

SOCIAL MEDIA AND YOUTH SUICIDE: A SYSTEMATIC REVIEW

Research paper

Channarong Intahchomphoo, TIK Centre for Technology, Innovation and Culture, University of Oslo, Norway, channari@tik.uio.no / Electronic Business Technologies, University of Ottawa, Canada, cinta088@uottawa.ca

Abstract

This paper examines peer-reviewed publications studying the links between social media and youth suicide. For this systematic review, papers were collected from three academic databases: Scopus, Web of Science, and PsycINFO. From 495 papers reviewed, 82 were included in the initial review. In addition, a second search of the ScienceDirect database yielded 15 studies. From these 97 papers, the findings indicate that there are two major links between social media and youth suicide: (1) the positive link, which is mainly about youth suicide prevention including detecting youth at risk of suicide with their social media posts, running youth suicide prevention awareness campaigns, and offering consultations to youth with suicide ideation via social media; and (2) the negative link, which focuses on how social media is used as a tool to encourage and pressure youth towards suicide including cyberbullying, sexting, and disseminating information about self-harm techniques or pro-suicide content on social media. This research demonstrates that social media has both positive and negative links to youth suicide. We make suggestions for future information systems research.

Keywords: Social media, youth suicide, systematic review

1. Introduction

The past decade has seen a significant increase in the use of social media platforms such as Facebook, Twitter, and YouTube, coinciding with the global adoption of such media as a form of entertainment and social interaction. Social media platforms have increasingly been integrated into many aspects of peoples' daily activities, as a result of the ubiquity of applications on mobile devices (Mihailidis, 2014). People have also turned to social media to disseminate information about their mental health (McClellan, Ali, Mutter, Kroutil, and Landwehr, 2017). However, many personal wellbeing posts contain disturbing suicidal messages, particularly the ones being generated and shared by youth.

UNESCO (2016) defines youth as the population group ranging from 15 to 35 years of age. Youth, according to that definition, are the most at risk age group of committing suicide in populations across societies and cultures (World Health Organization, 2017). Transitioning through this stage of life requires young people to cope with changes in hormones, physical state, mood, and social behaviour in their exploration of identity and quest for autonomy. Some groups of young people face higher risks of suicide as they have to deal with all of those transitional challenges as well as dealing with other challenges such as a broken family, intimate relationship break-up, poverty, sexual abuse, and vulnerability. This review addresses suicide as well as suicide attempts.

We focus on the social media and youth suicide combination because of the high and increasing worldwide usages of social media. Adolescent suicide is also a worldwide challenge that many countries and cultures are currently facing. In our recent research conducted with urban indigenous youth in Ontario, Canada, we found that Facebook was used as a tool by some indigenous teenagers to live stream their suicide attempts (Intahchomphoo, Vellino, and Gundersen, under review).

There is currently no systematic review documenting a focus on information systems academic literature to find links between social media and youth suicide. In recent years, researchers have conducted general and systematic literature reviews on text mining applications in psychiatry (Abbe, Grouin, Zweigenbaum, and Falissard, 2016), using technology to deliver mental health service to children and youth (Boydell et al., 2014), social media and public health practice (Capurro, et al., 2014), social media usage to discuss and view self-harm acts (Dyson et al., 2016), ethno-cultural aspects of suicide in young people (Colucci and Martin, 2007), media roles in suicide prevention (Sisask and Värnik, 2012), prevalence and effect of cyberbullying on children and youth (Hamm et al, 2015), social media use among patients and caregivers (Hamm et al, 2013), social media and youth violence (Patton et al., 2014), suicide prevention via the internet (Jacob, N., Scourfield, J., and Evans, R., 2014), social media and suicide prevention (Robinson et al., 2016), and suicide prevention strategies (Zalsman et al., 2016). Thus, it is important to develop an understanding in this specific area of social media and youth suicide and address a research gap.

2. Methods

The purpose of the review is to establish the current state of knowledge in the academically indexed literature on the roles that social media plays in the youth suicide. We chose the systematic literature review method because it is transparent, reproducible and limits personal bias. This literature review method has its origins in the Cochrane systematic review method in the medical field (Cochrane Training, 2017). This method was designed for evaluating and interpreting literature on evidence-based human health care and has since been applied to other disciplines. Each of the main steps in such a review has to be clearly identified and explained. The method requires that specific literature review question(s) be formulated at an early stage of the process (Kitchenham, 2007). The review question provides the criteria for the scope of literature content and determines how the included studies will be examined, coded, and reported. This systematic review was conducted in the summer and fall of 2017 and revised with feedback from reviewers in the spring 2018. We formulated the following review question: "What are the links between social media and youth suicide?"

2.1 Data sources and search strings

For this systematic review, we collected papers from three academic databases: Scopus, Web of Science, and PsycINFO. We performed full-text searches in these databases on the same day using the same search strings.¹ We conducted the search as a full-text search rather than limiting it to metadata fields such as the title, keywords and abstract. Searching for the full-text has the advantage that any document containing the search terms will be retrieved, thus not missing a potentially relevant study; i.e. it maximizes recall. The disadvantage is a loss in precision: some documents may be retrieved that contain the keywords but occur in the full-text incidentally and are not directly relevant to the research question (Manning, Raghavan, and Schütze, 2008). The increased recall thus required a human filtering process to eliminate irrelevant papers in which search terms were merely mentioned.

The search expression was designed around two main concepts: “social media” and “youth suicide”. The first concept, “social media”, is also referred to as “social networking” and includes popular tools such as Facebook, Twitter, and YouTube. Even though the terms “social networking” and “social media” are often used interchangeably, especially in non-academic contexts, each has its own distinct definition. Social media refers to Web 2.0 functionalities relating to user generated content (Obar and Wildman, 2015), and social networking is about how people use social media tools to communicate and engage with other users to build online communities (Subrahmanyam, Reich, Waechter, and Espinoza, 2008). There are various types of social media including social networks, micro-blogging, online forums, online bookmarking, wikis, social news, and media sharing (Farzindar and Inkpen, 2015). The second concept, “youth suicide” is also referred to as “teen suicide”, “teenage suicide”, and “adolescent suicide”.

2.2 Selection criteria

The criteria for selecting the primary studies to be included in the sample and subsequently analysed included:

Type of publication: The studies must have been published in peer-reviewed journals. The content also had to be available in full-text. The criteria of peer-review offers some level of quality control, as does the fact that they are indexed in Scopus, Web of Science, PsycINFO, and ScienceDirect. The availability of publications in full-text guarantees that the indexing and retrieval process covers all the terms in the articles, not just in the metadata fields. In addition, literature review papers are not included because their selected studies would overlap with our search results.

Date of publication: The studies must have been published between January 2004 and December 2016. The date of publication constraint is based on the fact that Twitter started in 2006, YouTube in 2005, and Facebook in 2004. Twitter and Facebook are of particular importance as they are the most widely used international social media tools. The year 2016 is the last completed year before this review began.

Relevance to the review question: The studies must be relevant to the review question. Queries in a search engine only retrieve documents that contain the search terms and the presence of a term or even a combination of terms is not a sufficient condition for the relevance of the study to the research question. It could be that the terms occurred, for example, only in the bibliography of a study and not in the study itself.

Relevance assessment: This is completed by reading the article. Papers included could cover all possible studies related to social media and youth suicide, including those on how social media features have caused youth suicide and papers investigating social media usage among youth preceding suicide.

Language: The studies must have been written in English.

¹ (“social media” OR “social networking” OR Facebook OR Twitter OR YouTube) AND (“youth suicide” OR “teen suicide” OR “teenage suicide” OR “adolescent suicide”), performed on August 22, 2017

Subject: Studies could come from any academic discipline so there is no constraint in this area. The absence of disciplinary constraints ensured that the search expression would retrieve as many relevant articles as possible (maximum recall). Furthermore, academic discipline need not be restricted as research on this question spans multiple disciplines.

Duplicates: If the searches on Scopus, Web of Science, PsycINFO, and ScienceDirect produced duplicate results only one occurrence of the document would be counted.

2.3 Included and excluded studies

This is a summary of the search results and the number of studies that met the review criteria. We found 495 papers matching the search criteria. We reviewed the studies with 419 results matching the search string in Scopus being reduced to 202. It was because there were 217 results in the irrelevant type of publication, written in the wrong language and time period. In Web of Science, 10 results matching the search string were reduced to 1. This was because there were 8 duplicated studies as they already presented in the SCOPUS search results in this review and 1 study in the wrong type of publication. 66 results matching the search string in PsycINFO were reduced to 65. This was due to 1 study being duplicated within the PsycINFO research results. No duplicated studies were found with the SCOPUS and Web of Science search results.

After completing a review of all the retrieved studies, there are 82 studies addressing our review question. The publication years of the included studies shown in the timeline (Figure 1) indicates that there was a gradual increase in the number of studies relating to the social media and youth suicide between 2008 and 2015 with a spike in publications in 2016. Relevance to the review question was determined by reading the article. Examples of categories of irrelevant articles from the 186 studies that were eliminated include: traditional media and suicide coverage; physician education on adolescent suicide prevention; youth suicide and family environment; suicide attempts among children; youth suicide and barriers to access to mental health treatment; suicide association with video game and Internet overuse; adolescent smoking; adolescent alcohol abuse; follow-up study after youth suicide attempt; adolescent sleep efficiency; Facebook and stress management among medical students; the role of culture in youth suicide prevention; youth suicide effects of parents, peers, and school; how to cope with youth suicide incidents; and the impact of parental suicide on child and youth.

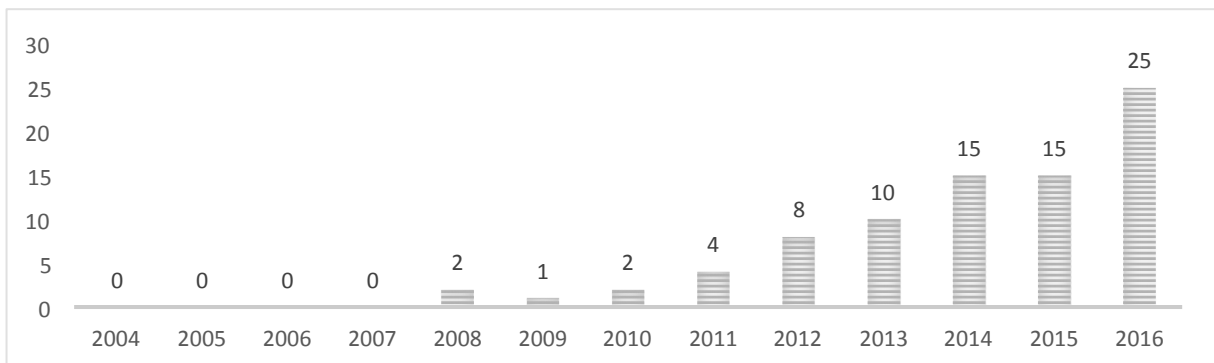


Figure 1: Publication Years Timeline of Studies Answering to Our Review Question

Supplementary Search

Following reviewer feedback we conducted a second search in the ScienceDirect database on April 3, 2018 using the same search strings and selection criteria, this new search yielded 15 studies that provide corroborating evidence to support the findings in the 82 main studies from the first search. Many studies retrieved from the second search were mostly from the psychology discipline and they did contain the keyword of social network. However, those studies referred and discussed about the social network as a face-to-face human relationship concept mainly happening among friends and

family. They were not about social media tools like Facebook or Twitter at all. Therefore, those retrieved studies did not qualify to be selected for this review.

3. Results

We read all the articles and listed all the themes and then clustered them together according to thematic similarity. The method for identifying themes was driven by a top down thematic analysis. The findings indicate that there are two major links between social media and youth suicide: (1) the positive link, which is mainly about youth suicide prevention; and (2) the negative link, which focuses on how social media is used as a tool to encourage and pressure youth toward suicide.

3.1 Positive link

The positive links between social media and youth suicide include: (1) detecting youth at risk of suicide with their social media posts; (2) running youth suicide prevention awareness campaigns on social media; and (3) offering online consultations to youth with suicide ideation via social media. These three categories based on patterns identified through thematic analysis.

In our sample, 18 papers identified detecting youth at risk of suicide through their social media posts. Social media gives an opportunity to quickly detect teenage suicidal tendencies in real time and it can be done on a large scale (Robert, Suelves, Armayones, and Ashley, 2015). Youth nowadays often express suicidal thoughts on social media before talking face-to-face to friends, family members, or healthcare professionals about their mental health issues. They are always connected through the Internet and social media. Social media has become a powerful monitoring tool for suicide among youth especially when data mining technology, artificial intelligence, and machine learning algorithms are applied (Goh, and Huang, 2009; Bushman et al., 2016; Nguyen, Phung, Dao, Venkatesh, and Berk, 2014).

Chen, Chai, Zhang, and Wang (2014) presented their development of a data mining system to understand teen suicide trends in China using data from Chinese webpages and blogs. Their system was programmed to produce a set of indicators to report suicide events. Similar studies (Li, Chau, Yip, and Wong, 2014; Cheng, Kwok, Zhu, Guan, and Yip, 2015) look at the language patterns and blog posting frequency to predict signs of suicidal processes among Chinese youth. Furthermore, other researchers created a suicide dictionary to detect, in real-time, suicide risks among Chinese-speaking youth on Weibo, China's largest micro-blogging site. These dictionary-based identifications are expected to be very useful for the development of suicide monitoring applications (Lv, Li, Liu, and Zhu, 2015). Another data mining research paper in our sample (Song, Song, Seo, and Jin, 2016) was conducted with social media posts of Korean adolescents. They found suicide-related words such as depression, victims of bullying, concern about illness, and financial hardship in the dataset.

Twitter was frequently discussed in our sample. Twitter was tested to be an effective surveillance tool for tracking the risk factors of youth suicide by identifying and analysing keywords and phrases from young peoples' tweets (Jashinsky et al., 2014). Youth in Japan also post their suicide ideation on Twitter. Their Twitter logs could be used to identify youth in danger of self-injury (Sueki, 2015). Facebook was also frequently mentioned in our sample. Facebook was found to be extremely helpful for youth with suicidal thoughts to be able to recognize their own mental health conditions. It helps them to agree to receive psychiatric and medical treatment. (Ahuja, Biesaga, Sudak, Draper, and Womble, 2014; Moreno et al., 2011; Moreno et al., 2012). In 2011, Facebook launched a tool for people to report suicidal content. Users can report if they see their Facebook friends have posted suicidal messages. This Facebook feature was designed to identify people with self-harm potential. Facebook will link the person with suicide prevention hotlines (Bell, 2014). In our sample, there are some Facebook studies focusing on university students. College students could notice and recognize the suicidal content of their peers' posts on Facebook. They intervened by calling or having a face-to-face conversation with friends who posted suicidal content on social media (Corbitt-Hall, Gauthier, Davis, and Witte, 2016; Egan, Koff, and Moreno, 2013) or report to the school staff (Michael et al., 2015). In this situation, Facebook is utilized for helping youth to combat with stigma associated with

mental health issues. Usually, suicidal thoughts are kept privately. Social media has completely changed how youth communicate to other people about their suicide attempts (Moreno et al., 2011).

In our sample, 20 papers identified running youth suicide prevention awareness campaigns on social media. Positive usages of social media could help to prevent youth suicide. Social media can facilitate peer support to youth with suicidal thoughts, and promote suicide prevention programs and awareness to reach a wider audience (Luxton, June, and Fairall, 2012; Sleet et al., 2012). Research by Jordan et al. (2012) shows that young men with suicidal ideation felt there should be more proactive outreach and campaigns on social media to encourage youth to access mental health care because social media is very heavily used among youth. Wyman (2014) further suggested researchers and communities should use social media to determine which adolescent suicide interventions effectively reach at-risk youth the most.

Several research papers in our sample focus on suicide prevention awareness campaigns specifically for lesbian, gay, bisexual, transgendered, and queer (LGBTQ) youth. As LGBTQ youth worldwide experience and suffer from homophobic abuses and distress related to their gender identity, they face higher rates of suicide. Social media helps to reach LGBTG youth at risk. Historically, this population has been quite difficult to reach (Silenzio et al., 2009). A study by McDermott, Roen, and Piel (2013) shows that online discussion forums become a place where many LGBTQ youth discuss their suicide attempts. The emotional data posted on the online forums could help to develop suicide prevention strategies and campaigns. For example, the “*It Gets Better*” project, a very successful LGBTQ youth suicide prevention campaign on YouTube, aims to create strong online communities to give hope and virtually engage with LGBTQ youth worldwide by informing them that their difficult situations will improve (Muller, 2012; Goltz, 2013). The campaign started in 2010 on YouTube and later extended to other social media platforms including Facebook, Google+, Instagram, Tumblr, and Twitter (Honda, 2016). The campaign encourages activists, politicians, celebrities, and people in general to make anti-bullying videos and post them on YouTube to show their support and offer hope to LGBTQ youth (Grzanka, and Mann, 2014). Many activists who self-identify their sex as straight also got involved in the “*It Gets Better*” campaign because they recognize how serious the LGBTQ youth suicide crisis is worldwide (Grzanka, Adler, and Blazer, 2015).

Another way of promoting youth suicide prevention awareness campaigns on social media is through online obituary or mourning pages. Parents, siblings, children, partners, and family friends posted on social media giving their memorial feelings and grief related to their deceased youth who died by suicide. Online obituaries on social media also help other young people who are seeking peer support after losing their friends to suicide (Krysinska, and Andriessen, 2015; Ferreday, 2010). A study by Hacker, Collins, Gross-Young, Almeida, and Burke, (2008) states that between the years 2000 and 2005, the city of Somerville of Massachusetts experienced a wave of suicides spreading among the local youth. Many of them were coping with substance abuse and overdoses as well. Various friends of the youth suicide victims posted obituary videos on YouTube to pay their respects to and express memories of those lost. The YouTube videos helped the city to determine the youth suicide contagion and identify individuals at risk. Other research by Cox et al. (2016) recommends that schools post memorial pages on social media when their students have committed suicide and one necessarily passes away when committing suicide. This is a way to raise awareness about the youth suicide crisis and to monitor for and identify individual at risk.

Moreover, some youth suicide prevention awareness campaigns on social media in our sample are being researched in school and university settings. High schools in Australia run suicide prevention campaigns to promote help-seeking intentions for youth with suicide ideas. A group of student leaders was asked to create positive messages on their Facebook pages and share them with other students. Their Facebook messages are about how the adult support staff at schools can be trusted for mental health advice. The campaign aims to prevent and act as a means of early intervention for youth suicide (Calea et al., 2016). In a similar study (Camelford, and Ebrahim, 2016), high school students were asked to watch YouTube videos about cyberbullying experiences and then participate in role-playing based on the cyberbullying situations. This educational activity aims to increase empathy from

students toward cyberbullying victims and reduce cyberbullying intentions. Other schools also used YouTube similarly for their bullying prevention and awareness campaigns. They showed video clips of the actual students who were the victim of bullying sharing their horrible experiences. These YouTube videos help teachers and students to start group discussions in the classroom about bullying-related topics (Ziomek-Daigle and Land, 2016; Doane, Kelley, and Pearson, 2016). At the university level, social media has become a main channel to disseminate and inform students about suicide prevention programs available at their universities (Manning, and Van Deusen, 2011).

In our sample, 11 papers identified offering online consultations on social media to youth attempting suicide. The utilization and awareness of youth crisis hotlines remain low. Many youth at risk of suicide prefer to seek help and information on the Internet including social media (Crosby Budinger, Cwik, and Riddle, 2015; Best, Manktelow, and Taylor, 2016). Online suicide discussion forums have been demonstrated to be somewhat beneficial for youth with suicidal thinking. The anonymous discussion of suicide helps youth who are forum readers or members to gain more support and they do not have to disclose their identity. On the discussion forums, youth who have overcome their mental health challenges share their experiences to inspire other youth. Importantly, the information on the forums can be accessed and is available anytime through the Internet (Wiggins, McQuade, and Rasmussen, 2016; Robert, Suelves, Armayones, and Ashley, 2015; Frost, Casey, and Rando, 2016). It is recommended that clinicians and therapists use online forums to establish a professional relationship with mental health patients (Scherr, and Reinemann, 2016). Social media-based mental health interventions could be done in various forms such as giving closed group online consulting as well. A study by Carson, Farrelly, Frazer, and Borthwick (2015) provides a good example of indigenous communities in Australia. Communities use Facebook to offer help to youth at risk of committing suicide by giving emotional support and guidance on how to access the available mental health services. As described above, social media helps to construct a sense of belonging, peer support, and positive relationships during social isolation among youth at risk of suicide (Rice et al., 2016; Tseng, and Yang, 2015). Gay youth at risk for suicide also felt social media allowed them to be a part of online communities while they were seeking encouragement and support (Davis, Stafford, and Pullig, 2014). Brooks and Longstreet (2015) point out that youth with depression also felt they lose track of time when using social media. They do not have to think about their psychological problems.

3.2 Negative link

Negative links between social media and youth suicide were also found. It relates to how social media is used to encourage and pressure youth toward suicide including cyberbullying, sexting, and disseminating information about self-harm techniques and pro-suicide content on social media.

In our sample, 27 papers identified cyberbullying. Cyberbullying through social media has caused several youth suicides. It involves sending or posting harmful and hurtful messages, pictures, and videos by one person or group of people, targeting the adolescent victims (Alvarez, 2012; Bhat, 2008; Chapin, 2016; Crosslin, and Golman, 2014; Doane, Boothe, Pearson, and Kelley, 2016; Eden, Heiman, and Olenik-Shemesh, 2013; Jane, 2015; King, 2010; Messias, Kindrick, & Castro, 2014; Rafiq et al., 2016; Sampasa-Kanyinga and Hamilton, 2015; Stoll, and Block, 2015; Luxton, June, and Fairall, 2012; Arango, Opperman, Gipson, and King, 2016; Hemphill et al., 2012). Personality disorders and jealousy in close relationships are found to be factors associated with the cyberbullying among young people (Stockdale, Coyne, Nelson, and Erickson, 2015). Furthermore, a metadata and content analysis of videos on Vine, a video-based social network, detected a number of videos that exhibited cyberbullying threats to young people (Rafiq et al., 2016). Female youth reported to be perpetrators and victims of cyberbullying more than male counterparts (Messias, Kindrick, & Castro, 2014; Rice et al., 2015). One such example occurred in Canada, resulting in the suicide of Amanda Todd, a Canadian youth who was blackmailed to show her breasts on a live webcam to an unknown person. Her body screenshots were later shared on social media. Many of her classmates then saw the photos. Before killing herself, Miss Todd posted a video on YouTube explaining her blackmail experience. She referred it as a cyberbullying action (Penney, 2016). In the United States, LGBTQ students often reported to be the victims of cyberbullying (Rice et al., 2015). An instance of LGBTQ cyberbullying

leading to suicide was that of Tyler Clementi, who jumped from the George Washington Bridge in 2010 after his roommate used a webcam to watch Clementi kissing another man and tweeted about it on Twitter. The incident brought national attention to the issue of cyberbullying on social media towards gay teens (Gilden, 2013; Corbo and Zweifel, 2013; Davis, Stafford, and Pullig, 2014). In many cases, cyberbullying found to be linked to the victims' race, gender, and sexual orientation (Stoll, and Block, 2015).

Often, the perpetrators of cyberbullying remain anonymous (Bharwaney, and Marwah, 2013) and not many young people inform their parents, guardians, or teachers about the cyberbullying they have encountered. Often, they do not seek help. They try to cope with cyberbullying by themselves (Chapin, 2016; Crosslin, and Golman, 2014; King, 2010). Youth protect themselves from cyberbullying on Facebook by deleting or blocking abusive social media users. Furthermore, some of them decided to quit using Facebook (Chapin, 2014). Teachers are very concerned about cyberbullying on social media happening to their students. Every school should have coping strategies for cyberbullying in place for their students and parents (Eden, Heiman, and Olenik-Shemesh, 2013). Cyberbullying among college students adds more risk of dropping out of college and skipping classes. Their learning is negatively impacted as the victims of cyberbullying are fearful and feel they are being targeted both online and offline (Gibb, and Devereux, 2014). In the United States, they had to enforce new legislation for schools to patrol and prevent cyberbullying on social media from happening to their students. There is a new duty to protect students and prevent any further youth suicides related to cyberbullying. Legislators, parents, and schools have to collectively work together to combat cyberbullying (Fenn, 2013; King, 2010; Marlin-Bennett and Thornton, 2012). Social media platforms such as Yelp, Facebook, and YouTube address the anti-cyberbullying reflected in their corporate values and terms of services to prohibit their platform usage for any hate speech, which may contribute to teenage suicide (DeNardis and Hackl, 2015).

In our sample, 7 papers identified sexting on social media, the sending and receiving of texts with sexual or nude images, or short videos. Sexting both receiving and sending among youth increases the risk of suicide, as it is associated with shame, humiliation, depression, and harassment that affect the person whose body images were taken and distributed (Ahern, and Mechling, 2013; Bailey, and Hanna, 2011). Sexting is found to be the most common method of harassment among youth who just ended violent dating relationships (Alvarez, 2012; Strassberg, Rullo, and Mackaronis, 2014). Girls are more often sexting victims than boys. After the breakup of romantic relationships, some youth use social media such as Facebook to track their ex-partners' new partnerships and other personal activities. Feelings of jealousy, potential cheating, and overprotectiveness on social media also initiate the first stage of abusive relationships, breakups, and suicidal ideation among many teens (Baker, Helm, Bifulco, and Chung-Do, 2015). These monitoring behaviours on social media also increase the risk of young people taking their own lives (Lee, and O'Sullivan, 2014). Youth sexting via social media is the distribution of images without the victim's consent and authorization. From a legal standpoint, both redistributors and viewers with involvement in such unconsented youth sexting should be prosecuted for child pornography offences (Bailey, and Hanna, 2011; Strassberg, McKinnon, Sustaíta, and Rullo, 2013).

Within our sample, 24 papers identified disseminating information about self-harm techniques and pro-suicide content on social media. Youth who are exposed to suicide-encouraging content on social media are more likely to think about killing themselves. YouTube self-harm videos are visually graphic while content on Facebook and MySpace was found to be more of group discussions related to suicide attempts (Mitchell, Wells, Priebe, and Ybarra, 2014). A study by Luxton, June, and Fairall (2012) indicates that self-harm videos are not difficult to find on YouTube. Some youth broadcast their suicidal thoughts and intentions on social media (Cash, Thelwall, Peck, Ferrell, and Bridge, 2013; Herbst, Stanley, and Byard, 2014; Karbeyaz, Toygar, and Çelikel, 2016; Klein, 2012; Ma, Zhang, Harris, Chen, and Xu, 2016). It is difficult to know what type of information youth with suicidal intentions will find on social media (Tseng and Yang, 2015). This is a real threat for organizations working to provide crisis assistance and suicide interventions to youth via social media

(Robert, Suelves, Armayones, and Ashley, 2015). In addition, online discussion forums are sometimes found to be the dark online communities among youth who try to encourage others to commit suicide as groups or in suicide pacts. Youth also exchange information concerning suicide methods on some of these forums. They try to recruit people to join their online discussion forum boards. This is very dangerous for youth who are already in vulnerable situations (Bell, 2014; Dunlop, More, and Romer, 2011; Klein, 2012; Luxton, June, and Fairall, 2012; Robert, Suelves, Armayones, and Ashley, 2015; Scherr, and Reinemann, 2016; Kølves and Leo, 2016). Between 2007 and 2014, researchers found there was a dramatic increase in the number of blogs and discussion forums that provide information about methods of suicide (Biddle et al., 2016).

A study by Oksanen et al. (2016) shows that American, British, German, and Finnish youth are often exposed to suicide content on social media. It was found that exposure to physically and psychologically harmful content leads to a higher risk of suicidal thoughts among the youth. A similar study suggests that among runaway and homeless youth, when interacting on social media with other runaway and homeless youth who are coping with thoughts of suicide, their own risk of suicide also increases (Fulginiti, Rice, Hsu, Rhoades, and Winetrobe, 2016). When social media becomes a source of suicide information, youth will be likely to have the misperception of peer suicide behaviour. Social media is forming a suicide contagion among some youth (Robertson, Skegg, Poore, Williams, and Taylor, 2012; Sawyer et al., 2012; Zimmerman, Rees, Posick, and Zimmerman, 2016; Colombo, Burnap, Hodorog, and Scourfield, 2016, Varghese and Gray, 2011). In another scenario, youth with suicidal ideation use social media to seek to build relationships with people online in order to combat their own social isolation. It does not help when they learn that other people's lives are much happier than theirs. Such a perception actually leads higher risks of suicide for them (Singleton, Abeles, and Smith, 2016). Brooks, and Longstreet (2015) conclude that when young people spend more time on Facebook, they become more exposed to more emotional messages. These messages could lead to the accumulation of bad feelings and the increase in levels of depression and suicide. Related research by Phillips (2014) remarks that social media enhances the way people communicate and connect, but it still does not decrease loneliness for some people. Social isolation and misleading information are not good for youth, particularly those coping with mental and psychiatric disorders.

4. Discussion and Suggestions for Information Systems Future Research

The table below shows the categorization of the papers included in the systematic literature review grouped by subject. To perform the relevance assessment each study is rated as pointing out the positive or negative aspects of the subject discussed. If the study entirely covered the aspects of the subject the score equals to 2, and if it partially covers it then it equals to 1.

<i>Author, Year</i>	<i>Relevance Score</i>	<i>Author, Year</i>	<i>Relevance Score</i>
Detecting youth at risk of suicide		Doane, Boothe, Pearson, and Kelley, 2016	2
Robert, Suelves, Armayones, and Ashley, 2015	2	Eden, Heiman, and Olenik-Shemesh, 2013	1
Goh, and Huang, 2009	2	Jane, 2015	1
Bushman et al., 2016	1	King, 2010	2
Nguyen, Phung, Dao, Venkatesh, and Berk, 2014	2	Messias, Kindrick, & Castro, 2014	2
Chen, Chai, Zhang, and Wang, 2014	2	Rafiq et al., 2016	2
Li, Chau, Yip, and Wong, 2014	2	Sampasa-Kanyinga and Hamilton, 2015	2
Cheng, Kwok, Zhu, Guan, and Yip, 2015	2	Stoll, and Block, 2015	2
Lv, Li, Liu, and Zhu, 2015	2	Luxton, June, and Fairall, 2012	2

Song, Song, Seo, and Jin, 2016	2	Arango, Opperman, Gipson, and King, 2016	2
Jashinsky et al., 2014	2	Hemphill et al., 2012	2
Sueki, 2015	2	Stockdale, Coyne, Nelson, and Erickson, 2015	2
Ahuja, Biesaga, Sudak, Draper, and Womble, 2014	2	Rice et al., 2015	2
Moreno et al., 2011	2	Penney, 2016	2
Moreno et al., 2012	2	Gilden, 2013	1
Bell, 2014	2	Corbo and Zweifel, 2013	2
Corbitt-Hall, Gauthier, Davis, and Witte, 2016	2	Davis, Stafford, and Pullig, 2014	2
Egan, Koff, and Moreno, 2013	2	Bharwaney, and Marwah, 2013	1
Michael et al., 2015	1	Chapin, 2014	2
Running youth suicide prevention awareness campaigns		Gibb, and Devereux, 2014	2
Luxton, June, and Fairall, 2012	2	Fenn, 2013	1
Sleet et al., 2012	2	Marlin-Bennett and Thornton, 2012	1
Jordan et al., 2012	1	DeNardis and Hackl, 2015	1
Wyman, 2014	2	Sexting	
Silenzio et al., 2009	2	Ahern, and Mechling, 2013	2
McDermott, Roen, and Piela, 2013	1	Bailey, and Hanna, 2011	2
Muller, 2012	2	Alvarez, 2012	2
Goltz, 2013	2	Strassberg, Rullo, and Mackaronis, 2014	2
Honda, 2016	2	Baker, Helm, Bifulco, and Chung-Do, 2015	1
Grzanka, and Mann, 2014	2	Lee, and O'Sullivan, 2014	2
Grzanka, Adler, and Blazer, 2015	2	Strassberg, McKinnon, Sustaíta, and Rullo, 2013	2
Krysinska, and Andriessen, 2015	2	Disseminating information about self-harm techniques and pro-suicide content	
Ferreday, 2010	2	Mitchell, Wells, Priebe, and Ybarra, 2014	2
Hacker, Collins, Gross-Young, Almeida, and Burke, 2008	2	Luxton, June, and Fairall, 2012	2
Cox et al., 2016	2	Cash, Thelwall, Peck, Ferrell, and Bridge, 2013	2
Calear et al., 2016	2	Herbst, Stanley, and Byard, 2014	1
Camelford, and Ebrahim, 2016	2	Karbeyaz, Toygar, and Çelikel, 2016	1
Ziomek-Daigle and Land, 2016	2	Klein, 2012	2
Doane, Kelley, and Pearson, 2016	2	Ma, Zhang, Harris, Chen, and Xu, 2016	2
Manning, and Van Deusen, 2011	2	Tseng and Yang, 2015	2
Offering online consultations		Robert, Suelves, Armayones, and Ashley, 2015	2
Crosby Budinger, Cwik, and Riddle, 2015	2	Bell, 2014	2
Best, Manktelow, and Taylor, 2016	2	Dunlop, More, and Romer, 2011	2
Wiggins, McQuade, and Rasmussen, 2016	2	Scherr, and Reinemann, 2016	2

Robert, Suelves, Armayones, and Ashley, 2015	2	Kölves and Leo, 2016	2
Frost, Casey, and Rando, 2016	2	Biddle et al., 2016	2
Scherr, and Reinemann, 2016	2	Oksanen et al., 2016	2
Carson, Farrelly, Frazer, and Borthwick, 2015	2	Fulginiti, Rice, Hsu, Rhoades, and Winetrobe, 2016	2
Rice et al., 2016	2	Robertson, Skegg, Poore, Williams, and Taylor, 2012	2
Tseng, and Yang, 2015	2	Sawyer et al., 2012	1
Davis, Stafford, and Pullig, 2014	2	Zimmerman, Rees, Posick, and Zimmerman, 2016	2
Brooks and Longstreet, 2015	2	Colombo, Burnap, Hodorog, and Scourfield, 2016	2
Cyberbullying		Varghese and Gray, 2011	1
Alvarez, 2012	2	Singleton, Abeles, and Smith, 2016	2
Bhat, 2008	1	Brooks, and Longstreet, 2015	2
Chapin, 2016	2	Phillips, 2014	1
Crosslin, and Golman, 2014	2		

Table 1: Categorization of the Papers Included in the Review

In all of the above six categories, there are 89 studies out of 107 studies rated with 2 as a relevance score. This indicates that most of the included studies in this systematic review contain contents directly related to social media and youth suicide. Some studies were coded into multiple categories, so the number of studies for each subject in the Table 1 is higher than the entire 97 individual studies included for this review.

The goal of this literature review is to find the research gaps and to present a summary of research to date. The data suggests the research gaps on social media and youth suicide are about sexting, offering online consultations, and detecting youth at risk of suicide (Table 1). These themes present with the least number of studies and we do not know much about them. Whereas, running youth suicide prevention awareness campaigns, cyberbullying, and disseminating information about self-harm techniques and pro-suicide content are the subjects receiving most attention from researchers worldwide with various academic backgrounds including computers sciences and information systems, psychology, social work, medicine and health sciences, law, and education.

Based on the findings of this review and our past research experience, it is imperative for future research to continue advancing how to detect youth at risk of suicide on social media. We suggest future research should be done specifically on social media algorithms to detect youth at risk of suicide, especially the victims of cyberbullying and sexting. We think it is very crucial to understand how youth in danger generate and share content on their social media including as text, photo, and video when they feel and are at risk. The ways they emotionally express and interact with social media could be used as indicators to detect youth at risk of suicide beyond solely relying on the methods of sentiment analysis of the keywords and a piece of text posted on social media, categorizing them into positive, negative, or neutral topics and categories. As mentioned earlier in the introduction section, our recent study with urban indigenous youth in Ontario, Canada indicated that research participants could tell if their friends was at risk of suicide through (i) the language or verbal tone of the content that their friend has generated or shared on Facebook, (ii) the images they used and (iii) the changes in their relationship status. Changes in relationship status are new indicators to detect youth at risk (Intahchomphoo, Vellino, and Gundersen, under review).

Furthermore, most youth with suicidal ideation and the victims of cyberbullying and sexting do not normally seek help from adults, so their help often arrives too late. As youth are at a stage of life when they face many changes, we think there should be more studies on developing social media algorithms to change the moods of youth identified as being at risk of suicide. It is evident that social media could

provide positive and hopeful alternative information to make them feel more positive. This same mechanism has been applied to advertisements on social media like Facebook. Useful information could be injected into youth's social media news stream. It is a highly personalized process depending on the online behaviour of users and keywords in posts. Moreover, this news feed could be relevant or helpful to them for managing that risk, such as pointers to health and public services.

Thus, we would like to encourage other information systems and health researchers to explore more ways to how to create effective online consultations through social media and online referral systems for youth in peril to receive needed help as soon as possible. Researchers and practitioners from both information systems and health sciences need to work together to make it happen. We think this task requires an interdisciplinary team. Finally, it is also a good idea to develop more information systems to identify abusive persons who bully youth on social media. Such a tool would be good for people in law enforcement.

5. Contributions and Limitations

This review identifies some important societal concerns regarding the links between social media and youth suicide. It identified key gaps in the literature in the particular areas of sexting, offering online consultations, and detecting youth at risk of suicide. The top research themes in the existing literature are about running youth suicide prevention awareness campaigns, cyberbullying, and disseminating information about self-harm techniques and pro-suicide content.

One limitation is that this review only searched for primary studies written in English. Another limitation is the format of publications. Conference proceedings, government studies, and books were not included in the selected databases. This review only includes literature from four academic databases from 2004-2016. Since then, additional studies have been completed on these very topics, although they were not included in our sample set. This review thus needs to be conducted again in a few years with studies from the year 2017 onward because social media and youth suicide topics are currently receiving a lot of research attention and social media technologies are developing rapidly.

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