=120) and healthy control adolescents, aged 12-18 years (n = 100)	To compare rates of problematic internet use among youth with Major Depressive Disorder compared to healthy controls and explore links between	Rates of problematic internet use were higher among depressed adolescents than healthy controls ($\chi^2 = 27.26$, $p < .001$) and hopelessness was more prevalent among depressed patients with problematic internet use ($z = 3.10$, $p = .002$); however there was no relation between suicidal ideation scores and problematic internet	None (problematic internet use had no relationship to suicidal ideation)	50

Table 5 Continued

		problematic internet use and suicide among depressed youth	use, controlling for age & gender ($z=.26$, $p=.792$).		
Aquila, 2018, Italy	Female adolescent, age 17 (n=1)	To test the "social-mobile autopsy" as a new method to reconstruct suicidal events	A case example was presented in which a social-mobile autopsy detected conflict among an intimate partner relationship proximal to a suicide attempt through analysis of phone messages and a social media content.	Conflict with intimate partner	0
Berryman, 2018, United States	Undergraduate students in Southeastern U.S., mean age 19.66 (n=467)	To examine time spent using social media, the importance of social media in daily lives, and the tendency to engage in vaguebooking (posting unclear but alarming sounding posts to solicit attention and concern from readers)	Hours spent online and the importance of social media in daily life did not have a significant association with suicidality or other mental health outcomes. However, vaguebooking predicted loneliness ($F=.099$, $p<.05$) and suicidal thoughts ($F=6.547$, $p<.05$).	Vaguebooking	50
Branley, 2017, United Kingdom	Young adults selected from an international survey, aged 18-25 (n = 412)	To examine the relationship between exposure to online content depicting risky behavior and users' own offline risky behavior (self-harm	The odds of self-harm among those exposed to risky content on social media were 71% higher than those who were not exposed ($OR = 1.712$, $p<.001$).	Exposure content depicting risk behaviors	50

Table 5 Continued

		and other risk behaviors)			
Brown, 2017, Germany	Self-harming youth Instagram users, aged 12-21 (n=6721)	To investigate photos on Instagram that directly depicted self-harm wounds	Pictures with increasing wound grades and those showing different types of wounds generated significantly higher numbers of comments in response to self-harm (F=44.4, p<.001).	Social reinforcement (relative to the posting of more severe self-harm photos on Instagram)	75
Cavazos-Reg, 2017, United States	Youth Tumblr users with popular posts pertaining to depression & DSH, aged 14-20 years (n = 17)	To gain a better understanding of the depression, self-harm, and suicidal content that is shared on Tumblr	The 17 Tumblr accounts selected posted a median number of 185 posts (range = 0 – 2,954). This content was reblogged or liked a median number of 1,677,362 times (range = 0 – 122,186,504).	Proliferation of self-harm content	100
Chen, 2018, China	Chinese high school students, aged 15-17 years (n = 18,341)	To investigate the associations between cyberbullying and family victimization among adolescents as well as the health correlates of cyberbullying and family pol-victimization	<p>Cybervictimization was positively correlated to self-harm and suicidal ideation (aOR =1.228-1.914, p<.001) after adjusting for demographics, parental socioeconomic status, and family structure.</p> <p><u>Vulnerable Subgroup Findings:</u> Boys were significantly more likely to experience internet victimization in the preceding year (70.3%, p<.001). Children facing adversity -- parents' divorce, separation, or widow (aOR = 1.27-1.68, p<.05), below-median family income (aOR = 1.11-1.35, p<.05), mother's low level of education (aOR = 1.37-2, p<.05), and father's unemployment (aOR=1.42.13, p<.01) -- all had higher odds for internet victimization than non-internet victimization after adjustment for sociodemographic factors.</p>	Cybervictimization, of which males and those experiencing familial adversity are particularly vulnerable	100

Table 5 Continued

Colombo, 2016, United Kingdom	Adolescent Twitter users who have posted content denoting suicidal thinking, aged 11-18 (n=3,535)	To understand the connectivity and communication characteristics of Twitter users who post suicidal content	The reciprocity of either follower/following relationships or mutual links between suicidal users is significantly high (up to 73%), suggesting a tightly-coupled virtual community. Suicidal content was highly propagated of suicidal content. Furthermore, bridge nodes and hub nodes within a graph of retweeted suicidal content, showed connectedness of users posting suicidal ideation with users who had not posted suicidal messages, demonstrating the potential for an information cascade and risk of a possible contagion effect.	Proliferation of deliberate self-harm content; risk of contagion	100
Dillman, 2016, United States	College students from 2 universities in the southeastern US, ages 18-24 years (n=357)	To understand the influences behind searches for information concerning depression, suicide, and mental health following the death of Robin Williams	Emotional distress following the actor's death mediated the relationship between involvement and certain types of information searches ($B = .31$, $SE\ B = .10$, $CI95 = .12$ to $.5$). Those respondents who sought information about the suicide reported changes in their thoughts about suicide, most often dealing with the difficulty in spotting warning signs and the idea that "it can happen to anyone."	Exposure to celebrity suicide	0
Duarte, 2018, United States	Adolescents presenting to an urban pediatric emergency department, aged 13 to 17 years (n=1031)	To investigate risk of negative mental health outcomes associated with cyberbullying among minority adolescents	Suicidal ideation was more prevalent among participants who reported any past-year cyberbullying than those who were not cyberbullied ($\chi^2 = 11.7$, $p < .001$). <u>Vulnerable Subgroup Findings:</u> Lesbian, gay, or bisexual adolescents were 2.49 times more likely to be involved in cyberbullying than their heterosexual	History of cyberbullying in the past year, of which lesbian, gay, and bisexual youth are most vulnerable	100

Table 5 Continued

			counterparts after controlling for all other sociodemographic factors and social media use. However, sexual minority status was not significantly associated with suicidal ideation.		
Hilton, 2017, United Kingdom	Adolescent Twitter users, estimated, mean age of 17.54 (n=317)	To conceptualize naturally occurring online communication surrounding self-harm behavior generated through Twitter	Five themes were identified of posts containing self-harm content using inductive thematic analysis : (1) celebrity influence, (2) self-harm is not a joke (feeling let down by unsupportive family/friends, (3) support for and from others, (4) eating disorders and self-harm (posting of various thin body parts in relation to self-harm thoughts/acts) and (5) self-harm videos and personal stories.	Lack of social support; celebrity influence (in some cases negative); distorted body image	75
Jacob, 2017, United Kingdom	Youth with a previous history of self-harm, aged 15-24 years (n = 21)	To explore young people's understanding and use of online images of self-harm	Images, rather than textual interactions, were the primary reason cited for using the internet for self-harm purposes. Images invoked a physical reaction and inspired behavioral enactment, corresponding to a ritualistic practice of self-harm. Engagement with online communities (particularly Tumblr) often led to an exacerbation of self-harm due to normalization of self-harm, increased exposure to self-harm content, and access to new techniques.	Proliferation of self-harm images online; ritualistic practice of self-harm as a result of online images	75
Keipi, 2017, Finland	Finnish adolescents, aged 15-30 years (n=555) and US adolescents, aged	To examine the association between exposure to harm-advocating online content and Finnish and American	Across the U.S. and Finland, those reporting higher SNS activity ($p<.05$), offline victimization ($p<.05$), and subjective wellbeing ($p<.001$) were more likely to be exposed to self-harm as well as suicide advocating sites. In the US sample,	Poor subjective wellbeing, frequent SNS activity, online & offline victimization, age, and male gender	75

Table 5 Continued

	15-30 years (n=1032)	users' subjective well being	online victimization was also associated with self-harm and suicidal harmful content sites ($p<.001$) with older youth. <u>Vulnerable Subgroup Findings:</u> In the US, older adolescents ($p<.05$) and males ($p<.05$) were more likely to visit self-harm sites.		
Kim, 2017, South Korea	Students nested within 125 schools, taking part in the Korean Youth Panel Survey, aged 12-15 years (n= 2099)	To examine the extent to which online media activities are associated with the psychological well- being of adolescents	When controlling for demographic variables, there was a strong and negative relationship between frequency of use of online activities (chatting, e-mailing, participating in communities or clubs and using bulletin boards) and self-reported mental health and suicidal ideation among a nationally representative sample of Korean students (OR = 1.36, 95% CI: 1.10- 1.67, $p<.01$). Additionally, cyberbullying and academic stress increase the odds of suicidality (OR = 1.77, 95% CI: 1.22-2.59, $p<.05$ & OR = 2.26, 95% CI: 1.12-4.54, $p<.05$ respectively).	Frequency of online activities, cyberbullying, & academic stress	100
Lee, 2017, United States	Participants of the 2015 Youth Risk Behavior Survey, 9th - 12th graders (n=15,624)	To determine differences by sex in the association between video gaming or other non-academic computer use with depressive symptoms, suicidal behavior, and being	Those spending 5 or more hours per day using video games or other nonacademic computer games (20% of the overall sample) had the highest prevalence of suicidal behavior (32.4%) <u>Vulnerable Subgroup Findings:</u> The prevalence of suicidal behavior among female adolescents was 22.5% when no hours were spent with video games (14.9% in males) and rose to 37.8% at 5 or more	Video game use volume of 5 hours or greater, on which a greater burden of suicidal behavior is associated among adolescent females	100

Table 5 Continued

		bullied among US adolescents	hours of video game use (compared to 25.1% among males).		
Merelle, 2017, The Netherlands	Early adolescents in The Netherlands, mean age of 14 years (n=21,053)	To understand health-related problems and demographic factors associated with problematic video-gaming or social media use in early adolescence	Problematic video-gaming and problematic social media use were both associated with suicidal thoughts, (OR=2.28, 95% CI [1.96-2.65], p<.001) and (OR=1.79, 95% CI [1.59-2.01], p<.01) respectively	problematic video-gaming and problematic social media use	75
Oksanen, 2015, Finland	Youth within the US, aged 15-30 years (n=1033), Finland (n=555); youth within Germany, aged 15-30 years (n=978); and youth within the UK, aged 15-30 (n=999)	To examine the context of sites advocating eating disorders, self-injury, and suicide among US, British, German and Finnish respondents	<p>German respondents had significantly lower levels of exposure to harm-advocating online content than respondents in the three other countries.</p> <p><u>Vulnerable Subgroup Findings:</u> Males witnessed more self-injury and suicide content across all four countries (p<.05). Younger respondents were more likely to be exposed to such material (p<.05). Other socio-demographic background variables significantly predicted exposure to self-harm and suicidal content, including not living with parents (p≤.001), scope of online activity (p<.001) as well as personal characteristics associated with negative self-schemata, including happiness (p<.001), online victimization (p<.001), and offline victimization (p<.001). Additionally, immigrant background predicting exposure to self-harm (p=.005) but not suicidal content.</p>	<p>Exposure to self-harm/suicide advocating sites, of which the following youth are most vulnerable:</p> <ul style="list-style-type: none"> - males - early adolescents - those who do not live with their parents - those who report a negative self-schema - those who report being victimized - immigrants 	50

Table 5 Continued

Patchin, 2017, United States	U.S. youth ages 12-17 (n=5593)	The extent of digital self-harm, or anonymous online posting, sending, or otherwise sharing of hurtful content about oneself, among adolescents	<p>About one out of every 20 12-17-year-olds participated in digital self-harm. Students who reported being depressed ($B=1.58$, 95% CI: 3.57-6.62, $p<.001$) or participated in offline self-harm ($B=.98$, 95% CI: 2.03-2.79, $p<.001$) were more likely to be involved in digital self-harm. Additional factors associated digital self-harm included bullying either at school or online, homosexuality, deviance (stealing), and drug use.</p> <p><u>Vulnerable Subgroup Findings:</u> Nonheterosexual youth had greater odds of engaging in digital self-harm than their heterosexual peers ($B = 1.09$, 95% CI: 2.1-4.04, $p<.001$).</p>	Nonheterosexual preference, bullying in school or online, deviance (stealing), and drug use	25
Poonai, 2017, Canada	Adolescents reporting to an emergency department in Ontario for suicidal ideation, intentional self-poisoning, and intentional self-harm, aged 11-17 years (n=36,854, 17,130, and 8,074 respectively);	To investigate whether emergency department visit rates for suicide-related diagnoses increased following Amanda Todd's YouTube video death announcement	There was a significant increase in the monthly ED visit rate for the composite outcome ($p = 0.02$) and death or ICU admission ($p = 0.006$) from April 2002 to December 2013. There was no significant change in the ED visit rate for the composite outcome before and after the announcement of Amanda Todd's death, (119.8 before versus 219.2 after, $p = 0.5$).	No specific risk factors were identified, rather this study's results were alternative to previous reports showing greater ED visits following high-profile suicides.	100
Rodway, 2015, United Kingdom	Adolescents who died by suicide between Jan 1, 2014 - Apr 30,	To describe antecedents to suicidal death from a range of inquiries,	Internet use related to suicide (i.e., internet searches for suicide methods, suicidal ideas posted on social media, or online bullying) was recorded in 30 (23%) deaths. In total,	Posting suicidal methods or plans on social media	75

Table 5 Continued

	2015 and were residents of or died in England, aged 10-19 (n=145)	including coroner inquest hearings, child death investigations, criminal justice system reports, and the English National Health Service	12 people posted suicidal ideas on social media prior to their death (9% of the sample).		
Roussel, 2016, United States	Female emergency room patients who sought care for intentional freezing burns that resulted from the "salt and ice challenge," ages 10-13 years, (n=5)	To describe injuries and motives behind injuries incurred as a result of the "salt and ice challenge"	The mean total body surface area impacted by burns was 0.408%. Salt and ice were in contact with skin for >10 min for two patients, >20 min for two patients, and an unknown duration for one patient. Complications included pain and burn scar dyschromia. Four patients cited peer pressure and desire to replicate the challenge as seen on the Internet as their motivation in attempting the challenge.	Exposure to self-injurious content (in reference to the "salt and ice" challenge)	50
Sampasa-Kanyinga, 2015a, Canada	Youth who completed the mental health portion of the Ontario Student Drug Use and Health Survey in 2013, aged 11-21 years (n=5,126)	To examine the link between the use of SNSs and psychological distress, suicidal ideation, and suicide attempts, and to test the mediating role of cyberbullying victimization on these associations	After adjustment for sociodemographic factors, heavy use of SNSs was associated with suicidal ideation (aOR = 3.44, CI = 1.54-7.66) and attempts (aOR = 5.10, CI = 1.45-17.88). Cyberbullying victimization was found to fully mediate the relationships between the use of SNSs with suicide attempts; whereas, it partially mediated the link between use of SNSs and ideation.	Heavy use of SNSs; Cyberbullying victimization	100

Table 5 Continued

Sampasa-Kanyinga, 2015b, Canada	High school students who completed the 2013 Ontario Student Drug Use & Health Survey, 7th - 12th graders (n = 753 students)	To investigate the association between time spent on SNSs and unmet need for mental health support, poor self-rated mental health, and reports of psychological distress and suicidal ideation	Daily SNS use of more than 2 hours was also independently associated with suicidal ideation (5.93 [2.38–14.75]).	Heavy use of SNSs	100
Song, 2016, South Korea	Suicide-related documents retrieved by Crawler from social media websites in South Korea between Jan 1 2011 - Dec 31 2012, aged 19 years or under (n=99,693)	To investigate online search activity of suicide-related words in South Korean adolescents through data mining of social media website	The link from grade pressure to suicide risk showed the largest path coefficient ($B = .357, p < .001$) in structural models and a significant random effect ($p < .01$) in multilevel models with depression as a partial moderator. The multilevel models indicated that about 27% of the variance in the daily suicide-related word search activity is explained by month-to-month variations. A lower employment rate, a higher rental prices index, and higher rates of bullying were associated with an increased suicide-related word search activity.	Grade pressure; macro-economic factors such as the employment rate and rental price indexes	75
Sueki, 2015, Japan	Internet users in Japan, aged 20-29 years (n=1,000)	To examine the association between suicide-related tweets and suicidal behavior	Tweeting “want to die” and “want to commit suicide” was significantly related to lifetime suicidal ideation and behavior. Lifetime suicide attempts were more strongly associated with tweeting “want to commit suicide” than tweeting “want to die”.	Disclosure of suicidal intent	75

Table 6 Summary and Characteristics of Included Studies that Examined Deliberate Self-Harm and the Potential for Protection (n=13)

Lead Author, Year, Country	Study Population, Age (n)	Aims/Objectives	Key Findings and Findings Addressing Vulnerable Subgroups (if present)	Opportunities for Prevention	MMAT Quality Score
Brown, 2017, Germany	Self-harming youth Instagram users, aged 12-21 (n=6721)	To investigate photos on Instagram that directly depicted self-harm wounds and evaluate associations between photo characteristics and comments	While few comments were hostile, most comments in response to self-harm content were either neutral (i.e. discussion-based n = 3,291 out of 6,568 comments) or empathetic in nature (n= 1,562) in nature and some offered help (n = 462).	Potential for peer support following disclosure of self-injurious behavior on social media	75
Cavazos-Rehg, 2017, United States	Youth Tumblr users with popular posts pertaining to depression and DSH, aged 14-20 years (n = 17)	To gain a better understanding of the depression, self-harm, and suicidal content that is shared on Tumblr	Of the 249 of posts that involved interaction from another Tumblr user, 117 (47%) provided emotional support and 52 offered/sought advice; although 32 messages (25%) provided potentially harmful advice.	Emotional support following disclosure of DSH content	100
Chan, 2017, Hong Kong	Hong Kong adolescents, aged <17 - 29 years (n = 1,010)	To identify the factors associated with those who reported expressing emotional distress online and the differences in help-seeking	Help seeking and expression of distress online were found to be associated with a higher lifetime prevalence of suicidal ideation (OR=1.53 (1.04-2.25), p<.05). The “Seek formal help” and “Did not seek help” groups had a similar risk profile, including a higher prevalence of suicidal ideation and non-suicidal self-injury. The “Seek informal help” group was more	Online expression of distress/ help-seeking may act as an important avenue for the identification of suicidal risk	50

Table 6 Continued

		behavior among four groups of youth: (1) a non-distressed reference group, (2) a non-help-seeking group, (3) a group seeking informal help, and (4) a group seeking formal help	likely to express distress online (OR = 1.61 (.69-1.53), $p < .05$), which indicates that this population of youths may be accessible to professional identification. Approximately 20% of the distressed youths surveyed had not sought help despite expressing their distress online.		
Corbitt-Hall, 2016, United States	Students enrolled in psychology courses at a southeastern US university, aged 19 to 26 (n=468)	To test the willingness and ability of college students to notice, recognize, and appropriately interpret suicidal content expressed on Facebook	A larger proportion of those exposed to content reflecting moderate and severe suicide risk noticed, recognized, appropriately interpreted, and endorsed acting to intervene, as compared to those exposed to content representing no or low risk. Responsiveness was strongest among closest ties, e.g. close friend/family member.	Responsiveness of college students to friends' suicidal content	50
Gal, 2016, Israel	YouTube videos stemming from the "It Gets Better Campaign" targeting LGBTQ teens (n = 200)	To conceptualize the body of videos released in response to the "It Gets Better Campaign"	The content of the campaign involved expressing experiences of distress experienced by LGBTQ youth and sharing solution-focused language, frequently featuring emotional support. However, most videos echoed the prevalent community norms that were embedded in the founding clip characterized by an emphasis on private, apolitical experiences. Participation structures rarely included representatives from marginalized populations, e.g. specific age	Emotional support offered through a prevention campaign	100

Table 6 Continued

			or ethnic groups, indicating a tendency toward conformity, despite the absence of any formal gatekeeping in an online environment.		
Gritton, 2017, United States	American Indian and Alaskan Native (AI/AN) youth, aged 14-22 years (n=32)	To understand AI/AN adolescents' perspectives on concerning social media posts, including those expressing suicidal intent	<u>Vulnerable Subgroup Findings:</u> AI/AN youth conceptualized themselves as having a primary role and responsibility to respond to their peer's concerning social media content. While youth endorsed being frequently distressed by these responsibilities (see risk factor section), they support AI/AN-specific technological interventions, e.g. "We R Native."	Social media-based prevention resources can offer acceptable tools for protection among AI/AN youth	100
Hilton, 2017, United Kingdom	Adolescent Twitter users, estimated, mean age of 17.54 (n=317)	To conceptualize naturally occurring online communication surrounding self-harm behavior generated through Twitter	Among the 5 themes identified (see Table 4) the potential for celebrity influence to offer support for self-harming youth was identified.	Social support offered through celebrity influence	75
Hobbs, 2017, United States	Cases of young adult suicide deaths with a Facebook profile, aged 18-24 years (n=15,129) and living controls with a Facebook profile, aged 18-24 years (n=30,258)	To examine social networks on Facebook in which a friend died by suicide in comparison to networks in which no death occurred	Overall, friendship interactions increased sharply at the death of a friend and slowly faded as time went on (log months from death slope -0.026, CI -0.032 to -0.020). However, among close friends of the deceased, there were 4.5% (95% CI 3.4-5.7%) more interactions in close friend networks nine months after losing a mutual friend than the control group, and these interactions were less likely to fade over time. Furthermore, estimates were	Social connectedness; recovery of social interactions following loss of a friend to suicide	100

Table 6 Continued

			used to simulate the degree to which social interactions lost due to the death of a friend were recovered through interactions with others in bereaved users' networks, which showed that an estimated 99% of social interactions were recovered (simulated 95% CI 77% to 126%).		
Ma, 2016, China	Chinese young adults who have live-broadcasted suicidal incidents on Weibo, aged 18 to 25 years (n=6)	To examine the behaviors of both suicide broadcasters and their audience, with attention on prevention/crisis opportunities	Case studies of emergent adults who live broadcasted suicidal behavior on Weibo showed most audience members attempted to prevent suicides through active engagement and contact with suicide prevention services, while few audience members engaged in cyberbullying, inciting suicidal behaviors to occur. Audience members demonstrated a desire to help but lacked appropriate skills or knowledge in how to effectively respond.	Willingness of audience members of live suicide broadcasts to offer assistance	75
Seko, 2015, Canada	Youth members of the messaging board, SelfInjury.net, aged 16 to 27 years (n = 17)	To investigate the motivations behind the creation and publication of content related to non-suicidal self-injury in online spaces	A thematic analysis of participants' narratives identified two prominent motives: self-oriented motivation (to express self and creativity, to reflect on NSSI experience, to mitigate self-destructive urges) and social motivation (to support similar others, to seek out peers, to raise social awareness). Participants also reported a double-edged impact of NSSI content both as a trigger and a deterrent to NSSI.	Self-expression within a moderated environment, emotional support	100
Seward, 2016, Australia	Emerging adults recruited from Google &	To elucidate relationships between	Among emerging adults, help-seeking likelihood increased with informal online sources as suicidal risk increased.	Online help-seeking through social networking sites	50

Table 6 Continued

	Facebook advertisements, aged 18-25 (n=400) and an adult/older adult comparison group, aged 26-71 years (n=313) *Only the results from emerging adults are reported.	suicidality and both online and offline help seeking	Emerging adults viewed online help-seeking as generally acceptable, particularly those who had a history of going online for personal relationships and among those who perceived greater social support. Various dispositions toward online help-seeking were noted, i.e. online professional help-seeking, online anonymous help-seeking, and online + friend help-seeking typologies.		
Tan, 2017, China	Microblog users with suicidal ideation, mean age = 21 (n = 4,222)	To assess suicidal young adults' perceptions toward being contacted for treatment by a doctor offline vs. on a microblog	78.62% of participants were not opposed to online suicide intervention, if the information was communicated in a way that was reliable, brief, and offered appropriate contact information for services.	Suicide intervention via microblog chats may be acceptable to young adults when targeted appropriately	50
Wood, 2016, United States	Twitter users who have publicly stated that they have tried to take their own life, mean age of 22, (n=125)	To derive insights and quantifiable signals from the language of social media users who have previously attempted suicide using machine learning	The machine learning classifier correctly identified 70% of users who attempted suicide. The authors estimate that if used in clinical practice between one third and one half of the users flagged for further screening would attempt suicide.	Identification of suicidal risk through machine learning analysis of social media data	100

3.0 Understanding and Responding to Adolescent Suicidal Risk Within Online Spaces: Exploring the Context and Feasibility of Automated Digital Media Monitoring

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3.1 Introduction

During the same time period that suicide emerged as the 2nd leading cause of death among adolescents, the proportion of youth who use social media multiple times per day has doubled, now encompassing 70% of US adolescents.^{2, 6, 7} These trends are of concern because maladaptive use of social media is associated with adverse mental health effects, including increased adolescent suicidal risk.^{39, 43} Poor mental health outcomes resulting from problematic internet use have been observed longitudinally,⁴³ and heavy use of social media is associated with higher rates of suicidal thoughts.³⁹ Due to the heightened risk of suicidality, there is a need to determine effective strategies for monitoring at-risk adolescents' use of digital media. Based on this concern, mental health researchers have explored the capacity to monitor patients' online presences, including searching adolescents' digital media content to explore the context of events and posts that antedated to a subsequent suicide attempt.^{104, 116}

The exploration of digital media content could prove especially advantageous within clinical practice for the detection of adolescent suicidal risk, especially because suicidal disclosures are frequent within online spaces, even more so than through in-person communication.⁷² Typical assessment practices within clinical settings heavily rely on subjective report of suicidal thoughts and behaviors. Patient self-report, while useful, is limited in predicting suicidal risk because patients may understate their suicidal intent, either to avoid more restrictive treatment, or to carry out their suicidal plans. The detection of words or phrases indicative of suicidal risk from digital media content could offer a more direct assessment that could improve upon currently available assessment methods. However, a critical barrier to the identification of risk phrases is managing the burden associated with reviewing the massive amount of digital media content produced by adolescents.

Advances in language analytic methods, such as Natural Language Processing (NLP) now allow for the efficient collection and analysis of adolescents' digital media data. NLP is a method that was initially designed by computer scientists for the processing of language data. It allows large amounts of textual data to be analyzed, such as the high volume of data that is produced by adolescent digital media users. NLP can be used to analyze frequency of words or emojis, which can be distilled into measure of linguistic structure, interpersonal awareness (such as self-referential phrases, which are common in suicidal individuals), and emotional and psychological states (e.g. hopelessness or depressed affect). Using these analytic methods, NLP can evaluate the valence of words and phrases to understand not only what was said but also some idea of the tone that was used. As a prime example of application of NLP in analyzing digital media content, investigators at Qntfy have used their platform OurDataHelps to collect and analyze donated social media content using NLP to detect risk among users with a history of suicide.^{67, 117}

Data analytic approaches such as NLP have the potential to enable an automated approach for monitoring of suicidal risk. Within the framework of an automated monitoring approach, data could be analyzed in real-time to detect language indicative of suicidal risk. Once risk language was identified, a digital alert could be sent to an adolescents' mental health clinician, who would respond as they found appropriate. See **Figure 1** for a visual depiction of the proposed strategy for automated digital media monitoring. An automated method of review and response such as this would be considerably less burdensome than currently available means of monitoring, which involve searching digital media content line by line. Nonetheless, these software-based approaches for the collection and analysis of digital media data have not been tested with adolescent patients in a clinical setting.

Determining adolescents' perspectives on the acceptability of data collection and analysis by software is critical to developing a process for automated monitoring that would be feasible, effective, and acceptable within a clinical setting. First, understanding the context of acutely suicidal adolescents' online environments, particularly the impact that these experiences have on their mental health, will lead to greater effectiveness in detection and response to suicidal risk. While the extant literature has uncovered risk factors for adolescent suicide associated with digital media use, notably via impaired sleep, cyberbullying, and heavy or problematic digital media use,^{35, 36} little information exists on the context of online experiences from the perspective of acutely suicidal youth. Second, adolescents' perspectives on acceptable means for the collection and monitoring of their digital media data are necessary to inform a feasible and acceptable automated monitoring strategy. One previous report,¹¹⁸ which gauged adolescents' perspectives on automated monitoring, pointed to concerns regarding digital privacy, loss of freedom of expression, and disbelief that software would be effective in adequately interpreting online communications. However, this report did not address adolescents' attitudes towards monitoring of suicidal risk or use of automated monitoring within a clinical context.

The perspective of parents is also critically important. Parents are (or should be) the key gatekeepers of youth's access to media and can be highly influential in adolescents' online decision-making and digital media usage patterns.¹¹⁹⁻¹²¹ Therefore, an effective automated monitoring strategy must be informed by and responsive to parents' existing monitoring strategies. Additionally, a feasible automated monitoring approach is conditional upon the acceptability to parents of their child's digital media data being monitored and analyzed by a third party. Further, it is necessary to explore parents' willingness and preferences toward engaging with therapists in response to their child's risky incidents of digital media use.

This paper presents the findings from a mixed-methods study aimed to inform the development of an automated monitoring strategy designed to reduce adolescent suicidal risk by gathering perspectives from acutely suicidal adolescents and their parents. The exploration of both parent and child perspectives are critical to the establishment of an effective and feasible monitoring strategy, capable of implementation within a clinical setting.

3.2 Methods

Participants and Setting. Adolescent patients and parents were purposively sampled¹²² from an intensive outpatient program at Western Psychiatric Hospital between January and July 2018. The population of the outpatient program is predominantly female (72.5%), Caucasian (84.3%), Non-Hispanic (98.2%), and from urban/suburban residences (approximately 80%). The adolescents recruited were between 13 to 18 years of age and were in treatment for recent suicidal ideation or behavior. The parent participants were those who have a child within this age range who is being treated or has recently concluded treatment within the intensive outpatient program. The first and second author were introduced to adolescents by their clinicians to discuss the study. The parents of youth who expressed interest were contacted via phone to discuss their child's participation, and these parents were invited to participate. If interested, an appointment was made for the youth to participate in a survey and focus group and for the parent to participate in a survey and interview. Research visits were conducted separately for youth and parent participants. Parents provided informed consent and adolescents assented. The University of Pittsburgh institutional review board approved this study (PRO17100339).

Data Collection. A concurrent triangulation design was used to guide data collection. This design involves the collection of quantitative and qualitative data at one point in time whereby the two methods are used to confirm or corroborate findings within a single study.¹²³ Adolescents (n=15) participated in-person with a brief survey completed via tablet followed by focus groups. Three focus groups were conducted in total with group sizes ranging between 3 to 6 in each group. Twelve parents participated in surveys followed by interviews, either by phone or in-person based on their convenience. Nine of the parents had a child who also participated in the study.

Overall, data collection focused on the digital media use and experiences of acutely suicidal adolescents, parental monitoring strategies, and perspectives on automated digital media monitoring. Digital media is an umbrella term referring to digitized content that is transmitted online.¹²⁴ Forms of digital media investigated through this study included use of text messaging, direct messaging (private messages sent via a social media platform or phone application), social networking sites, and other forms of social media.

Surveys focused on adolescents' digital media use and interactions and parents' involvement in monitoring. Items were drawn from the Pew Research Center's surveys: Teens, Social Media and Technology,¹²⁵ Teens, Technology and Friendships,¹²⁶ and Teens, Parents, and Digital Monitoring (see **Appendix B**).¹²⁷ The teen and parent surveys included 28 and 23 items, respectively, and were administered on Qualtrics either via tablet or desktop computer. Data gathered from parent and teen surveys were used to inform qualitative data collection. For example, the amount of time of adolescents' use digital media daily was identified via survey and then explored in further depth during focus groups, and parents' monitoring strategies determined during surveys were contextualized through interviews.

Interview and focus group guides were developed to facilitate semi-structured discussion (see **Appendix C**). Guides were constructed to understand the digital media experiences of acutely suicidal youth, the experiences of parents in monitoring their children's use of digital media, as well as perceptions toward an automated monitoring strategy used within clinical practice.

Although guides were used to focus discussion, the conversations remained open to topics that were most salient to the participants, which facilitated the spontaneous generation of themes. This approach increases the validity of collecting experiential data.¹²⁸ The first and second author conducted adolescent focus groups, and the first author conducted parent interviews. Inclusion of participants continued until saturation was reached.¹²⁹ Focus group duration was approximately 1 hour in length and interviews were approximately 45 minutes in length.

Data Analysis Plan. Univariate analyses of demographic characteristics, adolescents use of digital media, and parents use of digital media mediation strategies collected via survey data from adolescent and parent participants were conducted. These data were used to contextualize and inform qualitative analyses of the online experiences of adolescents and parents' experiences in social media monitoring. SPSS, Version 25.0⁸⁵ was used for all statistical analyses.

Focus groups and interviews were audiotaped, transcribed, and coded using NVivo,¹³⁰ a qualitative data management program. Qualitative data was analyzed using a thematic analysis approach designed by Braun and Clark,¹³¹ a recommended approach for applied health research.¹³² A codebook was constructed and subsequently revised based upon themes that emerged within focus groups and interviews. All transcripts were coded based on the final version of the coding scheme.

Constructs from Berkman's Social Network Theory,¹³³ a theory which conceptualizes how social networks impact health, were applied to conceptualize themes that emerged surrounding

adolescents' experiences of connectedness within online social networks. Berkman postulated that psychosocial mechanisms exist within social networks that affect health behavior and psychological pathways. Three constructs from this theory emerged within adolescent focus groups, which included the provision of social support, social engagement, and social influence. Social support refers to the extent to which network ties provide assistance emotionally, materially, informationally, or in decision-making.¹³⁴ Social engagement refers to encouragement to participate in social interaction, e.g. getting together with friends or participating in social roles. Social influence refers to the confirmation or reinforcement of shared attitudes or the alteration of attitudes that are discrepant from a comparison group.¹³³

The Theory of Parental Mediation¹³⁵⁻¹³⁷ was used to offer context to themes that emerged surrounding parents' experiences with monitoring digital media. This theory considers how parents utilize interpersonal communication to mitigate the negative effects they believe communication media have on their children and has evolved to address digital forms of media.¹³⁶ Livingstone and colleagues¹³⁷ operationalized this theory in the digital age by defining four primary mediation strategies that parents deploy when monitoring their child's use of digital media: active co-use, interaction restrictions, technical restrictions, and monitoring. Active co-use refers to a parent remaining present while the child is engaging with media or co-using media with them. Interaction restrictions are a form of restrictive mediation of electronic media associated with enforcement of social rules, e.g. banning or restricting electronic interactions viewed to be problematic. Technical restriction refers to implementing technical means to block or filter certain online activities. Finally, monitoring refers to the covert or overt tracking of a child's online activity following their use of digital media.

3.3 Results

I. Evaluating the Context of Teens' Digital Media Use and Experiences

Survey Results. (See **Table 7**). Surveys conducted with teens (n=15) showed digital media was widely used within the sample. Participants most frequently reported digital media use through social media (n=14, 93%), mobile videogames (n=14, 93%), or video calls or chats (n=13, 86%). Nearly all participants reported using the internet either several times per day (n=7, 47%) or almost constantly (n=7, 47%). Engagement in messaging was frequent with the median number of text messages and direct messages per day being 20 and 15, respectively. Two-thirds of adolescents surveyed (n=10, 67%) reported using social media 2 or more hours daily.

The presence of both supportive and stressful experiences was reported on social media. Participants endorsed feeling more connected to their friends' lives (n=14, 93%) and feelings (n=8, 53%) after digital media use and having received support through challenges or rough times from friends/followers on digital media (n=11, 73%). Negative experiences noted in surveys included indications of social comparison, e.g. feeling worse about their own life in comparison to others on social media (n=10, 63% reported "a little" or "a lot"), inauthentic communication (n=10, 63% reported "a little" or "a lot"), and peer conflict, e.g. "stirring up drama" (n=12, 80% reported "frequently" or "occasionally"), blocking (n=12, 80%), unfriending/unfollowing (n=11, 73%) or untagging behaviors (n=10, 63%), and having a fight with a friend over something that happened online (n=8, 53%).

Focus Group Results. Consistent with the findings from surveys, teens reported high rates of digital media consumption and online experiences that had both positive and negative consequences on their daily lives. See **Table 8** for selected quotes from teens.

Positive Experiences on Social Media. Positive experiences on digital media resulted in feelings of enhanced peer connectedness, most frequently reported through social engagement and the provision of social support. 1) *Social support* received on digital media was predominantly emotional in nature, while there was some acknowledgement of informational support, in using digital media to expand their knowledge base on a given topic. Several participants reported experiencing emotional support from significant others and from interacting with others who had similar lived experiences. 2) *Social engagement* was facilitated on digital media through an ability to stay in touch with friends and family who were near and far and to make plans or spend time with peers in online or offline spaces. The desire to engage with others was a primary reason for maintaining digital media accounts, despite whatever negative experiences they encountered.

Negative Consequences of Digital Media Use. Overall, teens reported a sense that negative or stressful experiences on social media contributed to poor self-esteem, depressed mood, anxious thoughts, and suicidal urges. In fact, participants consistently agreed that digital media contributed to suicidal thoughts. One participant noted the potential of negative online experiences to initiate a “depressive spiral” that results in lowered inhibitions toward the idea of suicidal behavior. Teens reported several harmful aspects of their social media use that resulted in heightened distress. Several social influences emerged from their digital media use, including negative upward social comparison, inauthentic self-presentation, feelings of thwarted belongingness, and cybervictimization. Additionally, teens reported feeling compelled to maintain use despite consequences, such as impaired sleep.

Problematic and Nighttime-Specific Use. Teens nearly unanimously reported experiences consistent with problematic use of digital media, which refers to an inability to control one’s use that results in negative consequences in daily life.⁴¹ They reported an addictive quality to digital

media use demonstrated by a strong desire to continue checking for up-to-date content. Teens frequently used digital media more than intended even when it had significant consequences on their lives, particularly interfering with their homework and sleep. Digital media use was noted as problematic before the onset of sleep, during which time the desire to maintain communication with friends trumped their desire to go to sleep, as well as in the middle of the night when the desire to check their phones kept them up at night. Teens described a cycle that began with accessing digital media as a means of distracting themselves from depressed thoughts that occurred before bed, but then the feeling of relief was attenuated by the effects of subsequent sleep loss.

Social Influences. Teens noted that their online social networks were influenced by the social constructs described in Social Network Theory. 1) *Inauthenticity* is a form of self-presentation associated with an emotional experience of being untrue to one's self.¹³⁸ Participants consistently reported a pressure to communicate inauthentically, feeling pressured to appear positive, happy, or successful, when their real feelings were in contradistinction to this public persona. 2) *Negative upward social comparison* refers to a consequence derived from the evaluation of oneself in comparison to an individual or group perceived to be superior or better. This was a common concept reported among teens, associated with a sense of not being "good enough" in comparison to others' social lives. This occurred when they observed others enjoying or partaking in life in a way that they felt incapable of doing with their current depressed mood state. Teens reported these experiences exacerbated their anxiety and depression.

Additional social influences emerged that are observed among the social network of suicidal individuals.¹³⁹⁻¹⁴¹ 1) *Thwarted belongingness* is a construct from the Interpersonal Theory of Suicide that is characterized by a psychologically-painful mental state that results from an unmet need to connect to others and is considered a precursor to suicidal ideation.¹³⁹ Nearly all teens

recalled experiences in which they had been excluded. A couple of teens elaborated that experiences of exclusion contributed to a sense of disconnection from friends or followers or feeling they were a third wheel within online social interactions that made them question how or if they belonged within their peer network. Teens agreed the experience of exclusion contributed to feelings of social isolation and triggered anxious and depressed thoughts. 2) *Behavioral Reinforcement* refers to the strengthening of a behavioral intention when that behavior contributes to a positive consequence or sense of reward in others.¹⁴² Youth reported exposure to online content from friends or celebrities that depicted self-harm or suicidal behavior in a positive light. They acknowledged this strengthened teens' urges to engage in self-injurious behavior themselves.

Cyberbullying victimization is an additional social influence present within online social networks that is described as harassment received via information and communication technologies.¹⁴³ In every focus group, participants reported a number of experiences of cybervictimization. Some teens reported that they were hurt when trusted friends spread private information about their mental health on digital media resulting in public ridicule. Once an inflammatory comment was made online, there was a tendency for others to follow suit and respond with comments that were equally or more offensive. Participants agreed these experiences perpetuated suicidal thoughts.

Perspectives on Monitoring. While teens universally acknowledged that digital media at times had harmful consequences, most had mixed feelings regarding monitoring. Teens balanced a need for protection within online spaces with a desire to express themselves freely and privately. Some teens expressed a moral opposition to monitoring, noting that it was an infringement on their personal freedoms. While others did not take a strong moral stance to monitoring, they reported valuing the ability to identify with a group of like-minded others on digital media and worried they

would not have authentic conversations if they knew they were being watched. Teens also reflected on harmful digital media experiences, particularly noting exposure to violent digital content, which made them feel that monitoring was important. Youth agreed that despite concerns they may have, monitoring was a necessity under certain circumstances, which they defined as when illegal activity was endorsed online or when monitoring was needed to maintain safety.

Involvement of Parents. Several teens reported their parents did not monitor their digital media content at all. Those who did noted that monitoring was done in a way that did not meet their preferences toward digital privacy or involved mediation that inhibited their social lives.

Involvement of Therapists. Most teens noted they had never discussed digital media with their therapists or did so infrequently. They described a sense of anxiety in initiating conversations with therapists about their online lives. Some youth felt concerned they would be burdening their therapists, because they felt petty for feeling distressed over online experiences that they saw as inconsequential, e.g. feeling down after not receiving a desired number of likes.

II. Evaluating the Context of Parents' Experiences in Digital Media Monitoring

Survey Results (See **Table 9**). Surveys of parents (n=12 in total) revealed that most had access to smartphones and used some form of social media, most frequently Facebook. Most parents reported frequently texting their children (n=11, 92%). Parents reported a variety of digital media mediation strategies -- the most frequent of which involved monitoring. As examples of this, over three-quarters of parents checked their child's profile on social media (n=10, 83%) and discussing appropriate online behavior with their child (n=10, 83%). Forms of interaction restriction, e.g. limiting total amount of use or times of day the child can go online (n=8, 67%), and technical restrictions, e.g. using parental controls or means of blocking, were also common

(n=7, 58%). Additionally, some parents reported engaging in active co-use, which was operationalized as being friends with a child on a digital media platform (n=3 on Facebook, n=1 on Twitter, n=5 on other platforms).

Qualitative Interview Results. During qualitative interviews, parents provided a context for their engagement in digital media mediation strategies, describing and evaluating specific strategies they have implemented. See **Table 10** for selected quotes from parents.

Reasons for Monitoring. Parents universally reported engaging in digital media monitoring primarily because of their overall desire to protect their children's online environments. Their concerns regarding the negative aspects of digital media use were primarily focused on loss of sleep, teens' disclosure of depression or suicidality, victimizing peer interactions, and the potential for their child to engage in inappropriate conversations with strangers or adults. Parents reported feeling a strong obligation to monitor, because they felt these negative digital media experiences could trigger their child to have depressed or suicidal thoughts.

Parental Mediation Strategies. Parents described mediation strategies they employed to protect their children from perceived harms.

1) *Active Co-Use.* Some parents acknowledged engaging in active co-use with their children through being friends with their child on social media platforms. Several parents acknowledged that this method of mediation was limited, because youth often had multiple accounts on the same platform, not all of which were known to parents.

2) *Interaction Restrictions.* Most parents reported engaging in interaction restrictions through taking their child's phone away at certain times of the day, particularly when youth were engaging in maladaptive use that was counter to therapeutic goals. Parents generally found removal of devices at night prior to sleep to be an effective strategy. However, removing access to

electronics for long durations had several consequences: limited effectiveness due to teens' ability to access digital media through alternative means (e.g. a friends' phone), parent-child conflicts arising as a result of restrictions, and the unintended consequence of removing access to protective aspects of digital media use (e.g. seeking social support from peers).

3) *Technical Restrictions*. Parental controls innate to smartphones, such as those present in iPhone settings, and parental control phone applications were commonly used as means of technical restriction. Parents reported using these resources to put controls in place to require approval for their teen to download new applications, limit the total amount of use, block certain sites, or restrict access to content deemed too mature for younger audiences. Some parents noted their use of technical restrictions was limited by their knowledge of effective parental monitoring tools and their child's capacity to circumvent mediation through breaking passcodes or finding other ways to disable parental control features.

4) *Monitoring*. All parents reported engaging in either overt or covert forms of monitoring, which included directly viewing their child's digital media content and having conversations about appropriate and safe online behavior. Approximately half of parents reported using technical methods to view their child's text messages, websites visited, or videos watched to monitor for harmful or explicit content. Other parents read over their child's shoulder or directly asked their child to show them their digital media content. Participants acknowledged the primary limitation of these monitoring approaches was the burden it placed on parents. The process of monitoring content was described as exhausting and only used when parents felt they had a reason to be concerned. Approximately a quarter of parents reported primarily or solely using conversation as a means of monitoring rather than directly observing digital media content. These parents

acknowledged that they may not have as much information; however, they felt that it was more important to support their child in making autonomous decisions as they grew to be young adults.

Impact of Monitoring on Parents. Parents consistently noted that monitoring their at-risk teens' digital media use took an emotional toll on them. Several participants reported a foreboding sense of fear over the harmful ramifications of digital media use on teens' daily lives. While participants noted a desire to be "good" parents who were aware of what was happening with their child, they felt the onset of social media made it much harder to do so. Further, several parents felt that engaging in monitoring with a child who is depressed or having suicidal thoughts was particularly challenging, because they had to weigh the perceived benefit of engaging in monitoring against the consequences of potential conflicts that could impact their mental wellbeing. This dynamic contributed to parents' perceived powerlessness to be effective in protecting their children from digital harms. Overall, parents generally felt they needed help in monitoring their child's digital media content. When asked if they felt therapists could be helpful in social media monitoring, all parents agreed that their child's therapists would be a desirable source of support for them.

III. Teens' and Parents' Perceptions of Automated Digital Media Monitoring

A process for automated monitoring was described to teen and parent participants for them to offer informed feedback (see **Table 11**). Participants were told that the process of obtaining their digital media content would involve securely connecting to a website in which they would be asked for permission to release their digital media content from several platforms. Once collected, they were told that software would be used to analyze their digital media content. The software would identify "risk phrases" or phrases that were indicative of suicidal risk. When identified, the

content of risk phrases would be sent to adolescents' therapists for response. Teens and parents offered feedback on the acceptability of this proposed approach and identified opportunities and challenges associated with automated monitoring.

Facilitators of Automated Monitoring.

Protection from Harm. Participants reflected that the chief facilitator was the potential for automated monitoring to protect online environments. Several teens felt the automated detection of risk could protect youth from harm, particularly on anonymous sites where victimization is more likely to occur. Further, youth described how many teens may disclose suicidal thinking on social media, who may not do so in-person or directly to a key support person who could act to prevent a crisis. They noted that disclosing suicidal content felt easier online than in-person, and at times that disclosure was accompanied by a hope that someone in their network would notice and perhaps respond. They felt automated monitoring had the potential to catch youth who reach out for help online in situations when their comments may go unnoticed. Parents consistently reflected on the capacity to identify youth who were at-risk. Some parents commented that even with their existing monitoring strategies it was hard to know when their child was having suicidal thoughts and believed that the automated detection of signs of risk from digital media content could aid in their ability to maintain their child's safety.

Software-Facilitated Risk Detection. Teens and parents were generally accepting of monitoring strategies that engaged software to detect suicidal risk but for different reasons. Teens consistently found the use of software as part of an automated monitoring approach more acceptable, because it would only share content indicative of suicidal risk rather than the idea of a person reviewing all their private conversations. They also felt this approach would be effective in reaching youth who found greater ease reaching out online compared to in-person. Several parents

appreciated that automated means of detecting risk statements would decrease the burden associated with the manual review they have done as part of their monitoring or active co-use strategies. They perceived that an approach that engaged software to gather digital media content would result in greater reach than what they were capable of on their own.

Involvement of Therapists. All participants appreciated that alerts delivered to therapists would prompt conversations about risky incidents of digital media use. Although teens agreed these conversations still had the potential to be stressful, they acknowledged being directly asked about a specific instance of use that triggered a risk alert would help them engage with their therapists about digital media use. All parents saw the involvement of a trained mental health professional in digital media monitoring as a welcomed benefit. They felt therapists were likely to be effective, because they regularly engaged with their child and knew their circumstances well. Some parents who had experiences working with therapists to implement interaction restrictions, commented that the involvement of therapists contributed to greater insight on appropriate online interactions and to teens deciding to back away from harmful aspects of digital media use themselves.

Barriers to Automated Monitoring.

Loss of Digital Privacy. Parents and teens agreed that their primary concern was the loss of digital privacy associated with releasing digital media content. Most teen and parent participants feared the release of personal communications on digital media, particularly regarding release of text message information. They felt their text messages held very private information, and they had concerns if the software may review not only their messages but the messages of friends or family members with whom they were communicating. Some parents also voiced concerns about data security, noting fear of data breaches.

Potential for False Labelling. Due to the complicated ways that teens communicate online, many did not fully trust software to detect risk statements. Teens noted using sarcasm and humor heavily online, describing that suicidal youth especially joke about wanting to kill themselves. They had concerns whether a machine could effectively interpret when they were joking and when they were serious.

Tendency to Alter Behavior. When teens became aware that their digital media content was being monitored, some suggested teens may alter their online behavior. They suspected some teens would change their behavior to post strictly positive content to negate the potential for risk alerts to be generated. They felt others may opt not to disclose suicidal thinking online, because they knew they were being monitored.

Limited Reach. Some teens commented that the proposed strategy of automated monitoring may not work for everyone. They noted not all teens generally comment about their mental health on digital media. Some teens preferred to address conversations pertaining to suicidality in-person or may engage in other online behavior such as searching for methods to kill oneself that would not be detected with an approach targeting risk statements.

Communication with Parents About Risk. While some parents were confident that communication with their child's therapist would be effective, others demonstrated less trust. Those who were less trusting emphasizing the need to be adequately included in communication about risk detected through an automated monitoring strategy. While nearly all parents strongly trusted their child's therapist to gauge when they needed to be made aware of risk associated with digital media use, they wanted to be sure there would be an effective and systematic means for notifying parents when necessary.

3.4 Discussion

This study offers insights from parents and teens to inform the development of an automated means of digital media monitoring aimed to detect and respond to adolescent suicidal risk in real-time. Toward this goal, we sought to understand adolescents' digital media experiences and parents' monitoring experiences, in order to give context for an automated monitoring intervention. Adolescents' digital media use was explored through surveys, and constructs from Social Network Theory were used to conceptualize focus group data exploring the impact of digital media experiences on acutely suicidal youth. Surveys of parents of youth in this treatment population, and interviews that were contextualized by constructs from Parental Mediation Theory, were used to explore the use of parents' digital media mediation strategies. These perspectives are critical, because few studies have explored digital media experiences from the perspective of youth at acute risk of suicide,^{141, 144} and no published studies that we are aware of have evaluated digital media mediation strategies of parents of teens within this population. We additionally aimed to understand the acceptance of a potential digital media monitoring intervention through evaluating barriers and facilitators to implementation through the vantage point of teens and parents.

Discussion of Contextual Factors. Adolescents within this sample were heavy users of digital media with two-thirds using social media for 2 hours or longer per day, a threshold that has been associated with heightened risk for suicidal ideation.³⁹ Both surveys and focus groups reflected the presence of beneficial social interactions in online spaces, most notably through the provision of emotional support and engagement with peers that strengthened social connectedness, which is consistent with literature focused on salient digital media-related protective factors for adolescent suicidality.^{35, 36} Adolescents reported a number of digital media experiences that they found harmful to their mental health. Problematic and nighttime-specific use was endorsed by

nearly all teens, which is concerning because Hokby and colleagues showed that sleep and indicators of problematic use had lasting direct effects on poor mental health among adolescents.⁴³ Teens report of social influences that had a negative impact on their mental health was consistent with the literature, which shows associations between adolescent self-injurious thought and behavior with negative upward social comparison,^{145, 146} thwarted belongingness,^{147, 148} behavioral reinforcement of self-injurious behavior,^{141, 149} and cybervictimization.¹⁵⁰ However, several of these factors have not been thoroughly studied within online social networks and warrant closer examination in order to understand their impact on suicidal risk within a digital context.

Notably, teens reported negative experiences contributed to depression, anxiety, and suicidal urges; however, they acknowledged having never or very infrequently discussed these risks with their therapists. Intervention to improve communication between teens and therapists about the harmful aspects of digital media use is critical.

Parents most frequently reported parental mediation strategies that involved having open dialogue with teens about appropriate use of digital media and restricting phone use before bedtime. Parents also perceive these strategies as most effective. This is consistent with findings indicating the influential nature of parental restrictions in decreasing adolescents' use of social media and monitoring to increase the frequency of appropriate use of media, e.g. for homework.¹⁵¹

Exploring the context of adolescents' digital media use and experiences and parents' mediation strategies can influence the development of an effective monitoring strategy. Adolescents' feedback can inform the development of an effective algorithm to detect suicidal risk. For example, NLP analyses evaluating linguistic structure to identify the presence of emotional and psychological states associated with suicidal risk can be guided by the digital media experiences adolescents report most frequently and saliently contribute to heightened suicidal risk.

Furthermore, clinicians engaged in the future implementation of an automated monitoring approach could potentially be offered information on the most frequently reported digital media experiences of adolescents, as well as the most frequently and successfully used mediation strategies reported by parents. This information could offer valuable context to clinicians when responding to risk alerts with adolescent patients and coordinating a response with their parents.

Acceptance of Automated Monitoring. Parents and teens in the study perceived that automated monitoring has the capacity to protect youth from harmful digital media experiences. Facilitators that influenced acceptance were the use of software to facilitate monitoring, which is viewed as more private and less burdensome than reviewing content by hand, the involvement of therapists in response to risk alerts, and the capacity to help youth who may not be comfortable disclosing suicidal risk in-person.

Parents and adolescents also reported barriers that have implications for the development and implementation of an automated monitoring strategy. Two key barriers are risks to digital privacy and data security. In order to address the loss of digital privacy, a flexible approach to monitoring is recommended, where teens and parents can decide which platform(s) of digital media they are willing to share. For example, it may be advisable to first request permission to share public forms of digital media content like newsfeeds and walls, rather than text messages or direct messages for which there may be greater resistance due to an expectation of privacy. Further, parents expressed concerns about data security associated with the release of their child's digital media data. This concern is rational within a climate with increasing rates of complex computer criminal actions against healthcare data.¹⁵² It is clear that judicious protection of teens' data is essential to an effective monitoring strategy.

Parents described one other concern, which was the need to be properly notified when a risk alert was made to a therapist. Because parents' views were discrepant in how much they would trust the therapist to know when to notify them, open communication between the parent and therapist is needed to assure both parties agree to a plan for notification.

Teen participants described additional complexities associated with the use of software to determine risk statements and the potential to alter behavior to avoid risk detection. Teens are concerned about the limitations of software to detect nuances in language, as well as how adolescents' tendencies toward altering or inhibiting online discussion suicidal risk when they were watched would impact the effectiveness of automated monitoring. While teens offered the example of jokes about suicide that may be misinterpreted, the use of code words such as “#blithe” for self-harm photos or “#sue” for feeling suicidal that were reported by Moreno and colleagues,¹⁵³ could also make the ability to detect risk a challenge. Approaches to NLP may offer the capability to detect subtle aspects of social media communications that are indicative of suicidal risk;¹¹⁷ however, these have not yet been tested in a clinical setting to determine the rate of false positive alerts or false negatives, the latter being instances when an alert should have been sent but was not. Thorough informed consent procedures that adequately describe these risks, as well as the potential benefits of protection of harmful online environments are necessary.

Limitations. The use of a convenience sample of adolescents and parents, the small sample size, and the exploratory nature of this study limit our ability to generalize results to the larger population. Adolescents and parents were part of a program of intense treatment at an academic medical center, and therefore the results presented may be different than within less resourced clinical settings. Also, the perspective of clinicians would be useful, to understand how they believe this might impact their therapeutic alliance and treatment, for better or for worse.

While further investigation is necessary, this study provided critical formative data toward the development of an acceptable and feasible method of automated monitoring. Further, exploring the experiences of acutely suicidal youth in using digital media and their parents' experiences in monitoring is a novel line of inquiry. In particular, the positive and negative consequences of adolescents' digital media could serve as targets for further inquiry to determine their generalizability among a larger sample of suicidal youth or for more in-depth qualitative inquiry.

Implications. A means of detecting risky incidents of digital media use and responding through risk alerts to therapists has the potential to improve current clinical methods for the detection of suicidal risk, which remain heavily dependent on patient self-report. Further, developing a strategy for monitoring that is responsive to the needs of parents and adolescents strengthens the acceptability and feasibility of implementation.

Conclusion. Our findings provide valuable insights to inform the development of an effective and feasible automated monitoring intervention, based upon a recognition of possible strategies for mitigating key barriers, chiefly loss of digital privacy and concerns toward security of data that is shared. Involving adolescents and parents in developing approaches to automated monitoring is likely to result in a more widely accepted, understood, and effective monitoring strategy and a greater capacity to protect teens from harmful online experiences.

3.5 Tables and Figures

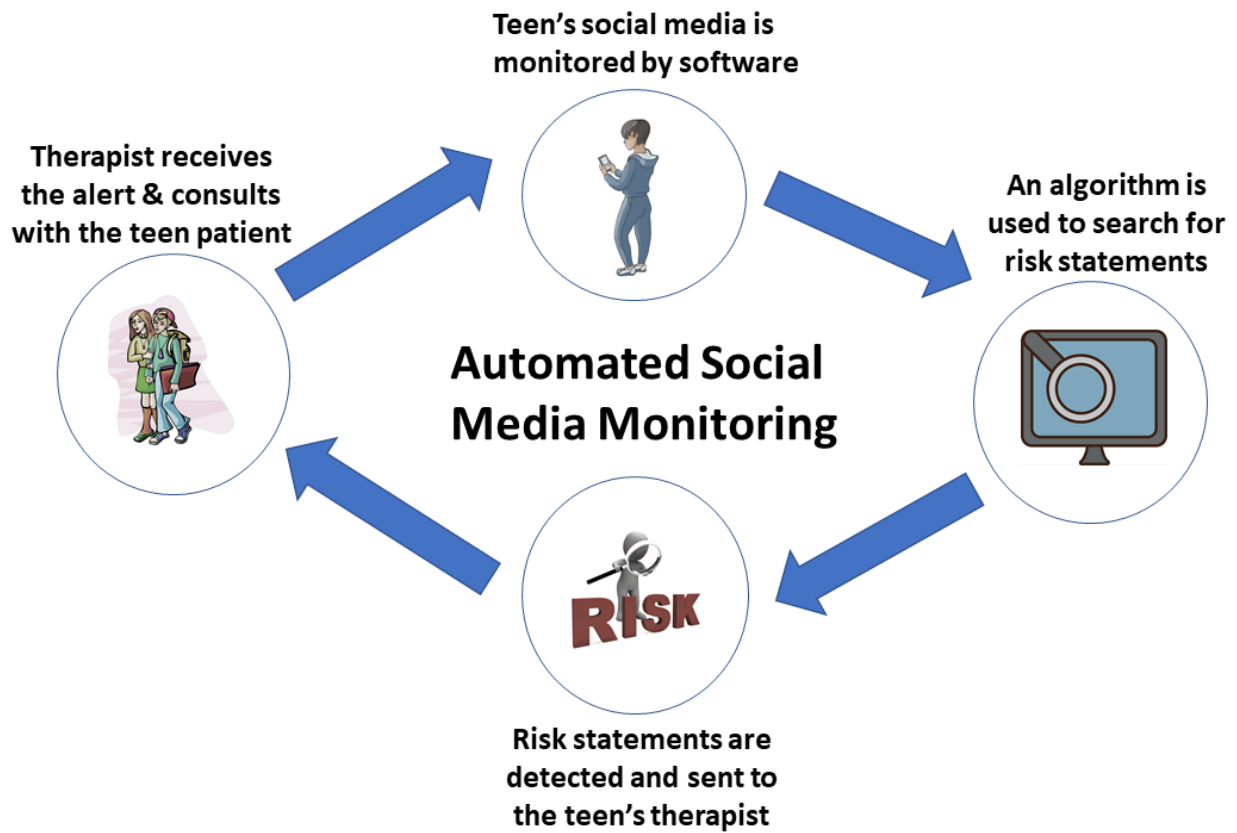


Figure 2 Proposed Strategy for Automated Digital Media Monitoring

Table 7 Teen Sample Characteristics

Age, mean (SD)	15.1 (\pm 1.7)
Gender, n (%)	
Male	6 (40%)
Female	7 (47%)
Other Gender Identity	2 (13%)
Frequency of Daily Social Media Use n (%)	5 (33%)
More than 4 hours	1 (7%)
More than 3 hours but less than 4 hours	4 (27%)
More than 2 hours but less than 3 hours	2 (13%)
More than 1 hour but less than 2 hours	3 (20%)
Less than 1 hour	
Daily Text Messages	
Mean (SD)	44.3 \pm 78.4
Median (IQR)*	20 (47.5)
Daily Direct Messages	
Mean (SD)	82.1 \pm 183.4
Median (IQR)*	15 (73)
Social Networking Site Usage, n (%)	
Instagram	15 (100%)
Snapchat	15 (100%)
Tumblr	8 (53%)
Facebook	6 (40%)
Twitter	6 (40%)
Google+	2 (13%)
Other	7 (47%)
Social Networking Site Used Most Frequently, n (%)	
Instagram	5 (33%)
Snapchat	5 (33%)
Tumblr	1 (7%)
Facebook	1 (7%)
Twitter	1 (7%)
Google+	0 (0%)
Other	2 (13%)
Positive Social Media Experiences, n (%)	
Feel connected to information about friends' lives	
Yes (a little or a lot)	14 (93%)
Feel connected to friends' feelings	
Yes (a little or a lot)	8 (53%)
Supported through challenges or rough times	
Yes (a little or a lot)	11 (73%)
Negative Social Media Experiences, n (%)	
Feel worse about my own life because of friends' content	
Yes (a little or a lot)	10 (63%)
Feel pressure to only post content that looks good to others	

Table 7 Continued

Yes (a little or a lot)	11 (73%)
People are less authentic and real on social media than offline	
Agree (strongly agree or agree)	10 (63%)
Friends/followers stirring up drama	
Yes (frequently or occasionally)	12 (80%)
Blocked someone you used to be friends with	
Yes	12 (80%)
Unfriended/unfollowed someone you used to be friends with	
Yes	11 (73%)
Untagged/deleted photos of you and a previous friend	
Yes	10 (63%)
Having a fight with a friend that started online or via text	
Yes	8 (53%)

**Interquartile range (IQR) calculated as the 75th percentile minus the 25th percentile*

Table 8 Selected Quotes: Teens' Digital Media Use and Experiences

Positive Experiences: Social Support	"Sometimes it'll be like, 'I really need to talk to her.' And I'll text her and she'll say something really encouraging that just genuinely makes my day. So, I feel like it's just- I would really not want to do without texting at least."
Positive Experiences: Social Engagement	"I mostly use it [social media] just to see if like any of my close friends have anything that they want to share on there that I should know about. Just like stay updated on the world. ...I usually only use it to contact my friends to see if we're going to go hang out or something along those lines."
Negative Experiences: Nighttime-Specific Social Media Use	"At night I get stuck in the cycle of 'Well, this is distracting me, and this is working, but I need to stop now to go to bed because that's what I need to do.' But then I'm like, 'Or, you could not. And you could keep using this coping mechanism that's like healthy and can turn unhealthy if I don't get the amount of sleep I need too.'"
Negative Experiences: Self-Presentation	"I think social media is like a mask. Like, someone could be hurting really bad, but they could put pictures of them laughing with friends, and everybody thinks they're okay. But on the inside, they're actually dying."
Negative Experiences: Social Comparison	"This probably sounds like super petty or stupid, but I want to have the most followers like I want to be the best. And so, many people are competing. Some people take it too far when they want to be the best. People start bullying..."
Negative Experiences: Thwarted Belongingness	"I see my friends doing these things with each other that I'm not doing with them and it sort of makes me feel excluded from that group of friends. And they care about each other more than they care about me. And it's sort of being out of that tight-knit

Table 8 Continued

	group that you thought you were a part of when you see things like that.”
Negative Experiences: Exposure to Self-Harm Content	“They’re like, ‘Oh my gosh, this girl’s cutting herself, I think it’s cool, so I’m going to do it.’ Because social media puts that idea in your head that whatever you see online is cool.”
Negative Experiences: Cyberbullying	“Because I think bullying is a big part of social media. I think that’s what drives kids to commit suicide or think about committing suicide, and I think the bullying- they think they’re not good enough. They think they’re not worth it. So, they go into that spiral and start to get upset, and that leads them to post things like that.”
Negative Experiences: Impact on Mental Health and Suicidal Risk	“I think social media definitely, definitely contributes to having suicidal thoughts, at least for me.” [All participants agree.] “I think social media- or to keep in contact with friends to even text- but, social media could put ideas in kids’ heads, and then they can start on a depressive spiral and they can develop depression because they see it. They’re like, “Oh my gosh, this girl’s cutting herself. I think it’s cool, so I’m going to do it,” because social media puts that idea in your head that whatever you see online is cool.”
Perspectives on Monitoring: Need for Protection	“[Facilitator] Should social media be monitored in your mind? [Participant] Yeah, you know occasionally yeah. Like, some people on Instagram are like- post like some pretty bad stuff like somebody getting jumped. Like, just a group of people just running up to this person just walking on the sidewalk and beating the living crap out of them. Like, I’ve seen that too on Instagram about people just like pulling out guns on people on Instagram, and I’m like, Why is this thing on Instagram in the first place? Like, this should be monitored and all that.”
Perspectives on Monitoring: Loss of Digital Privacy	“[Facilitator:] “Do you think that someone should monitor your posts on social media? [Participant] Oh, that’s a hard one. I feel like that would make it a lot less authentic. [Participant agrees]. And a lot more uncomfortable if you knew you were like constantly being watched and monitored for all you were doing.”
Perspectives on Monitoring: Freedom of Expression	“It’s easy to have like a place that you want to express yourself like on social media, but you don’t want people in like real life to like see because of- like you said, the people in your community probably wouldn’t be accepting of it or whatever.”
Perspectives on Monitoring: Necessity to Monitor	“If there was a reason to monitor social media or text messages, although I’m pretty against it, would be if somebody was in danger of hurting themselves or others or crimes but like mainly for their safety.”
Involvement of Parents	“[Facilitator:] Do your parents monitor what you post on social media? [Participants:] No, that would be terrible.

	<p>...I have my phone locked. ...I don't want them like snooping!"</p> <p>"At one point my mom said, 'If people are saying things to you to make you cry, then I think you should just be grounded from it [Snapchat]. Like, we'll just get you off it.' And I'm like...I'm not going to be able to text most of my friends and all that because they're literally all on Snapchat.' Like, if I try to get with other people- meet up with other people- and I try and text them, but they don't have my number so I go on Snapchat and that's how most people text."</p>
Involvement of a Therapist	<p>"I feel like I'd have to be prompted. Like I would have to be asked a question pertaining to it. Like I probably wouldn't talk about it out of the blue."</p> <p>"I would be on edge. I'm sure I would be anxious or whatever, but it is something that- I'm sure it would be something that I wanted to talk to my therapist about and I didn't know how to bring it up. It wasn't something that I necessarily wanted to hide, but I didn't know how to like approach the subject."</p>

Table 9 Parent Sample Characteristics

Age, mean (SD)	49.3 (\pm 4.2)
Gender, n (%)	
Male	3 (25%)
Female	9 (75%)
Other Gender Identity	0 (0%)
Access to Digital Devices, n (%)	
Smartphone	12 (100%)
Cellphone that is not a smartphone	2 (17%)
Desktop computer	9 (75%)
Laptop computer	7 (58%)
Tablet computer	7 (58%)
Use of Social Media, n (%)	
Facebook	12 (100%)
Twitter	5 (42%)
Other Form of Social Media	6 (50%)
Knowledge of Child's Passwords, n (%)	
Know child's password for any social media accounts	3 (25%)
Know child's password for their e-mail	6 (50%)
Know child's password for their cell phone	7 (58%)
History of Engagement in Parental Mediation Strategies, * n (%)	
<i>Active Co-Use</i>	
Friends with child on Facebook	4 (33%)
Friends with child on Twitter	1 (8%)
Friends with child on other form of social media	5 (42%)

Table 9 Continued

<i>Interaction Restriction</i>	
Removed child's phone as a punishment	7 (58%)
Limited time or times of day child can go online	8 (67%)
<i>Technical Restriction</i>	
Used parental controls or means of blocking	7 (58%)
Used parental controls to restrict phone use	4 (33%)
<i>Monitoring</i>	
Checked which websites child visited	9 (75%)
Checked child's profile on social media	10 (83%)
Used monitoring tools to track location	9 (75%)
Discussion of appropriate online behavior	11 (92%)
Frequency of Discussion of Appropriate Behavior, n (%)	
Appropriate online behavior toward others	
frequently	6 (50%)
occasionally	4 (33%)
Appropriate content to share online	
frequently	7 (58%)
occasionally	2 (17%)
Appropriate content to view online	
frequently	5 (42%)
occasionally	3 (25%)
Appropriate behavior in school, home, or social lives	
frequently	9 (75%)
occasionally	2 (17%)
Appropriate content on other forms of media (e.g. TV, music, books)	
frequently	3 (25%)
occasionally	7 (58%)

**Strategies were categorized using the Theory of Parental Mediation¹²¹*

Table 10 Selected Quotes: Parents' Experiences in Digital Media Monitoring

Reasons for Monitoring	<p>"Well, I think it's the same as just any parental involvement in a child's activities, and it would depend on the child herself, but you have to make sure that, I think, that they are doing things that are risky or dangerous or could lead to some bad activities later."</p> <p>"And, once my son was diagnosed with depression, I think that we knew what information he was getting or the things he was being sent because that could also be potentially harmful."</p>
Parental Mediation Strategies: Active Co-Use	<p>"It started out with- we said we had to have access to- we had to be not blocked. We had to be friends with her, so that we could see when she did post things. Then we noticed that she was having more than one account and we were friends with her on one account, but we were not friends with her on another account even though it existed. And, the school district actually called us</p>

Table 10 Continued

	and said that there were some things on there that were disturbing.”
Parental Mediation Strategies: Interaction Restrictions	“And, um, I take her phone away and try to make her earn it back by making her do chores and service projects. She gets very angry, and either she’s just horrible to live with when we take her phone away. She’s angry, she’s bullying her sisters, she will not help around the house, won’t do anything I ask her to do, kind of to punish us, I guess. Or, she gets really depressed. Her biggest coping skills are her friends, like text messaging her friends and listening to music. And when I’m taking away her phone, I’m taking away her biggest coping skill. And then I feel like, oh my gosh, it’s going to be my fault if she gets suicidal because I’ve taken away her phone.”
Parental Mediation Strategies: Technical Restrictions	“I had used on their computers- they had laptop computers- I put in a parental, like I added a separate user account that I could limit the amount, the hours of when they can access their laptops. That was the first thing I did. I did put in a monitoring program to track where they were going, but it either didn’t work or I couldn’t figure it out. Or else they were unable to use it for their school work because everything kept getting blocked.”
Parental Mediation Strategies: Monitoring	<p>“His text messages also come to my iPad. So, I am reading them. I mean, like I said, he’s not allowed to take the phone in his room, so he plugs it in downstairs every night and we go through them and read it. But, if anything comes in after ten, we don’t necessarily read it, but we can still see them on the lock screen and make sure that things are under control, I guess for lack of a better term.”</p> <p>“I don’t necessarily always check his Snapchat, but we do ask him about it frequently because of what we’re talking about, specifically social media. So, yeah we talk to him about it frequently every once in a while.”</p>
Impact of Monitoring on Parents	“Like, I put parental controls on her phone, and she knows how to break into them and change them, and I feel very powerless a lot that all the monitoring that I know how to do I feel like she still circumvents that. And it’s very frustrating to me.”

Table 11 Selected Quotes: Teens' and Parents' Perceptions of Automated Digital Media

Monitoring

Facilitators: Protection from Harm	[Teen:] "I'm sure that a lot of kids turn to social media because they don't know how to turn to the people in real life and sometimes it's easier hiding behind a screen. And, sometimes I am the kind of person that will make a post about my real feelings, but am I going to talk to anyone in real life about it? No, just because there's just something easier about like you want to get it out there, you want people to see, but you don't really want anybody to respond. If that makes sense. But then again, at the same time you put something out there because you don't have somebody to go to and you want somebody to respond."
	[Parent:] "But, I would love to you know be able to figure out before having to ask my son, right? You know, we ask him nightly, 'How do you feel on a scale from one to ten? Where are you mood wise?' And all of that stuff, but it would be lovely to get an alert if something was happening sooner and not having to press and pry and, you know?"
Facilitators: Software-Facilitated Risk Detection	[Teen:] "I feel like having those [alerts from risk statements] would help because there will be so many people that would reach out for social media and that should help people."
	[Parent:] "I think that's an awesome idea. I mean again, if you had a way to monitor it sort of automatically then I feel like that would be more instrumental in finding out what's really going on. You know? Like, I can only do what I can see, what she'll let me see on her phone."
Facilitators: Involvement of Therapists	[Teen:] "Yeah, especially for like the people that post on social media stuff like they post pictures of their self-harm. I think that is really good to refer that to a therapist because not only is it somebody like looking this up out of curiosity or speculating that this person needs help because it's like proof that they do."
	[Parent:] "I've also had the experience with more than one therapist in different programs just talk directly to my daughters about their social media use and work with them- I mean, that's partly why [name of child] has backed off of some of her social media uses because she's been talking about how she uses it and what she expects to gain from it with a therapist who [name of child] can, with that help, reach the insight that, 'Maybe this isn't the best platform for me.'"
Barriers: Loss of Digital Privacy	[Teen:] "I really- like it's not being rude, but I don't like the idea that people are looking for what I text. It's just scary to me. Even if it's a software, it's very- I feel like creeped out because you lose any confidentiality that you're supposed to have, but I get why."

Table 11 Continued

	[Parent:] “You know, I guess with social media I would be a little more comfortable just because it’s already – it’s kind of out there anyway. You know what I mean? So, I think I’m more adversely more at the text side.”
Barriers: Potential for False Labelling	[Teen:] “I’m going to say this right now with social media and whatever and one of those risk statements can’t be anything about wanting to kill yourself because there are so many jokes. Some people are serious, some people are just joking, some people are suicidal and joking. But there are so many jokes about wanting to kill yourself, that it would be too hard to actually pinpoint the actual people who are at risk when there are just so many jokes about that.”
Barriers: Tendency to Alter Behavior	<p>“I feel like it could keep people from reaching out in a lot of ways over social media.</p> <p>-Yeah, I think that too, and I also think that people- like it should be monitored, but I think kids will be like, ‘Oh my gosh, there’s a monitor? This is like a mom. I hate Instagram now,’ and they’re going to delete it.</p> <p>-Yeah, it would make people go off of it. They’d find their way around it. It’d be- or it’d be completely fake people trying to be happy so that they wouldn’t get monitored. But, at the same time, no monitoring is also kind of an issue.”</p>
Barriers: Limited Reach	[Teen:] “And I know that when I actually am at risk, I don’t say anything about it. So, I think personally for me with the texting is that if I was actually at risk, none of the things would go through the computer because I wouldn’t end up actually saying anything. But if I was just like joking or saying this or venting or whatever, but I wasn’t at risk and I could keep myself safe and using my safety net and using my coping mechanisms, but like personally that’s just me.”
Barriers: Communication with Parents about Risk	[Parent:] “I would hope that they would at least send a text message and let me know that there’s possibly a problem...I mean, if my child’s in danger, yeah, I would want- if there’s something posted that says she’s at risk for harming herself, I want to know.”

4.0 Development of an Ecological Momentary Assessment Tool of Distressing Social Media Use Among Suicidal Youth

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4.1 Introduction

During the same time period that consumption of social media among adolescents has soared, the rate of suicide continues to rise, now the 2nd leading cause of death in this age group.^{6,}
⁷ While these simultaneous trends are not causal in nature, their cooccurrence has left researchers, prevention experts, clinicians, and parents alike pondering the influence of social media on adolescents, particularly adolescents who are at-risk of suicide. The literature to date has shown an association between frequent social media use with heightened risk of suicidal thoughts³⁹ and has pointed to a number of potential risk and protective factors.^{36, 73} However, few longitudinal studies have been conducted to explain the temporal relationship between social media use and suicide risk. Those studies have observed an enduring impact of problematic internet use, internet-related sleep disturbance, and online peer victimization on poor mental health outcomes over time, as well as the potential for peer support to protect against risk.^{43, 71} While these studies offer important contributions, they assessed a limited range of risk and protective factors and studied youth within the general population. Additional longitudinal studies are needed that explore the impact of a range of risk and protective factors and that focus on adolescents at high risk.

Ecological momentary Assessment (EMA) presents an opportunity for extending longitudinal study. EMA uses repeated sampling of subjects' experiences in order to develop a fine-grained understanding of behavioral phenomena. Assessment in real-time is a defining feature of EMA, which mitigates recall bias.¹⁵⁴ This methodology has long been used to assess children's use of media,¹⁵⁵ and it has been used in several studies exploring fluctuations in suicidal thoughts and well-known risk factors for suicide (e.g. hopelessness, burdensomeness, and loneliness).¹⁵⁶⁻¹⁵⁸ However, the use of EMA has not yet been extended to exploring suicidal risk within the context of adolescents' social media use.

The use of EMA to assess social media's influence on adolescent suicidal risk could offer significant value. First, the use of EMA could offer a unique contribution above and beyond currently available assessment methods that focus on directly accessing adolescents' social media content to search for objective statements of suicidal risk. EMA offers the ability to get a window into the inner life of adolescents – the subjective experience of using social media, that may or may not be revealed in their posts. Secondly, EMA could shed light on the sequence by which youth are exposed to supportive or stressful online content and subsequently experience changes in distress. Evaluating the types of exposures that result in the greatest magnitude of subsequent changes to distress levels could identify risk and protective factors that have the most significance to proximal suicidal risk. Information such as this would be of high value to both prevention experts and mental health clinicians.

In order to extend EMA methodology to the exploration of social media's impact on real-time fluctuations in suicidal risk, it is necessary to develop an acceptable EMA measure and sampling protocol. Shiffman and colleagues¹⁵⁴ outline a number of considerations toward these goals. First, a set of items must be identified, tested, and refined in order to assure comprehension, which is especially important within a pediatric sample, and to ensure minimal participant burden.¹⁵⁴ Second, a sampling protocol must be developed that maximizes compliance while minimizes reactivity, i.e., the potential for a behavior to be impacted by the act of assessing it.¹⁵⁴

This manuscript describes the iterative development of an EMA measure and sampling protocol aimed to assess changes in distress associated with social media use among adolescents at high risk of suicide.

4.2 Methods

A multi-staged approach was used to draft and refine this EMA measure and protocol. Initial drafting of the EMA measure was informed by a literature review and focus groups with acutely suicidal youth. Once drafted, the measure was iteratively refined based on interviews with experts and youth in the target population. This study was approved by the University of Pittsburgh Institutional Review Board (PRO18030665).

Data Sources Influencing Drafting of the EMA Measure

Literature Review. Drafting of the initial EMA measure was informed by factors identified within the literature that convey suicidal risk or protection associated with the use of social media. The primary data sources were two systematic reviews, performed by Marchant and team³⁶ and Dyson and team³⁵ and a rapid review that updated the known risk and protective factors from the time of these two systematic reviews concluded their search (2014 and 2015, respectively. See Paper 1 for a description of the rapid review, which concluded its search on May 20th, 2018. These literature reviews were focused on social media's influence on suicidal outcomes within studies focused on adolescents.

Focus Groups. The initial draft of the EMA measure was also informed by the results of focus groups that explored the digital media experiences of acutely suicidal youth patients participating in an intensive outpatient program. See Paper 2 for a full description of these focus groups. Focus group themes associated with positive and negative consequences of digital media use were considered as domains to be included within the EMA measure.

Additional Sources. When unique factors were identified from focus groups themes that were not present within the previously mentioned systematic reviews, additional literature was

consulted to find if these factors were reported within studies that assessed non-suicidal mental health outcomes. This was done to understand if the factors identified within focus groups may be generalizable beyond the small focus group sample to mental health outcomes, such as depression, that are strongly associated with suicidal risk.¹⁵⁹ These sources included a systematic review focused on social media's impact on depression and anxiety³⁷ and longitudinal studies assessing the positive and negative mental health consequences of adolescents' online experiences.^{43, 50}

Methods of Refining the EMA Measure and Determining a Sampling Protocol

Expert Interviews. Consultation with both content and measurement experts is recommended in the development of survey measures.¹⁶⁰ As such, experts within the University of Pittsburgh were recruited to provide feedback on the initial draft of the EMA measure. In total 5 experts completed in-person interviews with the first author. Of the 5 experts, all had substantial experience in research focused on adolescent mental health, two had expertise and published in the study of suicidal risk, two were published experts in the study of social media use, and two were published experts in the use of EMA. One individual had overlapping expertise in suicidal risk and the use of EMA.

Interviews with experts were semi-structured and followed an interview guide to explore the appropriateness of the drafted measure for the intended target population, including the intended constructs to be assessed, and the potential for items to effectively measure each construct. Because the target population was adolescents at risk for suicide, experts were also asked to reflect on the potential burden of the measure as suggested by Scott and colleagues.¹⁶¹ Questions pertaining to participant burden focused on item and instrument length and

complexity/simplicity of questions and response options. Finally, experts were asked to reflect on elements of the EMA sampling protocol: sampling density (or the frequency with which participants will be sampled), timeframe for daily sampling, and potential mechanisms for delivering prompts to complete the EMA measure.

Analytic memos of responses were created immediately following interviews. Analytic memos are a written description of concepts and themes that emerged.¹⁶² These memos were used to develop summary tables of key themes of experts' feedback. These themes were reviewed by the first and second author in order to identify recommended changes to the EMA measure and associated sampling protocol prior to cognitive interviewing.

Cognitive Interviews. The next draft of the EMA measure and protocol was evaluated by adolescents through cognitive interviewing. Cognitive interviews are a recommended step in the measure development process that involve engaging with individuals within the measure's target population to provide feedback on a drafted measure.¹⁶⁰ Through cognitive interviews, the researcher aims to understand thought processes that occur while considering both questions and response options. A total of 10 adolescents were recruited to participate. Adolescents recruited for this study were past participants of a National Institute of Mental Health-funded project (MH100155), which assessed treatment history, psychopathology, and history of suicidality using semi-structured research interviews. Participants of this study had a history of treatment for depression and suicidal thoughts or behaviors. Parents of adolescents eligible for this study were contacted via phone to discuss their child's participation. If both the child and the parent expressed interest, informed consent was obtained from the parent and assent was obtained from the adolescent.

In order to simulate the experience of completing the EMA measure electronically, adolescents viewed a web-based version of the measure that was developed on Qualtrics. Adolescents sat with the first author to review two versions of the measure on separate monitors. The two versions of the measure had slightly different options in word choice and appearance of questions and response options in key areas where experts indicated potential concern over clarity or burden of included items.

The process of cognitive interviewing followed a concurrent interview approach, in which several techniques were used to illicit adolescents' feedback as they engaged with the online survey. As described by Groves and team,¹⁶⁰ these techniques included think-alouds, in which respondents were asked to verbalize their thought processes while responding to questions; paraphrasing, in which respondents restated a question in their own words; and definitions, in which respondents defined key terms within questions. Per the recommendation of Centers for Disease Control and Prevention for cognitive interviewing of youth participants,¹⁶³ an interview guide was used to prompt follow-up questions aimed at assessing the appropriateness of the EMA tool for the developmental level of adolescent participants. Adolescents were asked about their perceptions of the overall readability and comprehension of the measure, burden associated with information retrieval in response to questions, ability to correctly interpret questions and response options, and the relative meaningfulness of measure content. Additionally, the interview guide was used to explore adolescents' feedback on the EMA protocol, including sampling density, timeframe, and mechanism of delivery.

A content analysis approach was used to evaluate the information gathered during cognitive interviews. Interviews were audio-recorded and transcribed. Analysis of the EMA measure occurred through item-level evaluation of 4 criteria: 1) participants' overall

comprehension, i.e. subjective readability 2) their perceptions of burden, 3) their ability to interpret question wording accurately to the intended constructs and 4) their ability to interpret response options. In addition to these criteria, participants were asked to choose the domain within the measure they found to be most meaningful to fluctuations in distress based on their social media experiences. Further, overall perceptions toward the usability of the sampling protocol were thematically summarized into tables. The results from cognitive interviews were used to assess the content validity of the EMA measure and the acceptability of the sampling protocol.

Following the analysis of both cognitive and expert interviews, one final step was conducted to assess the objective readability of the EMA measure. Objective readability was analyzed using the Flesch-Kincaid Grade Level and Flesch Reading Ease readability tests using an automated scoring program offered through <https://readable.com>. Initially developed for the United States Navy, these tests assess how difficult a passage in English is to understand.^{164, 165} They are now commonly used to assess the readability of health surveys.^{166, 167}

4.3 Results

Drafting of the EMA Measure

A pool of risk and protective factors for adolescent suicide associated with social media use was gathered from the systematic reviews led by Marchant³⁶ and Dyson,⁷³ the rapid review which updated findings since their previous systematic reviews, and focus groups of acutely suicidal youth aimed to assess positive and negative consequences of social media use.

Seven risk factors were identified, which are shown in **Table 12**. Five of these factors emerged within at least one of the literature reviews, as well as within focus group content. These

5 factors included heavy use (evidenced by use in high frequency or volume), problematic social media use (referring to an inability to control use that results in negative consequences in daily life),⁴¹ cybervictimization, exposure to self-harm/suicidal content (often associated with the glorification or normalization of self-harm content), and feelings of thwarted belongingness. Thwarted belongingness refers to a psychologically-painful mental state that results from an unmet need to connect to others.¹³⁹ Two additional factors, negative upward social comparison and nighttime-specific use, emerged as themes within focus groups but were not reported in the Marchant or Dyson literature reviews, nor the rapid review. However, social comparison was noted as a risk factor for depression and anxiety within Seabrook and colleagues' review,³⁷ and sleep disturbance has been reported as a negative consequence to use within a previous longitudinal study.⁴³

Three protective factors were identified, which are shown in **Table 13**. These beneficial aspects of adolescents' social media use included: social connectedness, which was observed by a reduction in perceived social isolation or through feelings of belongingness, peer support (most often emotional or informational support), and social engagement. Social engagement refers to the encouragement to participate in social events,¹³³ e.g. using social media as a means for making plans to spend time with friends. Social connectedness and support were consistently discussed within the literature reviews and focus groups; whereas social engagement only emerged as a theme within focus groups and was not observed in the additional sources reviewed.

Each of these factors were evaluated for the strength of evidence in reference to near-term changes in suicidal risk. Based upon this review, risk and protective factors were selected for inclusion in the measure. When possible, validated measures were sought in order to identify

items that appropriately assessed each factor. Items were adapted to be appropriate for repeated sampling, i.e. verb tenses were changed to be appropriate for the timeframe of sampling.

Psychological Distress. A 1-item measure of distress associated with social media use was included, consistent with other studies assessing distress alongside of psychosocial treatment with degree of change showing utility in correlating clinical outcomes.^{168, 169}

Duration of Social Media Use. One item was added to measure duration of social media use since the last EMA prompt, which was adopted from Frison and team's brief longitudinal study of adolescent social media users.⁷¹

Peer Victimization and Support. Measures of peer victimization and support were chosen, which mirror those included in Frison's brief longitudinal study of victimization and adolescent well-being.⁷¹ In their study they assessed peer victimization with the 12-item Social Networking-Peer Experiences (SN-PEQ) scale¹⁷⁰ and the peer support with the 4-item peer subscale of the Multidimensional Scale for Perceived Social Support (MSPSS).¹⁷¹ Both measures demonstrated excellent internal consistency reliability over both waves of Frison's study ($\alpha=.90 - .94$).⁷¹

Social Comparison and Connectedness. Buunk's 2-item scale of Negative Upward Social Comparison Affect was selected, which demonstrated adequate internal consistency reliability ($\alpha=.77$) within a sample of older adolescent social media users.¹⁷² Thirteen items from Grieve and colleagues Facebook Social Connectedness Scale (which demonstrated an excellent internal consistency reliability, $\alpha=.92$)¹⁷³ were adapted for use across social media platforms.

Sleep Disturbance. Two items were drawn from Levenson and colleagues' study of night-time specific social media use, which showed the harmful impact of use of social media in the hour before sleeping on overall sleep disturbance.^{174, 175}

Thwarted Belongingness and Perceived Burdensomeness. Items were drawn from the 10-item version of the Interpersonal Needs Questionnaire, which has demonstrated good internal consistency reliability ($\alpha = .84$),^{176, 177} to assesses 2 constructs from the Interpersonal Theory of Suicide, Thwarted Belongingness and Perceived Burdensomeness. These constructs have been shown to fluctuate momentarily over just a few hours and are associated with a pathway from depressed to suicidal thoughts.¹⁵⁶

Exposure to Self-harm/Suicidal Content. No available measures were available to assess exposure to self-harm/suicidal content. Therefore, one was drafted that assessed exposure from peers, strangers, or other sources.

The initial measure included 37 items in total across all these domains. A summary of included items is presented in **Table 14**, and the drafted measure is provided in **Appendix D**.

Refining of the EMA Measure and Determining a Sampling Protocol

Expert Interviews. A complete list of themes summarizing recommended changes to the EMA measure and recommendations for the sampling protocol are shown on **Tables 15 and 16**, respectively. Recommended changes to the measure primarily addressed concerns toward participant burden. Overall, experts felt the drafted measure should be shortened. The primary change made based upon this feedback was revising the structure of the survey to follow pathways, using skip logic. The measure was revised so that a screening question would identify the presence of either a “negative/stressful” or “positive/supportive” social media experience. Depending on the response to that question, participants proceeded to questions related to risk or protective factors. The measurement experts also recommended the inclusion of a “no use” pathway, which would assess distress when participants had not engaged in use of social media within the

timeframe that the EMA measure was triggered. The intention of this pathway was to gain a better understanding of adolescents' distress level when there was no exposure to social media use.

Additional changes to the length of the measure were made by reducing the number of included domains. Three domains were removed from the measure as a result of expert feedback, connectedness, perceived burdensomeness, and exposure to self-harm content. First, the connectedness and exposure domains were removed due to concerns of limited variation over time. Belongingness was suggested as a more proximal indicator of social connectedness. This feedback is consistent with a paper by Lee and colleagues,¹⁷⁸ who studied social connectedness among college students and found an effect of belongingness on psychological distress, mediated by dysfunctional interpersonal behaviors. For consistency among the different pathways, belongingness questions were framed as the antithesis of thwarted belongingness questions from the Interpersonal Needs Questionnaire. Second, questions pertaining to perceived burdensomeness were removed from the Interpersonal Needs Questionnaire, due to experts feeling that these questions were least likely to be relevant to near-term changes in distress.

Experts also recommended reducing the number of questions per domain and simplifying question wording and response options in order to reduce participant burden. To address the recommendation of simplifying question wording and response options, the cognitive interviewing protocol was revised so that teen participants would view two versions of the EMA measure, allowing comparison of questions and response options from the published measures to revised versions based on expert feedback. Further, changes were made to cognitive interviews to address concerns of the number of negative and supportive peer experiences probed by asking adolescents to consider the experiences they found most meaningful and frequent in occurrence with the intent of removing those found least relevant.

The revised items from the expert interviews (which were shown to adolescents during cognitive interviews) are present in **Table 17**. This version of the measure included a total of 12 items on each of the pathways (negative/stressful, positive/supportive, and no use) that would be included each time an assessment was triggered plus 2 questions related to the impact of social media on sleep intended to be triggered once per day.

Experts offered specific feedback on the sampling protocol. They recommended sampling for approximately 10 days in duration with frequencies of approximately 2-4 times per day, varying by weekday and weekend. They suggested setting personalized timeframes around school and sleep schedules. Further, they felt that the best mechanism of delivery was via an online survey deployed to participants with a link provided within a text message.

Cognitive Interviews. Ten adolescents participated in cognitive interviews. Most participants were female (60%) with a mean age of 15.2 years (range: 13 to 18 years). The mean grade level was 9th (range 8th to 12th grade). Eight of the 10 participants identified themselves as Caucasian and two identified as biracial or multiracial.

A complete list of themes summarizing feedback on the EMA measure is presented in **Table 17**. Evaluation of the EMA measure's 18 items occurred across four measurement criteria: comprehension, question interpretation, response interpretation, and the acceptability of burden.

Changes Made to Improve Comprehension. Across the measure, the questions assessing psychological distress were consistently considered difficult to comprehend. Because experts indicated that the distress ratings were the items most likely for adolescents to find challenging, participants were given two options for rating distress levels. The first option asked participants to rate how an experience on social media changed their level of distress on a scale from -10 (worsened significantly) to +10 (improved significantly). Participants felt the use of a bipolar

scale was hard to understand. However, the alternative option that asked participants to rate their current distress level on a scale from 0 (no distress) to 10 (extreme distress) generated challenges with respect to temporal understanding, because it focused on a time period separate from the targeted social media experience. On this basis, the final measure focused on the timeframe of the social media experience using a 0 to 10 scale with 0 representing no change in distress and 10 representing either improved significantly or worsened significantly (depending on the pathway that was chosen).

Changes Made to Reduce Burden. Nearly half of participants found the items assessing social comparison to be burdensome. Because these items were estimated to be potentially burdensome by experts, teens were presented with two options for wording. Teens offered feedback on wording that would reduce burden based on these two options. These changes were made in the final version of the measure. Additional concerns toward burden were in relation to the items assessing thwarted belongingness. Teens felt that the items were long and somewhat repetitive. To reduce burden, one item was removed from this domain (“I felt like an outsider among friends/followers on social media”). This item was chosen for removal, because some participants felt the wording was unclear and because this item had the weakest factor loading within the psychometric validation of the Interpersonal Needs Questionnaire.¹⁷⁶

Changes made to Improve Question Interpretability. Participants requested a change in wording to the screen question, “Think about the most significant time you used social media within the past X hours. How would you describe this social media experience?” They reported feeling unsure of how a “significant” social media experience would be defined. They suggested revising the wording to an “impactful” social media experience, which was included within the final survey version. Further, participants suggested that when this EMA measure is tested, teens

may benefit from some orientation to how an impactful social media experience is defined, e.g. an experience that impacted their level of distress either positively or negatively.

Interpretability of Responses. Based upon expert feedback indicating that participants may be burdened by too many response options, teens were presented with two options for responses to the items assessing belongingness/thwarted belongingness, a 3-point and 7-point Likert scale. Contrary to expectations, nearly all participants preferred the 7-point response option, which they felt was useful in effectively communicating ambivalent feelings toward their online connectedness to others. Based on participants feedback, examples of social networking sites were added for clarity and video chatting was added as an option, which teens felt was a unique form of communication different than the others listed.

Meaningfulness. Participants consistently found that the questions pertaining to belongingness/thwarted belongingness and negative interactions with peers on social media were most important to include. Reflecting on the importance of addressing questions of belongingness, one participant said, *“The other ones are important, but how you felt is significant...If I had to shed every single other question, I would choose that one.”*

Participants were also asked if there were any meaningful domains that were not included and should have been. Three participants noted that “triggering” online experiences were not included. The way in which triggering was defined was diffuse with some reporting that news articles about natural disasters had the potential to be triggering, while others pointed to specific instances in which they were exposed to others’ self-harm content. When probed, they noted that being exposed to others’ suicidal or self-harm content was consistently triggering, meaning it had a negative impact on their mental health and in some cases incited self-harm urges. Teens further noted that exposure to content such as this within their peer group occurred frequently enough that

it would be justified to ask about this through repeated sampling. Because this was discussed as a missing domain by cognitive interview participants and because this was a significant risk factor observed in the literature reviews, an item was added to the final measure to assess exposure to friends' self-harm/suicidal content.

Adolescents additionally suggested revising the “No Use” pathway. Initially this pathway was included to evaluate distress when there was no exposure to social media at the timeframe of an EMA trigger. However, adolescents found this line of questioning inconsistent with the other pathways, which led to confusion around the intent of the question and response options. To reduce confusion, they suggested mirroring the structure of the two pathways focused on social media (assessing stressful and supportive social media experiences) to two pathways that would explore distress associated with offline social interactions (assessing stressful and supportive offline social interactions). Creating these two pathways required use of items that assessed offline vs. online interactions. In most cases, the measures chosen within each of the included domains had been adapted to assess social media, and there was an original version of the measure that was developed to assess offline social interactions from which items could easily be drawn.

The final revised EMA measure is presented in **Appendix E**, which depicts changes made based upon the feedback gathered in cognitive interviews. This measure contains pathways, which assess: 1) positive/supportive social media experiences, 2) negative/stressful social media experiences, 3) positive/supportive offline social experiences, and 4) negative/stressful offline social experiences. Each pathway has a maximum of 11-12 questions, in addition to 2 questions pertaining to sleep disturbance that are probed once daily.

The final version of the EMA measure was assessed for objective readability by calculating Flesch-Kincaid Grade Level and Flesch Reading Ease scores. The overall Flesch-Kincaid Grade

Level score was 6.9, which means roughly 7 years of formal education is estimated to be necessary in order to read and understand the survey. The Flesch Reading Ease score was 60.0. Reading ease scores of 60 or higher and grade level scores of 8th grade or higher are recommended for the general population and are considered sufficient for youth ages 13 and higher,¹⁷⁹ which is the targeted age for this measure. However, Doak and colleagues recommend health literature be written at or below a 5th grade reading level.¹⁸⁰ Therefore, it is possible that youth of low literacy levels may experience some level of difficulty reading this survey based on these measures. Nonetheless, readability formulas such as this are known to be limited in their ability to diagnose survey question difficulty.¹⁸¹ This approach of cognitive interviewing is likely to present a more robust picture of the comprehension for youth within the measures' intended target population.

Analysis of the EMA protocol feedback focused on themes within 3 areas: sampling density, timeframe of sampling, and mechanism of delivery.

Sampling Density. Participants were asked to consider the burden of the total measure within the determination of appropriate sampling density. All participants found the length of the overall measure to be acceptable for multi-daily use over a brief time period. Recommendations for the duration of daily sampling ranged from 3 days to 1 month with a mean of 10.6 days. The number of times per day of sampling was recommended to be 2-4 times per day (mean of 3 times daily). Some youth expressed that sampling on the weekend could occur more frequently, while others thought the day of the week would not matter.

Timeframe of Sampling. Teens suggested avoiding times during which they may be in class, having meals with family, attending church or extracurricular activities, or sleeping. They suggested good times to sample would be in the morning when they are getting ready for school or on the bus, at lunch (on weekends or when the school policy allows this), after school, and prior

to bedtime, e.g. 2 hours before bedtime as to not disrupt sleep. Youth felt that receiving alerts to remind them to complete surveys would be useful but thought they should occur at a reasonable interval, e.g. a reminder 15 minutes later may be annoying but being reminded after an hour would not be.

Mechanism of Delivery. All youth indicated that administration via a web-based survey deployed through a text message was an acceptable method for delivering EMA prompts. They felt it would be effective, because they are typically responsive to text messages. Two teens indicated that their first choice may have been a mobile phone application; however, they also acknowledged that texting was an acceptable alternative.

Based on this feedback, an acceptable EMA protocol for adolescents that surveyed social media effects was estimated to be around 10 days in length with approximately 3 daily samplings, at times considered to be acceptable youth, e.g. prompts must be flexible to school and sleep schedules. Ideal times for prompts would be upon waking, after school, and before bed. Finally, administration via a web-based survey sent via a text message link appears to be acceptable.

4.4 Discussion

The current study was conducted in order to develop an EMA measure and sampling protocol to assess changes in distress associated with the social media use of youth at risk for suicide. Development of the EMA measure and protocol was executed through 1) drafting a measure based upon literature review and qualitative evidence and 2) refining the measure and protocol through expert and cognitive interviews with adolescents. This research offers initial evidence of the content validity of the EMA measure and acceptability of the associated sampling

protocol. Content validity refers to the extent with which an instrument appropriately and comprehensively covers all facets of concepts it intends to measure relative to the context of use.¹⁶⁰ Feedback from experts and the target population is essential to ensure content completeness and relevance. Thus, the expert and cognitive interview process led to refinements to item content so that the proposed EMA measure addresses concepts deemed to be most relevant to understanding fluctuations in distress among youth at risk of suicide, anchored with meaningful response options, delivered in a manner and at times that would be acceptable to adolescents.

Strengths and Limitations

The study's methodological strengths lie in its approach to measure development and refinement using an iterative approach that incorporated feedback from both experts and adolescents. The small sample size and use of convenience sampling limits generalizability of the findings. Further, while these methods have established the initial content validity of the measure and acceptability of the sampling protocol, the utility of the measure and sampling protocol remain unknown until psychometric testing is completed and pilot testing reveals adherence with the sampling protocol and some measures of convergent and predictive validity.

Implications and Conclusion

The proposed EMA measure offers potential to ask important scientific questions that could expand the extant literature exploring the influence of social media use on adolescent suicidal risk. First, the measure uses skip logic to allow the participant to respond to one of four pathways assessing social media use and in-person interactions. This approach reduces burden in assessing a broad range of risk and protective factors: frequency of use, sleep impairment, negative peer interactions, social support, social comparison affect, and belongingness. Each of these factors are prevalent on social media and have been linked to the suicidal risk or protection of

young people.^{35, 36, 38, 71, 147, 182, 183} Further, they were deemed meaningful by experts in the field and adolescents alike. Casting a wide net of risk and protective factors will allow for an identification of those factors most critical to either increasing or reducing suicidal risk. Additionally, this EMA measure includes an assessment of offline social interactions. The inclusion of items assessing in-person communication offers the ability for within-subjects comparison of online versus offline social interaction's impact on youth.

This measure could aid in the identification of targets for the prevention and treatment of adolescent suicidal behavior. Within clinical practice, deployment of the EMA measure over a brief time could give mental health providers valuable insights into the contributions of social media use to a number of proximal risk factors, including sleep disturbance which is an acute risk factor for suicidal death among adolescents.¹⁸⁴ Further, by evaluating harmful and beneficial aspects of use, future investigation with this measure could expand media use recommendations for youth to focus on targets most salient to the proximal suicidal risk of adolescents.

In conclusion, this report describes the development of an EMA measure and sampling protocol aimed to assess social media's impact on the suicidal risk of adolescents. Although future studies are necessary to assess its psychometric properties, this newly developed EMA measure shows promise as an acceptable assessment of social media's influence on proximal suicidal risk.

4.5 Tables

Table 12 Risk Factors of Social Media Use for Adolescent Suicide

Risk Factors:	Marchant et al, 2017	Dyson et al, 2016	Rapid Review	Focus Group Inquiry
Heavy Use	X		X	
Problematic Social Media Use	X		X	X
Nighttime-Specific Use				X
Cyberbullying/ peer victimization	X		X	X
Exposure to Self-harm/ suicidal content	X	X	X	X
Negative Upward Social Comparison				X
Thwarted Belongingness/ Social Isolation		X		X

Table 13 Protective Factors of Social Media use for Adolescent Suicide

Protective Factors:	Marchant et al, 2017	Dyson et al, 2016	Rapid Review	Focus Group Inquiry
Social Connectedness	X	X	X	X
Peer Support	X	X	X	X
Social Engagement				X

Table 14 Summary of the Initial Draft of the Ecological Momentary Assessment Measure

Item	Domain	Measure
1	Social Media Frequency	1-item measure adopted from Frison's longitudinal study of adolescent SNS users ⁷¹
2-3	Psychological Distress	1-item impact thermometer ¹⁸⁵
4-5	Nighttime-specific SM Use	2-item measure developed by Levenson & colleagues ¹⁷⁴
6	Peer Victimization	Social Networking-Peer Experiences Questionnaire ¹⁷⁰
7-10	Peer Support	Multidimensional Scale of Perceived Social Support ¹⁷¹
11-12	Social Comparison	Buunk Negative Upward Social Comparison Affect Scale ¹⁸⁶
13-26	Connectedness (authenticity)	Facebook Connectedness Scale ¹⁸⁷
27-36	Thwarted Belongingness; Perceived Burdensomeness	Interpersonal Needs Questionnaire ¹⁷⁷
37	Exposure	Exposure to Triggering Content

Table 15 Expert Interviews Themes: Measure Development

Recommended Changes	Revisions to the Measure to Address Recommendations:
1. The length of the measure may be too burdensome for repeated sampling.	The measure was revised into pathways, and skip logic was incorporated to reduce the burden of the measure at each assessment timepoint.
2. The number of questions per domain may be too burdensome for repeated sampling.	It was recommended to reduce the number of negative and supportive peer interaction questions. Cognitive interview scripts were revised to inquire which peer experience questions adolescents thought were most meaningful and frequent.
3. Most domains included were likely to vary, except for connectedness.	The connectedness domain was removed, because it was the domain most consistently viewed by experts as least likely to vary over time.
4. The included domains were relevant; however perceived burdensomeness may be less relevant.	The perceived burdensomeness domain was removed, because it was seen as the least relevant to near-term changes in distress associated with social media use.
5. Item wording needed revision to be applicable to momentary assessment.	Wording of questions and responses throughout were revised to be appropriate for momentary assessment (rather than how a participant generally feels).
6. The items assessing distress before social media use and after may be burdensome and may suffer from recall bias.	Two options for distress scales were drafted, to be reviewed by adolescents during cognitive interviews for clarity and perceived burdensomeness.
7. Revise response options to be less burdensome.	The Interpersonal Needs Questionnaire, which included 7-point response options, was suggested to be reduced. During cognitive interviews, participants were asked to compare a 3-point and 7-point response option.
8. The measure of social media use duration may produce cognitive burden.	Rather than asking about duration of social media use since the last trigger, the question was revised to ask how many times social media was checked, which experts thought would be more realistic to the way teens use social media and less burdensome.
9. The safety protocol in place was viewed as sufficient.	A message providing crisis resources for youth that was included at the end of the survey was retained.

Table 16 Expert Interview Themes: Protocol Development

Protocol Elements	Recommendations:
Sampling Density	Recommendations for the duration of daily sampling were approximately 10 days, and recommendations for frequency of sampling varied between 2 – 4 times per day. Some suggested twice daily on weekdays and 4 times per day on weekends.
Timeframe for Daily Sampling	The timeframe of sampling should be flexible based on participants' sleep and school schedules. Participants should have an option to “snooze” alerts to complete surveys, in case the timing is bad for them.
Mechanisms of Delivery	The recommended mechanism of delivery was web-based data collection via an online survey that would be deployed to participants via a link within a text message.

Table 17 Cognitive Interview Themes: Measure Development

Items	Themes
Context Item	
<p>CON1) What were you doing right before receiving this alert? Please check all that apply.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Using a social networking site <input type="checkbox"/> Playing videogames with others <input type="checkbox"/> Texting/direct messaging <input type="checkbox"/> Talking on the phone <input type="checkbox"/> Talking to someone in-person <input type="checkbox"/> Not socializing at the moment <input type="checkbox"/> Other: socializing in another way that is not listed 	<ul style="list-style-type: none"> - All participants reported comprehending and being able to interpret questions with minimal burden. - <u>Response Interpretation</u>: 2 teens suggested giving examples of what a social networking site was in order to enhance interpretability. - <u>Other Comments</u>: 1 teen suggested adding video chatting, which they felt was a different type of communication that what was represented here.
Screening Item	
<p>SCR1) How often did you check social media since <timeframe of signal>?</p> <ul style="list-style-type: none"> a. Almost constantly b. A few times c. At least once d. I haven't checked social media. (<i>Proceed to No Use Pathway</i>) 	<ul style="list-style-type: none"> - All participants reported comprehending and being able to interpret questions and responses with minimal burden.
<p>SCR2) Think about the most significant time you used social media since <timeframe of signal>. How would you describe this social media experience?</p> <ul style="list-style-type: none"> a. It was a positive/supportive experience. (<i>Proceed with Support Pathway</i>) 	<ul style="list-style-type: none"> - All participants reported comprehending and being able to interpret responses with minimal burden. - <u>Question Interpretation</u>: 2 teens were confused by what a most significant time might be. They suggested possible alternate wording of “impactful” or “significant.”

Table 17 Continued

<p>b. It was a negative/stressful experience. (<i>Proceed with Stress Pathway</i>)</p> <p>c. It was a somewhat positive and somewhat negative. (<i>Proceed with SCR 2a</i>)</p> <p>d. I didn't have a significant experience on social media. (<i>Proceed to No Use Pathway</i>)</p>	
<p>SCR2a) Would you describe this experience as mostly positive or mostly negative?</p> <p>a. Mostly positive/supportive (<i>Proceed with Support Pathway</i>)</p> <p>b. Mostly negative/stressful (<i>Proceed with Stress Pathway</i>)</p>	<p>- All participants reported comprehending and being able to interpret questions and responses.</p> <p>- <u>Burden</u>: 2 teens felt they would be annoyed by being asked a question like this, either because it felt repetitive to the previous question or because they wanted more response options (specifically a neutral response option).</p>
Sleep Items	
<p>SLE1) How many minutes did you use social media in the hour before you fell asleep yesterday?</p> <p>Response Options: 0, 1-15, 16-30, 31-45, 46-60</p>	<p>- All participants reported comprehending and being able to interpret responses.</p> <p>- <u>Question Interpretation</u>: 1 teen suggested rewording the question to "In the hour before you fell asleep yesterday, how many minutes did you use social media?" to improve clarity.</p> <p><u>Burden</u>: 1 participant thought that this question may be difficult to answer. This person indicated frequently falling asleep while using social media, which would create some difficulty answering the question.</p>
<p>SLE2) To what extent do you feel social media interfered with your sleep yesterday?</p> <p>Response Options: Not at all, Mildly, Moderately, Severely</p>	<p>- All participants reported comprehending and being able to interpret questions and responses with minimal burden.</p>
Negative/Stressful Pathway	
<p><i>Directions: Please answer these questions based on the NEGATIVE/STRESSFUL experience you had on social media.</i></p>	<p>- All participants reported comprehending these directions with minimal burden.</p>
<p>STR1) Option 1: How did this NEGATIVE/STRESSFUL experience on social media change your level of distress?</p> <p>Response Options: Followed a scale from -10 (worsened significantly) to 0 (no change) to +10 (improved significantly)</p> <p>Option 2: Please indicate the number that best represents your distress level you feel right now in this moment.</p> <p>Response Options: Followed a distress thermometer from 0 to 10</p>	<p>- Participants reported variances in their ability to comprehend and interpret questions and response options, as well as the level of burden required to do so.</p> <p>- <u>Comprehension</u>: Some participants found Option 2 to be generally unclear (n=3), but some participants (n=4) had lesser temporal comprehension with Option 1.</p> <p>- <u>Question Interpretation</u>: 3 participants expressed difficulty interpreting the meaning of Option 1.</p> <p>- <u>Response Interpretation</u>: 3 participants expressed difficulty interpreting the meaning of Option 1.</p>

Table 17 Continued

	<p>- <u>Burden</u>: Participants felt this question (either option) was the most burdensome one on the measure, but also acknowledged it to be important. Burden corresponded to the timeframe of Option 2 (n=4), as it caused them to reflect on multiple timeframes (now and at the time of the stressful event), and the complicated scale used in Option 1 (n=3).</p> <p>- <u>Other Comments</u>: Participants preferred the wording of improved significantly/worsened significantly and no change, but thought the bipolar scale was unnecessary. They thought it felt odd to see an option to indicate their distress level improved significantly when they endorsed a stressful experience.</p>
<p>STR2) During this NEGATIVE/STRESSFUL experience on social media, did you experience any of the following interactions with friends/followers? Response Options: A friend/follower...</p> <ul style="list-style-type: none"> <input type="checkbox"/> posted mean things about me on a public portion of a social media <input type="checkbox"/> posted pictures of me on social media that made me look bad <input type="checkbox"/> spread rumors about me or revealed secrets I had told them using public posts on social media <input type="checkbox"/> sent me a mean message on a social media <input type="checkbox"/> I wanted to be friends with on social media ignored my friend request <input type="checkbox"/> excluded from a party or social event over social media <input type="checkbox"/> interacted with me in another way that was negative that is not listed here <input type="checkbox"/> None of the above 	<p>- All participants reported comprehending and being able to interpret questions and responses.</p> <p>- <u>Burden</u>: 7 out of 10 participants felt the # of response options was just right, 1 felt the # of response options was too long (but noted they were unsure of what could be removed), and 2 felt the # of response options was somewhat too long but appreciated the comprehensive list of options. Teens felt if the number of responses were reduced, they may feel burdened by needing to think of an event that was not listed.</p> <p>- <u>Other Comments</u>: The most frequently occurring negative experiences included: posted mean things (n=4) and sent a mean message (n=3). The most impactful negative experiences included: spreading rumors (n=5) and posting mean things (n=3). All experiences were noted to be either frequent or impactful.</p>
<p>STR3) How much do you agree with the following statements about your NEGATIVE/STRESSFUL social media experience? Option 1: It gave me an unpleasant feeling when a friend(s) posted or commented in a way that made me feel like they have a better life than I do myself. Option 2: It made feel bad when a friend(s) posted or commented about their successes or happiness,</p>	<p>- All participants reported comprehending and being able to interpret responses.</p> <p>- <u>Question Interpretation</u>: The phrasing “successes or happiness” was equally liked (n=5) and disliked (n=5). Older teens reflected this phrasing made them think of more specific experiences of social comparison – thinking of seeing comments on social media related to applying to colleges & future plans. This missed the mark in terms of question interpretation, because this item was</p>

Table 17 Continued

<p>because they may have a better life than I do myself.</p> <p>Response Options:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Strongly agree <input type="checkbox"/> Moderately agree <input type="checkbox"/> Neither agree nor disagree <input type="checkbox"/> Moderately disagree <input type="checkbox"/> Strongly disagree 	<p>intended to target a less specific idea of social comparison.</p> <p>- <u>Burden</u>: 2 people felt that this question was long and hard to think about, but they felt this could be improved with changes in wording.</p> <p>- <u>Other Comments</u>: Participants' overall preferences between Option 1 & 2 varied widely. Preferences toward certain phrasing were paramount to the overall item. Most participants preferred the following phrasing: "made me feel bad" "made me feel like I had a better life"</p>
<p>STR4) How did this NEGATIVE/STRESSFUL experience on social media make you feel?</p> <p>a) I felt like I didn't belong among my friends/followers on social media</p> <p>b) I felt unfortunate for not having caring and supportive social media friends/followers</p> <p>c) I felt disconnected from other friends/followers on social media</p> <p>d) I felt like an outsider among friends/followers on social media</p> <p>e) I felt distant to other people on social media</p> <p>Response Option 1: 7-point scale from 1 (not at all true for me) to 7 (very true for me)</p> <p>Response Option 2: 3-point scale from 1 (not at all true for me) to 3 (very true for me)</p>	<p>- All participants reported comprehending and being able to interpret questions and responses with minimal burden.</p> <p>- <u>Question Interpretation</u>: 2 participants reported not understanding what "outsider" meant. Of note, other participants endorsed strongly relating to the feeling of being an outsider.</p> <p>- <u>Response Interpretation</u>: 9 out of 10 participants preferred the 7-point scale, indicating they preferred more options. They felt that the 3-point scale in Option 2 would make them feel frustrated due to lack of ability to rate ambiguous feelings.</p>
<p>Positive/Supportive Pathway</p>	
<p><i>Directions: Please answer these questions based on the POSITIVE/SUPPORTIVE experience you had on social media.</i></p>	<p>There were no concerns about the directions.</p>
<p>SUP1) Option 1: How did this POSITIVE/SUPPORTIVE experience on social media <u>change</u> your level of distress?</p> <p>Response Options: Followed a scale from -10 (worsened significantly) to 0 (no change) to +10 (improved significantly)</p> <p>Option 2: Please indicate the number that best represents your distress level you feel right now in this moment.</p>	<p>Preferences to this item remained consistent to what was reported in STR1.</p>

Table 17 Continued

<p>Response Options: Followed a distress thermometer from 0 to 10</p>	
<p>SUP2) During this POSITIVE/SUPPORTIVE experience on social media, did you experience any of the following interactions with friends/followers? Please select all that apply.</p> <p>Option 1:</p> <ul style="list-style-type: none"> <input type="checkbox"/> posted or sent a private message to show they were really trying to help me <input type="checkbox"/> posted or sent a private message to show me I can count on them, even when things go wrong <input type="checkbox"/> posted or sent a private message to listen to my joys or sorrows <input type="checkbox"/> posted or sent a private message to help me through a problem <input type="checkbox"/> interacted with me in another way that was positive that is not listed here <input type="checkbox"/> None of the above <p>Option 2:</p> <ul style="list-style-type: none"> <input type="checkbox"/> posted pictures of me on social media that made me look good <input type="checkbox"/> I wanted to be friends with on social media accepted my friend request <input type="checkbox"/> invited me to a party or social event over social media <input type="checkbox"/> posted or sent a private message about our shared interests <input type="checkbox"/> interacted with me in another way that was positive that is not listed here <input type="checkbox"/> None of the above 	<ul style="list-style-type: none"> - All participants reported comprehending and being able to interpret questions and responses for both Option 1 or 2. - <u>Burden</u>: Participants felt the number of responses for either option was acceptable in terms of burden, but that the combination of items for Options 1 and 2 would be too burdensome. - <u>Other Comments</u>: - 8 participants felt the items in Option 1 were more meaningful. 6 participants felt the items in Option 2 occurred more frequently. - Participants felt both options were relevant to changes in distress and to social media experiences. However, Option 1 was more directly relevant to changes in mood/distress, and that Option 2 was more relevant to daily social media experiences.
<p>SUP3) How much do you agree with the following statements pertaining to your POSITIVE/SUPPORTIVE social media experience?</p> <p>Option 1: It gave me a pleasant feeling when a friend(s) posted or commented in a way that made me feel like they have a better life than I do myself.</p> <p>Option 2: It made feel good when a friend(s) posted or commented about their successes or happiness, because they may have a better life than I do myself.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Strongly agree 	<ul style="list-style-type: none"> - All participants reported comprehending and being able to interpret questions and responses for both options. - <u>Burden</u>: 2 people felt that this question was long and hard to think about, but they felt this could be improved with changes in wording. - <u>Other Comments</u>: - The phrasing “successes or happiness” was deemed more comprehensible when framed as a supportive experience. - Participants’ preferences between Option 1 & 2 varied widely. Preferences toward certain phrasing were paramount to the overall item. Most participants preferred the following phrasing: “made me feel good”

Table 17 Continued

<input type="checkbox"/> Moderately agree <input type="checkbox"/> Neither agree nor disagree <input type="checkbox"/> Moderately disagree <input type="checkbox"/> Strongly disagree	<p>“made me feel like I had a better life”</p>
<p>SUP4) How did this POSITIVE/SUPPORTIVE experience on social media make you feel?</p> <p>a) I felt like I belong among my friends/followers on social media</p> <p>b) I felt fortunate for having caring and supportive social media friends/ followers</p> <p>c) I felt connected to other friends/ followers on social media</p> <p>d) I felt like an insider among friends/ followers on social media</p> <p>e) I felt close to other people on social media</p> <p>Response Option 1: 7-point scale from 1 (not at all true for me) to 7 (very true for me)</p> <p>Response Option 2: 3-point scale from 1 (not at all true for me) to 3 (very true for me)</p>	<p>- All participants reported comprehending and being able to interpret questions with minimal burden.</p> <p>- <u>Question Interpretation</u>: 2 participants reported not understanding what “insider” meant.</p> <p>- <u>Response Interpretation</u>: 9 out of 10 participants preferred the 7-point scale, indicating they preferred more options. They felt that the 3-point scale in Option 2 would make them feel frustrated due to lack of ability to rate ambiguous feelings.</p>
<p>No Use Pathway</p>	
<p>NOU1) Please indicate the number that best represents your distress level you feel right now in this moment.</p> <p>Response Options: Followed a distress thermometer from 0 to 10</p>	<p>Preferences to this item remained consistent to what was reported in STR1, Option 2.</p> <p><u>Other Comments</u>: Participants suggested following a similar pathway for offline experiences to online experiences. Rather than distress being asked now, they suggested referring to positive/negative offline experiences and reflect about changes in distress at that time.</p>
<p>NOU2) Since <timeframe of signal>, have you had a positive or supportive interaction off of social media, e.g. in-person, talking to someone over the phone, or texting?</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p>	<p>- All participants reported comprehending and being able to interpret questions and responses with minimal burden.</p> <p>- <u>Other Comments</u>: Participants thought that texting was more like social media experiences than it was offline experiences.</p>
<p>NOU3) Since <timeframe of signal>, have you had a negative or stressful interaction off social media, e.g. in-person, talking to someone over the phone, or texting?</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p>	<p>- All participants reported comprehending and being able to interpret questions and responses with minimal burden.</p> <p>- <u>Other Comments</u>: Participants thought that texting was more like social media experiences than it was offline experiences.</p>

Table 17 Continued

<p>NOU4) The following questions ask you to think about yourself and other people. Please respond to each question using your own current beliefs and experiences, NOT what you think is true in general, or what might be true for other people. Please base your responses on how you're feeling <u>right now in this moment</u>.</p> <p>a) I feel like I belong b) I am fortunate to have many caring and supportive friends c) I feel disconnected from other people d) I feel like an outsider e) I am close to other people</p> <p>Response Option 1: 7-point scale from 1 (not at all true for me) to 7 (very true for me)</p> <p>Response Option 2: 3-point scale from 1 (not at all true for me) to 3 (very true for me)</p>	<ul style="list-style-type: none"> - All participants reported comprehending and being able to adequately interpret question wording. - Preferences to the 7-point response option remained consistent with what was reported in STR5 and SUP4. - Burden to this question remained consistent with what was reported in STR5 and SUP4.
<p>Concluding Message</p>	
<p>Thank you, you've completed your survey! <i>If you are feeling unsafe, we are here to help. You can contact the STAR clinic at 412-246-5619. This number answers Monday through Friday between 8:30 a.m. and 5:00 p.m., except for observed holidays. If this is outside of normal business hours, we recommend contacting a 24-hour crisis hotline. The Re:Solve Crisis Network services Allegheny County and can be reached 24 hours per day, 365 days per year at 1-888-796-8226. Those outside of Allegheny County can call the National Suicide Prevention Lifeline at 1-800-273-8255, or alternatively contact the Crisis Text Line by texting CONNECT to 741741.</i></p>	<ul style="list-style-type: none"> - All participants reported this message was easy to comprehend and interpret with minimal burden. - Other Comments: Participants indicated they found this message appropriate and did not feel they would need anything further to maintain their safety.

5.0 Final Discussion and Future Directions

After a decade of increasing rates of youth suicide,¹¹⁴ the prevention of suicide among adolescents is a national imperative.¹⁸⁸ Public health researchers have been called to investigate the relationship between social media and adolescent suicide in order to establish putative targets for prevention.⁶⁴ This dissertation aimed to synthesize recent findings explaining social media's harmful and beneficial influences on youth, explore the context and acceptability of monitoring adolescents' social media content, and develop a measure to assess factors which may contribute to proximal suicidal risk among vulnerable adolescents.

5.1 Summary of the Main Findings

First, this dissertation updated risk and protective factors for adolescent suicide associated with the use of social media. Almost double the number of articles identified risk factors for deliberate self-harm associated with the use of social media than those that identified protective factors. This presents concern toward a potential risk relationship between social media use and adolescent suicide. However, positive consequences of adolescents' use of social media were considerably less studied, which may bias conclusions toward the helpfulness or harmfulness of youth's use of social media. Implications for vulnerable subgroups were reviewed, which suggested special concern toward cyberbullying for males, sexual minorities, and youth facing familial adversity. Additionally, the high rates of suicide attempts among female videogame users suggests further research is needed to understand risks associated with girls' use of gaming.

Second, the context of adolescents' online environments and parents' engagement in monitoring were evaluated toward the development of an automated social media monitoring intervention focused on youth at high-risk of suicide. Perhaps the most striking finding from this project was that adolescents universally agreed that their social media use at times contributed to heightened suicidal thoughts, but despite this recognition they never or infrequently discussed distressing social media experiences with their therapists. Notwithstanding some barriers toward implementation, adolescents and parents perceived that automated means of social media monitoring that engaged adolescents' therapists could be beneficial in protecting youth from harmful online experiences.

Third, the insights from the literature review and focus groups with teens were brought to bear in the development of a measure that aims to assess momentary changes in distress associated with suicidal youth's social media experiences. Experts in research focused on adolescent suicide, social media, and measurement and adolescent social media users guided the iterative development of the measure to a final form that aimed to maximize comprehension while minimizing burden. Further, these informants offered guidance toward a sampling protocol that will guide future psychometric testing of the measure.

5.2 Future Directions

The research conducted within this dissertation offers future directions for further formative work as well as opportunities to advance the work through a next stage of research.

Areas Where Additional Formative Work Is Needed

There are two key areas where future formative work is necessary. First, the opinions of parents and adolescents clarified ways in which automated social media monitoring may be acceptably and feasibly conducted from their vantage points. However, guidance from mental health providers is necessary in order to understand how the delivery of risk alerts should be managed in order to place minimal burden on clinical practice flow. Guidance from providers within academic medical centers as well as community mental health agencies is necessary to determine a feasible approach to automated monitoring within high and low resource settings.

Secondly, while the initial targets for the EMA protocol were determined based on expert and adolescent feedback on acceptable levels of burden, a small pilot test could inform the acceptability and feasibility of the sampling targets. Particularly given the vulnerability of the at-risk youth population, testing to confirm burden was sufficiently minimized could be beneficial.

Next Stages of Research

Each of the dissertation projects has directions for a next stage of research. The next stage of the rapid review is to conduct a systematic review by extending the search with a larger number of databases. While in an emerging field a rapid review is important to communicate updated findings in an efficient manner, engaging in systematic reviews is important to reduce bias associated with a less scoping review and more confidently draw conclusions about the harmful and beneficial aspects of adolescents' social media use. Further, a systematic review that broadened the inclusion criteria to include articles that had outcomes of other common risk factors for suicide, i.e. depression, anxiety, or sleep disturbance, could provide a more comprehensive picture of the known risk and protective factors.

The qualitative data and surveys collected from youth and parents could be extended through research to gain a broader perspective or a deeper understanding of the positive and negative consequences of adolescents' social media use and parents' engagement in monitoring. Next steps could take the form of evaluating the presence of the risky and protective aspects of social media use that adolescents identified, and mediation strategies identified by parents within larger samples, in order to draw generalizable conclusions. Alternatively, qualitative work of greater intensity could be conducted in order to gather more fine-grained insights into the digital media experiences of suicidal adolescents and their parents.

There are a couple of potential next steps for the development of an automated social media monitoring strategy. First, though the process of collecting social media content from youth has been tested and analyzed to identify suicidal risk,^{67, 189} this work has so far only occurred by a data donation basis. An important next step will be to evaluate the social media content of suicidal users alongside with clinical data that provides insight into fluctuations in suicidal risk over time. Work such as this could provide a deeper understanding of the ability of social media content to be harnessed to accurately identify suicidal risk. Secondly, evaluation is necessary to test the effectiveness of automated monitoring within a clinical setting. Given the information shared by parents and adolescents, testing an intervention such as this has complicated ethical implications, such as guarding teens' digital privacy while reporting and responding to concerning digital content. Future research testing automated social media monitoring strategies should be conducted with eye for potential implementation barriers associated with ethical challenges.

Finally, a necessary next stage of research for the EMA measure is assessing psychometric quality. Psychometric testing should include assessment of the measure's validity and reliability. Groves and team recommend testing concurrent validity or assessing the newly drafted measure

against a gold standard measure (concurrent validity).¹⁶⁰ The ability to test against a gold standard measure is somewhat limited, because of the newness of the study of social media. However, an instrument such as the Problematic and Risky Internet Use Screening Scale (PRIUSS),¹⁹⁰ which was rigorously tested, could be useful in this pursuit. Additionally, establishing the measures' predictive validity, or the ability to predict something it should theoretically be able to predict,¹⁶⁰ may be important, particularly in regard to predicting suicidal risk. Furthermore, testing both the internal consistency reliability of the included items (testing how well the items that reflect the same construct yield similar results) and test-retest reliability (testing the consistency of the measure over time) would be informative to identifying the psychometric quality of the measure.¹⁶⁰

5.3 Considerations for Research and Practice

There are several challenges to research and practice focused on the social media use of adolescents at-risk of suicide. The legal and ethical complications on this topic are significant. While the introduction addressed the need to consider the lack of privacy protections in place for social media data and the need for informed consent, the focus groups with adolescents shed light to another concern which is the need to consider adolescents' digital rights. The United Nations Convention on the Rights of the Child states that youth have a right to freedom of expression, which includes "freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of the child's choice."¹⁹¹ At the same time, this convention also proclaims a right to protection from harm, including harm to reputation. Thus, prevention interventions that involve limiting access to the digital media content of youth are faced with competing priorities in maintaining youth's safety

while being mindful of their needs for personal expression. In 2018, the United Nations International Children's Emergency Fund (UNICEF) released a toolkit that offers insights on these ethical challenges.¹⁹² Among several helpful suggestions, they suggest that children's online privacy and freedom of expression should be protected and respected in accordance with their evolving capacity, i.e. age, maturity level, and trusted adults' perspectives toward the psychosocial risks of maintaining privacy.

In addition to the insight offered by these international bodies, two national bodies in the United States have released guidelines which are highly relevant to practitioners working with suicidal youth. In 2019, the American Association of Suicidology (AAS) released guidelines for parents and providers.¹⁹³ AAS acknowledges that vulnerability to some of the harmful aspects of social media use is variable, and suggests an approach to maintaining online safety should be targeted to the individual child. At the same time, they acknowledge that for any child it is recommended to limit access to disturbing or violent images. They further recommend that parents and providers educate themselves on current social media trends and uses, as well as parental control features. AAS suggests both parents and clinicians engage in regular conversation with teens about their social media use, acknowledging not only risky aspects of use but also ways in which it may offer benefit. For providers, they acknowledge the need to engage in conversations about adolescents' digital lives when completing crisis intervention plans.

The American Academy of Pediatrics (AAP)¹⁹⁴ also offers guidelines for children and adolescents' use of social media. AAP recommends creating a family media use plan and offers a website to create such a plan with targeted advice based upon the child's age (www.HealthyChildren.org/MediaUsePlan). As part of their family media use plan, AAP offers a variety of recommendations to parents, such as setting screen-free zones within the home and

screen-free times as part of youth's daily lives, balancing online and offline time, and assuring youth unplug their digital devices enough to attain enough sleep and exercise.

5.4 Dissertation Conclusions

The study of social media's influence on adolescent suicide is rapidly growing to appropriately assess challenges to adolescents' safety and wellbeing and identify appropriate ways to intervene. This dissertation work addressed formative research questions aimed to expand the goal of understanding harmful and beneficial aspects of adolescents' use of social media, while also informing a monitoring intervention. Further research is necessary to continue scoping the growing literature, establish the psychometric validity of the EMA measure and feasibility of the associated sampling protocol, and evaluate the effectiveness of the monitoring intervention.

Appendix A Search Strategy

Database: Scopus

Date Searched: May 20th, 2018

<p>Deliberate Self-Harm Behavior MeSH Term: self-injurious behavior</p> <p>Deliberate Self-Harm Behavior Keywords: Self-injurious Behaviors, Nonsuicidal Self Injury, Nonsuicidal Self Injuries, Self-Injury, Self Injury, Self-Injuries, Non-Suicidal Self Injury, Non Suicidal Self Injury, Non-Suicidal Self Injuries, Self-Destructive Behavior, Self Destructive Behavior, Deliberate Self-Harm, Deliberate Self Harm, Parasuicide, Parasuicides</p>
<p>Youth Search MeSH Terms: adolescent, young adult</p> <p>Youth Keywords: Adolescents, Adolescence, Teens, Teen, Teenagers, Teenager, youth, Youths, Young Adults, Juvenile</p>
<p>Social Media MeSH Terms: Social Media, Blogging</p> <p>Social Media Keywords: Social Networking Site, Blog, Facebook, Google +, Health 2.0, Microblog, Medicine 2.0, Myspace, Social Medium, Twitter, Tweet, Twitter Messaging, Virtual World, Virtual Community, User Generated Content, Vlog, Xbox, Youtube, Instagram, Tumblr, Pinterest, Snapchat, Reddit, Wiki, LinkedIn, Second Life, World of Warcraft, Flickr, Content Communities, Massively Multiplayer Online Role-playing Game, Foursquare, SlideShare, Web 2.0, PlayStation, Online Communication, Digital Behavior, Online Social Network, Videogaming, Internet Addiction, Cyberbully, Problematic Internet Use</p>

Final Search Term: TITLE-ABS-KEY("social networking site" OR "social networking sites" OR "social network site" OR "social network sites" OR blog* OR facebook OR "google +" OR "google plus" OR "health 2.0" OR microblog* OR "medicine 2.0" OR myspace OR "social media" OR "social medium" OR "social mediums" OR twitter OR tweet OR "twitter messaging" OR "virtual world" OR "virtual community" OR "virtual communities" OR "user generated content" OR vlog* OR xbox OR youtube OR Instagram OR youtube OR tumblr OR pinterest OR snapchat OR reddit OR wiki OR linkedin OR "Second Life" OR "World of Warcraft" OR flickr OR "Content communities" OR "content community" OR "massively multiplayer online role-playing game" OR MMORPG OR foursquare OR slideshare OR "web 2.0" OR "web 2" OR playstation OR "online communication" OR "digital media" OR "internet platform" OR "internet platforms" OR "online platform" OR "online platforms" OR "online behavior" OR "online social network" OR "online social networks" OR "video-gaming" OR "internet addiction" OR cyberbully* OR "problematic internet use")

Appendix B Teen and Parent Surveys

Teen Survey

Thank you for participating in our survey! You will be asked to answer questions about your social media, text messaging, and internet usage, as well as your thoughts and opinions on these topics. If you have any questions as you proceed, please let the research team know.

Q1 Do you access the internet on a cell phone, tablet or other mobile device, at least occasionally?

☐ Yes (1)

☐ No (2)

Q2 Overall, how often do you use the internet?

☐ Almost constantly (1)

☐ Several times a day (2)

☐ About once a day (3)

☐ Several times a week (4)

☐ Once a week (5)

☐ Less often (6)

Q3 How much time do you spend on an average day on social media?

☐ Less than 1/2 hour (1)

☐ More than a 1/2 hour but less than 1 hour (2)

☐ More than 1 hour but less than 2 hours (3)

☐ More than 2 hours but less than 3 hours (4)

☐ More than 3 hours but less than 4 hours (5)

☐ More than 4 hours (6)

Q4 Do you, personally, have or have access to each of the following items, or not. Do you have...?
(Choose any that apply to you.)

- ☐ A smartphone (1)
- ☐ A cell phone that is not a smartphone (2)
- ☐ A desktop or laptop computer (3)
- ☐ A tablet computer like an iPad, Samsung Galaxy, or Kindle Fire (4)
- ☐ A gaming console like an Xbox, PlayStation, or Wii (5)

Q5 On an average day, about how many text messages do you send and receive on your cell phone
(excluding messages you receive from messaging apps like WhatsApp, Kik, or Snapchat)?

☐ Number of average daily text messages: (1)

☐ I don't text (2)

☐ Phone can't send or receive texts (3)

Q6 On an average day, about how many messages do you send and receive on your cell phone from direct
messaging apps like WhatsApp, Kik, or Snapchat?

☐ Number of average daily direct messages: (1)

☐ I don't text (2)

☐ Phone can't send or receive texts (3)

Q7 Do you do any of the following online or on your cellphone? (Choose any that apply to you.)

☐ Play video games - on a computer or on a game console or a portable device like a cell phone
(1)

☐ Use online pinboards (like Pinterest or Polyvore) to collect and share inspiring content or things
you would like to buy or make (2)

☐ Use social media (3)

☐ Read or comment on a discussion board (like Reddit or Digg) (4)

☐ Video call or chat (5)

Q8 Do you do any of the following online or on your cellphone? (Choose any that apply to you.)

- ☐ Use messaging apps like WhatsApp or Kik (1)
- ☐ Visit anonymous sharing or question apps (Whisper, YikYak, Ask.FM) (2)
- ☐ Use an app that automatically deletes the messages you send like Snapchat or Wickr (3)

Q9 Which of the following social media do you use? (Choose any that apply to you.)

- ☐ Facebook (1)
- ☐ Twitter (2)
- ☐ Instagram (3)
- ☐ Google+ (4)
- ☐ Snapchat (5)
- ☐ Vine (6)
- ☐ Tumblr (7)
- ☐ Other social media not listed here (8)

Q10 Which of these social media do you use MOST often?

- ☐ Facebook (1)
- ☐ Twitter (2)
- ☐ Instagram (3)
- ☐ Google+ (4)
- ☐ Snapchat (5)
- ☐ Vine (6)
- ☐ Tumblr (7)
- ☐ A different social media site (8)

Q11 What other social media sites do you use, if any? Please list all additional social media sites you use.

Thinking broadly about all your friends...

Q12 In general, does social media make you feel more connected to information about what's going on in your friend's lives?

- ☐ Yes, a lot (1)
- ☐ Yes, a little (2)
- ☐ No (3)

Q13 In general, does social media make you feel worse about your own life because of what you see from other friends on social media?

- ☐ Yes, a lot (1)
- ☐ Yes, a little (2)
- ☐ No (3)

Q14 In general, does social media make you feel better connected to your friends' feelings?

- ☐ Yes, a lot (1)
- ☐ Yes, a little (2)
- ☐ No (3)

Q15 In general, does social media make you feel pressure to post content that will be popular and get lots of comments or likes?

- ☐ Yes, a lot (1)
- ☐ Yes, a little (2)
- ☐ No (3)

Q16 In general, does social media make you feel pressure to only post content that makes you look good to others?

- ☐ Yes, a lot (1)
- ☐ Yes, a little (2)
- ☐ No (3)

Do you ever experience any of the following on social media...?

Q17 People posting about things you weren't invited to?

- ☐ Yes, frequently (1)
- ☐ Yes, occasionally (2)
- ☐ No (3)

Q18 People stirring up drama?

- ☐ Yes, frequently (1)
- ☐ Yes, occasionally (2)
- ☐ No (3)

Q19 People posting things about you that you can't change or control?

- ☐ Yes, frequently (1)
- ☐ Yes, occasionally (2)
- ☐ No (3)

Q20 People supporting you through challenges or tough times?

- ☐ Yes, frequently (1)
- ☐ Yes, occasionally (2)
- ☐ No (3)

Do you agree or disagree with each of the following statements?

Q21 People get to show different sides of themselves on social media that they can't show offline?

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)

Q22 People are less authentic and real on social media than they are offline?

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)

Q23 People share too much information about themselves on social media?

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)

Q24 Have you ever shared one of your passwords with a friend?

- ☐ Yes (1)
- ☐ No (2)

Thinking about your experiences online... Have you ever...?

Q25 Unfriended or unfollowed someone that you used to be friends with?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Does not apply (3)

Q26 Blocked someone you used to be friends with?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Does not apply (3)

Q27 Untagged or deleted photos of you and someone you used to be friends with?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Does not apply (3)

Q28 Had a fight with any of your friends that started because of something that happened online or because of a text?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Does not apply (3)

Parent Survey

Thank you for taking part in our survey! The following questions will ask about your and your child's use of social media, texting, and other forms of electronic communication, as well as ways in which you might monitor their use. Please answer the questions carefully and honestly. If you have any questions, please let the research team know.

Q1 Do you happen to have any of the following items? (Please choose all that apply.)

- ☐ A smartphone (1)
- ☐ A cell phone that is not a smart phone (2)
- ☐ A desktop computer (3)
- ☐ A laptop computer (4)
- ☐ A tablet computer (5)

Q2 We're interested in the kinds of things you do when you use the internet. Not everyone has done these things. Do you ever...? *(Please choose all that apply.)*

- ☐ Use Facebook (1)
- ☐ Use Twitter (2)
- ☐ Access the internet on a cell phone, tablet or other mobile handheld device, at least occasionally (3)
- ☐ Use some other social media site (4)

And now a few questions about your child...

Q3 As far as you know, does your child have their own cellphone or smartphone?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q4 As far as you know, does your child use Facebook?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (4)

Q5 Are you friends with your child on Facebook?

- ☐ Yes (1)
- ☐ No (2)

Q6 As far as you know, does your child use Twitter?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q7 Do you follow your child on Twitter?

- ☐ Yes (1)
- ☐ No (2)

Q8 Are you connected with your child on any other social media sites besides Facebook and Twitter? (Examples of other sites could include Instagram, Google+, Snapchat, Vine, Tumblr, etc.)

☐ Yes (1)

☐ No (2)

Q9 Aside from Facebook and Twitter, on which social media sites are you connected with your child? (Examples of other sites could include Instagram, Google+, Snapchat, Vine, Tumblr, etc.)

Q10 When you need to get a hold of your child quickly, what do you use MOST often to reach them?

☐ Text message (1)

☐ Phone call (2)

☐ Email (3)

☐ Message them on social media (4)

☐ Something else (5)

Q11 What other ways do you get a hold of child quickly that we did not previously list?

Q12 Do you happen to know your child's password for any of their social media accounts?

☐ Yes (1)

☐ No (2)

☐ Does not apply (3)

Q13 Do you happen to know your child's password for their e-mail?

☐ Yes (1)

☐ No (2)

☐ Does not apply (3)

Q14 Do you happen to know your child's password for their cell phone?

☐ Yes (1)

☐ No (2)

☐ Does not apply (3)

Q15 Have you ever done any of the following things? (Please check all that apply.)

- ☐ Used parental controls or other technological means of blocking, filtering or monitoring your child's online activities (1)
- ☐ Checked which websites your child visited (2)
- ☐ Checked your child's profile on a social networking site (3)
- ☐ Taken away your child's cell phone or internet privileges as punishment (4)
- ☐ Limited the amount of time or times of day when your child can go online (5)

Q16 Are you doing any of the following things currently? (Please check all that apply.)

- ☐ Using parental controls or other technological means of blocking, filtering or monitoring your child's online activities (1)
- ☐ Checking which websites your child visited (2)
- ☐ Checking your child's profile on a social networking site (3)
- ☐ Taking away your child's cell phone or internet privileges as punishment (4)
- ☐ Limiting the amount of time or times of day when your child can go online (5)

Q17 Have you ever done any of the following things? (Please check all that apply.)

- ☐ Used parental controls to restrict your child's use of his/her cell phone? (1)
- ☐ Used monitoring tools to track your child's location with his/her cell phone? (2)
- ☐ Looked at the phone call records or messages on your child's phone? (3)

Q18 Are you doing any of the following things currently? (Please check all that apply.)

- ☐ Using parental controls to restrict your child's use of his/her cell phone? (1)
- ☐ Using monitoring tools to track your child's location with his/her cell phone? (2)
- ☐ Looking at the phone call records or messages on your child's phone? (3)

Q19 How often do you talk with them about what is appropriate or inappropriate online behavior toward others?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Frequently (4)

Q20 How often do you talk with them about what is appropriate or inappropriate to share online?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Frequently (4)

Q21 How often do you talk with them about what is appropriate or inappropriate content for them to be viewing online?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Frequently (4)

Q22 How often do you talk with them about what is appropriate or inappropriate behavior in their school, home and social lives?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Frequently (4)

Q23 How often do you talk with them about what is appropriate or inappropriate content for them to be viewing/hearing/reading on TV, music, books or magazines or in other media?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Frequently (4)

Appendix C Interview Guides

ADOLESCENT FOCUS GROUP GUIDE

Use of Social Media and Text Messaging

1. What type of social media apps do you most commonly use?
 - a. Are there others that you use less frequently?
2. When do you use social media on your cell phone (by social media, I mean any apps like Instagram, Snapchat, Facebook etc., but not counting text messages)?
 - a. Are there certain times of day you're more likely to be on social media?
 - b. How much time do you spend in total on social media on an average day?
3. Do you have more than one profile within the same social media account, like having 2 separate Facebook or Instagram accounts?
 - a. If yes, what are your reasons for having different profiles?
4. Typically, what are your reasons for accessing social media, not including messaging applications?
 - a. Which social media platforms do you prefer to use with friends or other peers?
 - b. Which social media platforms do you prefer to use with parents or other family members?
5. What are your reasons for using messaging applications on social media?
6. What are your main reasons for text messaging?
 - a. Do you use messaging applications on social media differently than you would use text messaging? How?
7. When do you use text messaging?
 - a. Are there certain times of day you're more likely to text?
 - b. How much time do you spend sending and receiving text messages in total on a given day?

Monitoring of Social Media and Text Messaging

8. Do your parents monitor what you post on social media?
 - a. What about your text messages?
9. Do you think someone should monitor what you post on social media?
 - a. If yes – why; who would it be ok to monitor?
 - b. If no – why; are there any exceptions to when it would be ok?
10. Do you think someone should monitor what you post on text messages?
 - a. If yes – why; who would it be ok to monitor?
 - b. If no – why; are there any exceptions to when it would be ok?

11. How would you feel about your therapist receiving alerts about your social media and text messaging usage, if it were based on safety concerns, like if you said you had thoughts of killing yourself or if you posted something related to self-injury?
 - a. What if data suggested that, by doing so, we could better prevent suicide?
12. What kind of information are you comfortable sharing with your therapist? Not sharing?
 - a. Do you feel differently toward sharing what you write on social media vs. in text messages?
13. In what ways might it be helpful for your therapist to receive safety alerts based on social media and text messaging data?
14. If your social media and texting usage was monitored, would you be more comfortable having it monitored going backward in time (for example, look at the last 3 months up to today), or have it monitored going forward (over the next 3 months), or does it not matter either way—it could be forward or backward?

PARENT QUALITATIVE INTERVIEW GUIDE

Perceptions of Child's Social Media and Text Messaging

1. What types of social media does your child use?
2. When do they use social media on their cell phone?
 - a. Are there certain times of day your child is more likely to be on social media (by social media, I mean any apps like Instagram, Snapchat, Facebook etc., but not counting text messages)?
 - b. How much time does your child spend in total on social media on an average day?
3. When do they use text messaging on their cell phone?
 - a. Are there certain times of day your child is more likely to text?
 - b. How much time does your child spend in total texting on an average day?
4. From what you know or have observed, what are your child's reasons for accessing social media?
 - a. Is this different than why they would use text messaging?

Monitoring of Social Media and Text Messages

1. Do you think someone should monitor or regulate how your child uses social media?
 - a. What about their text messages?
2. If yes – whose job do you think that is?
 - a. A parent?
 - b. A therapist?
3. Are you monitoring your child's use of social media?
 - a. If so, how are you monitoring?

4. Are you monitoring your child's text messages?
 - a. If so, how are you monitoring?
5. To what extent do you think it would be helpful for your child's therapist to receive alerts about safety risk based on your child's social media & text message data?
6. Is there certain information that therapists should not be able to access?
7. How comfortable are you with your child's therapist receiving alerts based on your child's social media accounts?
8. How comfortable are you with your child's therapist having access to your child's text messages?
9. What would your expectation be of the therapist in terms of communication?

Feasibility of Research

10. How comfortable are you with researchers seeing information your child posts on social media or puts in private messages?
11. How comfortable are you with researchers having access to your child's text messaging data?
12. If you and your child were asked to participate in this study, what do you think would be the advantages of this research?
13. If you and your child were asked to participate in this study, what do you think would be the disadvantages of this research?

Appendix D Initial Draft of the Ecological Momentary Assessment Measure

Screen Question:⁷¹

- 1) How much time did you spend on social media in the past X hours?
- a. 0 hours
 - b. 0.5 hours or under
 - c. Over 0.5 – 1 hour
 - d. Over 1 hours – 1.5 hours
 - e. Over 1.5 – 2 hours
 - f. Over 2 – 2.5 hours
 - g. Over 3 – 4 hours
 - h. Over 4 – 5 hours
 - i. Over 5 hours

Distress Rating:¹⁸⁵

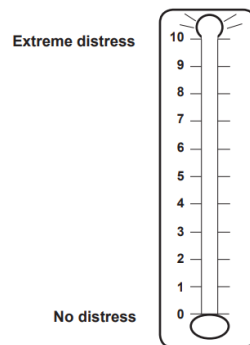
Consider the time that using social media that had the most impact on you, the time you felt either the best or the worst after using social media.

- 2) **Before** using social media, please indicate the number (1-10) that best describes how much distress you experienced.

Extreme distress

10
9
8
7
6
5
4
3
2
1
0
No distress

- 3) **After** I used social media, my distress level was a X out of 10 (with 1 being the lowest/worst distress and 10 being the highest/best distress).



Nighttime-specific Social Media Use¹⁷⁴

- 4) How many minutes did you use social media in the hour before you fell asleep last night?
Response Options: 0, 1-15, 16-30, 31-45, 46-60
- 5) To what extend do you feel social media interfered with your sleep last night?
Response Options: Not at all, Mildly, Moderately, Severely

Social Networking-Peer Experiences Questionnaire (SN-PEQ)¹⁷⁰

- 6) Did you experience any of the following peer interactions on social media?

A peer...

- ☐ I wanted to be friends with on a social networking site (i.e. Facebook or Instagram) ignored my friend request
- ☐ removed me from his/her list of friends on a social networking site
- ☐ made me feel bad by not listing me in his/her "Top Friends" list
- ☐ posted mean things about me on a public portion of a social networking site (SNS)
- ☐ posted pictures of me on a SNS that made me look bad
- ☐ spread rumors about me or revealed secrets I had told them using public posts on a SNS
- ☐ sent me a mean message on a SNS
- ☐ pretended to be me on a SNS and did things to make me look bad/damage my friendships
- ☐ prevented me from joining a group on a SNS that I really wanted to be a part of
- ☐ I found that I was excluded from a party or social event over a SNS (i.e. Facebook or Instagram)
- ☐ I was dating broke up with me using a SNS
- ☐ made me feel jealous by "messaging" with my girlfriend/boyfriend on a SNS (i.e. posting pictures together, writing messages on a Facebook wall, ranking him/her in a "Top Friends List"

Multidimensional Scale of Perceived Social Support¹⁷¹

Please indicate how you felt after your interaction on social media.

Response Options: 1 = Very Strongly Disagree to 7 = Very Strongly Agree

- 7) My friends really try to help me.
 - 8) I can count on my friends when things go wrong.
 - 9) I have friends with whom I can share my joys and sorrows.
 - 10) I can talk about my problems with my friends.
-

Buunk Negative Upward Social Comparison Affect Scale (Adapted)¹⁸⁶

Response Options: 1 = strongly disagree to 5 = strongly agree

- 11) It gave me a pleasant feeling when I saw that SNS friends live better lives than I do myself.
 - 12) It gave me an unpleasant feeling when I saw that SNS friends live better lives than I do myself.
-

Grieve's Facebook Connectedness Scale¹⁸⁷ (adapted for SNS use broadly, 13-item version - #s: 2-8, 10, 12-14, 16, 18, 19)

Please respond to the following based on how you felt following your use of social media?

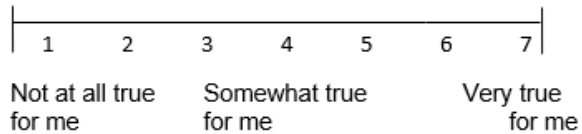
Response Options: 1 = Strongly Disagree to 6 = Strongly Agree

- 13) I am in tune with the social media world
 - 14) Even among my friends on social media, there is no sense of brother/sisterhood
 - 15) I fit in well in new situations on social media.
 - 16) I feel close to people on social media.
 - 17) I feel disconnected from the social media world around me
 - 18) Even around my friends on social media I know, I don't feel that I really belong
 - 19) I see social media friends as friendly and approachable
 - 20) I feel understood by the people I know when I'm on social media
 - 21) I am able to relate to my friends on social media
 - 22) I have little sense of togetherness with my social media friends
 - 23) I find myself actively involved in the lives of my friends on social media
 - 24) I am able to connect with other people on social media
 - 25) I don't feel related to most people on social media
 - 26) My social media friends feel like family
-

Interpersonal Needs Questionnaire (INQ-10):¹⁷⁷

Please answer the following questions based on how you felt after this interaction with social media.

Each question will use this scale:



- 27) The people in my life would be better off if I were gone. *PB*
- 28) The people in my life would be happier without me. *PB*
- 29) I think my death would be a relief to the people in my life. *PB*
- 30) I think the people in my life wished they could get rid of me. *PB*
- 31) I think I make things worse for the people in my life. *PB*
- 32) I feel like I belong. *TB*
- 33) I am fortunate for having many caring and supportive friends. *TB*
- 34) I feel disconnected from other people. *TB*
- 35) I feel like an outsider in social gatherings. *TB*
- 36) I am close to other people. *TB*

(*TB* = *Thwarted Belongingness*; *PB* = *Perceived Burdensomeness*)

Exposure to Triggering Content

37) Did you observe self-harm or suicidal thoughts or behavior on social media? *Please check all that apply.*

- ☐ Yes, I observed self-harm/suicidal content from someone I know.
- ☐ Yes, I observed self-harm/suicidal content from a stranger.
- ☐ Yes, I observed self-harm/suicidal content from another source.
- ☐ No, I did not observe self-harm/suicidal content.

Thank you, you've completed your survey!

If you are feeling unsafe, we are here to help. You can contact the STAR clinic at 412-246-5619. This number answers Monday through Friday between 8:30 a.m. and 5:00 p.m., except for observed holidays. If this is outside of normal business hours, we recommend contacting the Re:Solve Crisis Network, which can be reached 24 hours per day, 365 days per year at 1-888-796-8226. Those outside of Allegheny County can call the National Suicide Prevention Lifeline at 1-800-273-8255.

Appendix E Final Ecological Momentary Assessment Measure

Context Question:

CON1) What were you doing right before receiving this alert? Please check all that apply.

- ☐ Using a social networking site (like Facebook, Twitter, Instagram, or Snapchat)
- ☐ Texting/direct messaging
- ☐ Talking on the phone
- ☐ Video chatting with someone
- ☐ Talking to someone in-person
- ☐ Playing videogames with others
- ☐ Not socializing at the moment
- ☐ Other: socializing in another way that is not listed

Screen Questions:

SCR1) How often did you check social media since <timeframe of signal>?

- e. Almost constantly
- f. A few times
- g. At least once
- h. I haven't checked social media. (*Proceed to No Use Pathway*)

SCR2) Think about the most impactful time you used social media since <timeframe of signal>. How would you describe this social media experience?

- e. It was a positive/supportive experience. (*Proceed with Support Pathway*)
- f. It was a negative/stressful experience. (*Proceed with Stress Pathway*)
- g. It was a somewhat positive and somewhat negative. (*Proceed with SCR 2a*)
- h. I didn't have an impactful experience on social media. (*Proceed to No Use Pathway*)

SCR2a) Would you describe this experience as mostly positive or mostly negative?

- i. Mostly positive/supportive (*Proceed with Support Pathway*)
- j. Mostly negative/stressful (*Proceed with Stress Pathway*)

Sleep Questions (*Only asked once per day*):

SLE1) How many minutes did you use social media in the hour before you fell asleep yesterday?

Response Options: 0, 1-15, 16-30, 31-45, 46-60

SLE2) To what extent do you feel social media interfered with your sleep yesterday?

Response Options: Not at all, Mildly, Moderately, Severely

STRESS PATHWAY

Please answer these questions based on the NEGATIVE/STRESSFUL experience you had on social media.

STR1) Option 1: How did this NEGATIVE/STRESSFUL experience on social media **change** your level of distress?



STR2) During this NEGATIVE/STRESSFUL experience on social media, did you experience any of the following interactions with friends/followers?

A friend/follower...

- ☐ posted mean comments or pictures on social media that made me look bad
- ☐ sent me a mean private message on social media
- ☐ spread rumors about me or revealed my secrets on social media
- ☐ I wanted to be friends with on social media ignored my friend request
- ☐ excluded from a party or social event over social media
- ☐ interacted in another way that was negative that is not listed here
- ☐ None of the above

STR3) During this NEGATIVE/STRESSFUL experience on social media, did you experience any of the following interactions with friends/followers?

A friend/follower...

- ☐ Posted comments about self-harm or suicidal thoughts
- ☐ Posted images about self-harm or suicidal behavior
- ☐ None of the above

STR4) How much do you agree with the following statement about your NEGATIVE/STRESSFUL social media experience?

It made me feel bad when a friend(s) commented in a way that sounded like they have a better life than I do myself.

- ☐ Strongly agree
- ☐ Moderately agree
- ☐ Neither agree nor disagree
- ☐ Moderately disagree
- ☐ Strongly disagree

STR5) How did this NEGATIVE/STRESSFUL experience on social media make you feel?

a) I felt like I didn't belong among my friends/followers on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

b) I felt unfortunate for not having caring and supportive social media friends/followers.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

c) I felt disconnected from other friends/followers on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

d) I felt distant to other people on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

SUPPORTIVE PATHWAY

Please answer these questions based on the POSITIVE/SUPPORTIVE experience you had on social media.

SUP1) How did this POSITIVE/SUPPORTIVE experience on social media **change** your level of distress?

0	10
No change	Improved significantly

SUP2) During this POSITIVE/SUPPORTIVE experience on social media, did you experience any of the following interactions with friends/followers?

A friend/follower posted or messaged me...

- ☐ to show they were really trying to help me
- ☐ to show me I can count on them, even when things go wrong
- ☐ to listen to my joys or sorrows
- ☐ to help me through a problem
- ☐ interacted in another way that was positive that is not listed here
- ☐ None of the above

SUP3) How much do you agree with the following statements about your POSITIVE/SUPPORTIVE social media experience?

It made feel good when a friend(s) commented about their success or happiness, because it sounded like they have a better life than I do myself.

- ☐ Strongly agree
- ☐ Moderately agree
- ☐ Neither agree nor disagree
- ☐ Moderately disagree
- ☐ Strongly disagree

SUP4) How did this POSITIVE/SUPPORTIVE experience on social media make you feel?

a) I felt like I belong among my friends/followers on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

b) I felt fortunate for having caring and supportive social media friends/followers.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

c) I felt connected to other friends/followers on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

d) I felt close to other people on social media.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

NO USE PATHWAY

NOUSCR1) Think about the most impactful offline social interaction you had within <timeframe of signal>. How would you describe this offline social experience?

*Note: This includes talking to someone in-person or over the phone, not talking via text or social media.

- a. It was a positive/supportive experience. *(Proceed with Offline Support Pathway)*
- b. It was a negative/stressful experience. *(Proceed with Offline Stress Pathway)*
- c. It was a somewhat positive and somewhat negative. *(Proceed with NOUSCR1a)*
- d. I didn't have an impactful offline social experience. *(Proceed to End of Survey)*

- NOUSCR1a) Would you describe this experience as mostly positive or mostly negative?
- Mostly positive/supportive (*Proceed with Offline Support Pathway*)
 - Mostly negative/stressful (*Proceed with Offline Stress Pathway*)

OFFLINE STRESS PATHWAY

Please answer these questions based on your NEGATIVE/STRESSFUL offline social interaction.

NOUSTR1) How did this NEGATIVE/STRESSFUL experience on social media **change** your level of distress?



NOUSTR2) During this NEGATIVE/STRESSFUL offline social interaction, did you experience any of the following with other teens?

A teen...

- ☐ Threatened to hurt me or beat me up
- ☐ Did not invite me to a party or other social event even though they knew I wanted to go
- ☐ Spread rumors about me or revealed secrets I told them
- ☐ Said mean things about me so that people would think I was a loser
- ☐ Interacted in another way that was negative that is not listed here
- ☐ None of the above

NOUSTR3) How much do you agree with the following statements about to your NEGATIVE/STRESSFUL offline social experience?

It made me feel bad when I saw that a friend(s) was living a better life than I do myself.

- ☐ Strongly agree
- ☐ Moderately agree
- ☐ Neither agree nor disagree
- ☐ Moderately disagree
- ☐ Strongly disagree

NOUSTR4) How did this NEGATIVE/STRESSFUL offline social experience make you feel?

a) I felt like I didn't belong.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

b) I felt unfortunate for not having any caring or supportive friends.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

c) I felt disconnected from other people.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

d) I felt distant from other people.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

OFFLINE SUPPORT PATHWAY

Please answer these questions based on your POSITIVE/SUPPORTIVE offline social interaction.

NOUSUP1) How did this POSITIVE/SUPPORTIVE experience on social media **change** your level of distress?

0	10
No change	Improved significantly

NOUSUP2) During this POSITIVE/SUPPORTIVE offline social interaction, did you experience any of the following with friends?

A friend ...

- ☐ showed they were really trying to help me
- ☐ showed me I can count on them, even when things go wrong
- ☐ listened to my joys or sorrows
- ☐ helped me through a problem
- ☐ interacted in another way that was positive that is not listed here
- ☐ None of the above

NOUSUP3) How much do you agree with the following statements about to your POSITIVE/SUPPORTIVE offline social experience?

It made feel good when I saw a friend(s)' success or happiness, because it sounded like they have a better life than I do myself.

- ☐ Strongly agree
- ☐ Moderately agree
- ☐ Neither agree nor disagree
- ☐ Moderately disagree
- ☐ Strongly disagree

NOUSUP4) How did this POSITIVE/SUPPORTIVE offline social experience make you feel?

a) I felt like I belong.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

b) I felt fortunate for having caring and supportive friends.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

c) I felt connected to other people.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

d) I felt close to other people.

1	2	3	4	5	6	7
Not at all true for me		Somewhat true for me			Very true for me	

Thank you, you've completed your survey!

If you are feeling unsafe, we are here to help. You can contact the STAR clinic at 412-246-5619. This number answers Monday through Friday between 8:30 a.m. and 5:00 p.m., except for observed holidays. If this is outside of normal business hours, we recommend contacting a 24-hour crisis hotline. The Re:Solve Crisis Network services Allegheny County and can be reached 24 hours per day, 365 days per year at 1-888-796-8226. Those outside of Allegheny County can call the National Suicide Prevention Lifeline at 1-800-273-8255, or alternatively contact the Crisis Text Line by texting CONNECT to 741741.

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