

Social Media for Suicide Prevention

Introduction

According to the World Health Organization, every year, almost one million people die from suicide [1]. It is one of the leading causes of death in people 15-44 years old [1]. This does not include suicide attempts which are predicted to be at least twenty times more frequent [1]. In the last 45 years, suicide rates have increased by 60% in some countries [1].

This is not just a problem in other countries. In the US, the CDC reports that suicide was the tenth leading cause of death for all ages in 2010 [2]. There were 38,364 suicides in 2010, which is more than 100 per day [2]. In 2011, 487,700 people went to the ER for self-inflicted injuries [2]. Suicide costs are estimated to be \$34.6 billion in medical and work loss. 3.7% of adults report having suicidal thoughts[2]. For 15-24 year olds, there are 100-200 attempts for every completed suicide and suicide accounts for 20% of deaths[2]. 15.8% of high school students report seriously considering attempting suicide [2].

Teens aren't the only ones at risk. Exam-based stress affects students well into their academic careers. Around 6,000 students committed suicide in 2006 in India alone [3]. Cornell's recent suicides have raised concerns about how we can prevent similar tragedies, but very little has actually been done. The 2009-2010 academic year saw 6 separate suicides, prompting Cornell's Mental Health Initiatives Director Timothy Marchell to declare a "public-health crisis." After the 6th suicide, staff reportedly went door to door across the campus to personally inquire about students' mental health [4]. But it shouldn't take the loss of six lives to spark interest in monitoring students' health.

There are a lot of existing organizations that work to help prevent suicide and support people struggling with depression and bullying. To Write Love on Her Arms is a non-profit organization dedicated to helping people struggling with depression, addiction, self harm, and suicide. They connect people to mental health resources and create a safe space online for people to discuss their issues. The American Foundation of Suicide Prevention tries to spread awareness of suicide as a mental health and public health problem. The National Suicide Prevention Lifeline is a 24-hour, confidential suicide prevention hotline available to anyone in emotional distress. Their call centers provide crisis counseling and mental health referrals. In addition, many states have their own suicide prevention programs, such as the Suicide Prevention Center of New York State, which provides education and other resources for people in need. Aside from suicide, the Depression and Bipolar Support Alliance provides support for people with mood disorders. Bullying has been increasingly implicated in suicide and there are numerous organizations like "stopbullying.gov" dedicated to fighting the emotional abuse many people struggle with.

In the fight against depression, time is the enemy. Early intervention is critical when treating depression, anxiety, and mood disorders and it often determines the success of treatment. Substantial academic and clinical evidence supports the effectiveness of early intervention in adolescents manifesting significant mood symptoms and syndromes. Early intervention reduces the burden of illness on the individual, their family, and society. Many mental health disorders

get worse as time goes on and become harder to treat. Not only does the person experience more severe symptoms over time, but the brain becomes sensitized and is more and more easily triggered into a depressive episode (for example). Whereas early episodes might occur in response to a major stress or loss, later episodes may appear to not have a direct cause, but are in fact caused by chemical imbalances in the brain. Many critical problems accompany untreated mental health issues including inability to work, a higher risk of developing a substance abuse problem, and a significantly higher risk of suicide.

Even though we know early intervention is critical and despite the amount of organizations dedicated to this cause, our society prevents most people from seeking help. Most people are too embarrassed to admit that they have a problem that they can't solve by themselves and they see suicide as the only alternative. People use social media to express themselves in ways they probably wouldn't otherwise. People talk about their feelings more openly than they do to friends or family.

According to DepressionCenter.org, 50% of adult mental disorders are diagnosed by age 14, and 75% by age 24. Early management of depression leads to the best outcomes for these individuals, but this, of course, requires early detection. There have been efforts to start screening individuals earlier but it's challenging to encourage insecure young people to come in to be evaluated for a culturally-stigmatized disorder. But the widespread use of social media might make it possible for people to get the help they need without ever leaving their home.

There is a wealth of personal data being generated through social media. Current estimates claim there are 500 million Tweets and 77.6 million Tumblr posts per day [5]. Facebook, the most popular social media network, has 1.19 billion users that are active on at least a monthly basis [5]. 76% of Facebook users log in every day [5]. Most importantly, 66% of people age 15-34 use Facebook [5].

Monitoring social media networks can help people address their mental health issues. Big data techniques can support this goal, by uncovering early signs of mental health disorders and directing users to the resources they need.

Social networks are being leveraged for a wide variety of research. Nicholas Genes and Michael Chary analyze social media networks for toxicovigilance and biosurveillance. Their work is focused on disaster response, the evolution of epidemics, emergence of new drugs of abuse. Smaranda Muresan uses Twitter's wealth of self-tagged data to train machine learning classifiers to detect sarcasm.

Related work

Capturing sentiment is of interest to many people studying trends expressed through social media. Smaranda Muresan has used Twitter to create a corpus of sarcastic and non-sarcasm messages to investigate machine learning techniques for identifying sarcasm [6]. Much research

is being done in how to detect sentiment in reviews, ratings, recommendations, and other metrics businesses are interested in for marketing purposes [7]. Politicians are also interested in the way people feel about their campaigns and debates, as expressed through social media. All of this social media research is essentially exploring effective applications of machine learning and data mining.

John Paisley has used stochastic variational inference to analyze large corpora of text such as New York Times or Nature articles to classify them into topics. His method applies complex Bayesian models to large data sets that batch variational inference are not capable of processing [8].

Project Proposal

A few months ago, the Onion published an article: *Netflix Sends Message to Check If Area Man Okay After Watching Entire Season Of 'Sons of Anarchy' In Single Sitting*. Clearly, the Onion is a satirical publication, but the idea is enticing. Could monitoring people's online activities allow us to intervene in a positive way? Would people be open to a message from their online services to "check in" on their mental health? For a user who is happy and healthy, it might be a nuisance, but for a user who really is struggling with depression, anxiety, or other mood disorders, early intervention can be life-changing. Nicholas Genes discussed some studies that have been done to detect "depressive moods" and post-partum depression of Twitter users, but they have only begun to skim the surface of the amount we can learn from such resources. In the near future, we may be able to leverage the wealth of information on social networks to help people struggling with emotional problems get the help they need. I propose to leverage social media to reduce mortality and morbidity due to suicidal behaviors.

Before a person actually commits suicide, there are many detectable signs. NIH lists the following as common symptoms of depression and suicidal thoughts:

- Talking about wanting to die or to kill oneself
- Looking for a way to kill oneself
- Talking about feeling hopeless or having no reason to live
- Talking about feeling trapped or in unbearable pain
- Talking about being a burden to others
- Increasing the use of alcohol or drugs
- Acting anxious or agitated; behaving recklessly
- Sleeping too little or too much
- Withdrawing or feeling isolated
- Showing rage or talking about seeking revenge
- Displaying extreme mood swings

In fact, a lot of the warning signs of suicidal and depressed thoughts involve talking, or more usefully, expressing emotions through social media. As seen in Figure 1, searching for hash tags that you would expect to be associated with suicidal thoughts results in a lot of mixed results. Anxiety can be caused by a particular situation like a job interview and not be a long term concern. Dramatic hash tags like want-to-die are usually used sarcastically. Hopefully no one is

actually suicidal because they lost their fleecy bed sheets. The tags hopeless, stressed, and moodswings seemed best at finding posts that would be possible red flags for someone in need of clinical intervention. Obviously, you wouldn't want to bother a user who's having a bad day, but by watching a user's activity over time you could find repeated negative thoughts that might indicate they're at high risk for suicidal thoughts and behavior.

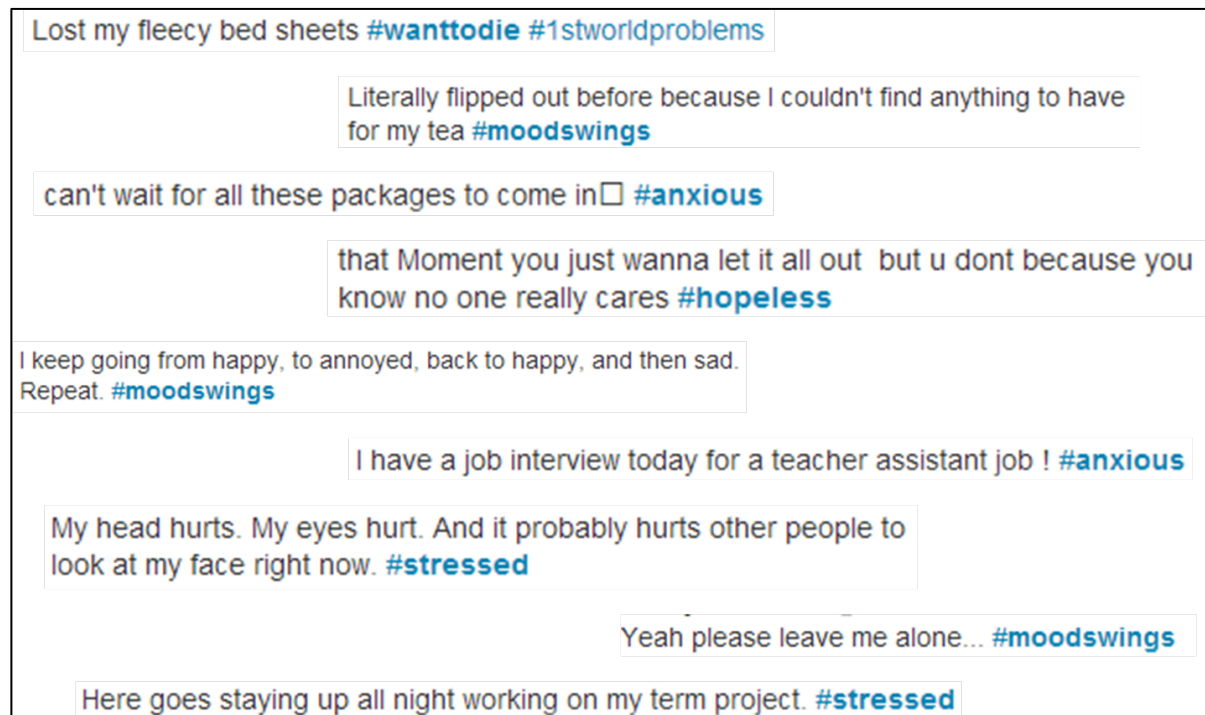


Figure 1: Examples of Tweets

It would be relatively easy to design an algorithm to search through online posts to find high incidences of words like “depressed”, “stressed”, “crying”, “unhappy”, “hopeless”, and so on. By monitoring individuals with repeated high frequencies of these words, we could discover when someone is at risk for suicide and other self harming behaviors. Obviously there are many privacy issues at hand for how to appropriately intervene in a positive way, but there is a huge opportunity to save lives. An automated message could be sent to a “high risk” user with referrals to local mental health service (Figure 2).

Hey,

Our automated detection algorithms have noticed that you've used the hashtag #stressed 50 times in the last two weeks and #hopeless 23 times. We think you might be struggling with depression and/or anxiety. This is a serious health concern and you can seek help from resources in your community. Here are some links to organizations that can help you:

The Samaritans of New York: (212) 673-3000; samaritansnyc.org

The [Jed Foundation](http://JedFoundation.org) is specifically for the emotional health of college students
ulifeline.org has information on a wide range of related topics

If you feel this message has been sent in error, please feel free to ignore it.
We hope you're having a good day.

Take care,

-Social Media Suicide Prevention

Figure 2: Example of an Intervention Message

Methods

Automated sentiment analysis is challenging, required complicated Natural Language Processing, keeping in mind that people's online communication has lots of complexity like sarcasm. Topic Classification is an easier approach. Classification can be based on positive (healthy) and negative (potentially harmful) "topics" where each topic has a probability distribution of words. Bayesian inference analysis can be used to sort posts into the correct topic. In this case, the probabilities would be chosen to give more false positives, telling people they were at risk when they aren't, rather than missing people who might be at high risk.

For details on the mathematics of John Paisley's approach to topic classification, see reference [6]. Since no improvements or changes have been made to it, I did not feel it was appropriate to copy his work here.

Ideally, you could have different topics for different issues a user could be experiencing so that you could direct them to the most appropriate resources. Someone who is struggling with an eating disorder will present different linguistic symptoms than someone who is clinically depressed (although in some cases people may struggle with more than one problem). Some examples of posterior topics are demonstrated in Figure 3. Obviously no one should be diagnosed with a serious disorder through their social media posts but classifying people into more specific categories to provide topic-specific resources would be more helpful than simply telling them they're at high risk for some mysterious issue.

Depression	Anxiety Disorder	Suicidal	Eating Disorder	Bipolar Disorder
depressed	stressed	death	diet	excited
sadness	anxious	dying	overweight	mood swings
unhappy	overwhelmed	depressed	fat	energetic
despair	OCD	failure	skinny	restless
anxious	panic	hopeless	anxious	depressed
irritable	worry	rage	stressed	sadness
exhausted	headache	trapped	binge	exhausted
worthless	afraid	angry	overeate	hopeless
hopeless	shy	stressed	guilt	anxious
pain	obsessed	give up	depressed	manic

Figure 3: Examples of Posterior Topics

The work would probably require an interdisciplinary team from psychology and computer science departments to combine knowledge of mental health with machine learning and data mining techniques.

Future Directions

Overall, the suicide rate among teens has climbed in the past few years, from 6.3% in 2009 to 7.8% in 2011, numbers which reflect the trend gaining national attention as more teen suicides are reported as a result of bullying. According to the CDC survey, about 20% of high-schoolers said they'd been bullied while at school, and 16% said they'd been 'cyberbullied' through email, chat, instant messaging, social media or texting.

Cyberbullying, online harassment by peers, is an increasing cause of suicide in teens. Algorithms could be developed to detect name calling and other types of verbal abuse in social media along with monitoring the subject's own posts for depression and anxiety keywords. Aside from suicide, according to the National Education Association, 160,000 kids stay home from school every day due to fear of bullying. This is especially a problem for LGBT students. In a 2007 study, the Gay, Lesbian, and Straight Education Network (GLSEN) reported that 86% of LGBT students are bullied at school. Many of these incidents are not reported to the school and even when they are, school staff often does nothing in response. The Suicide Prevention Resource Center reports that LGBT youth attempt suicide at a rate 2 to 4 times higher than that of their heterosexual and cisgender peers. Harassment and bullying have also been linked to 75% of school shooting incidents, where a bullied student tries to take revenge on their peers for years of abuse.

Studies have shown that cyber-bullied victims reported higher depression than bullies or bully-victims, which was not found in any other form of bullying. This is probably because cyber victims may experience an anonymous attacker who instantly disperses fabricated photos throughout a large social network. Victims of cyberbullying are more likely to feel isolated, dehumanized and helpless when they are attacked. Findings indicate the importance of further

study of cyber bullying as its association with depression is distinct from traditional forms of bullying.

To augment other techniques for detecting that a user is struggling with suicide and depression, an algorithm could be developed to detect repeated name calling and abuse directed at a user to help the victim, even if they don't complain about being bullied or express their thoughts in other ways.

In addition, as natural language processing techniques improve, they could be incorporated to do real sentiment analysis of the data. Collaboration with project such as Smaranda Muresan's work with sarcasm detection could also improve the classification of posts.

As the system was released, getting user feedback would be critical in improving it. Users could fill out surveys to say how effective different resources were or how the intervention message affected them. Ideally there would be many success stories to inspire other people who are struggling with similar issues.

Ideally, to help people be comfortable expressing their problems, a website with an online therapist network could be established. People could chat anonymously with a trained professional so they could get help and support without leaving their home or worrying about making an appointment. The future of mental health services is full of potential to help people through innovative methods such as those presented here.

References

- [1] W. H. Organization, "SUPRE: the WHO worldwide initiative for the prevention of suicide," *online*, 2013. .
- [2] CDC, "Suicide Facts at a Glance," *online*, 2012.
- [3] A. Mukherji, "Around 6,000 students committed suicide in 2006," *Times Of India*, 2008.
- [4] D. Shtrakhman, "Cornell suicides raise concerns across Ivies," *The Daily Pennsylvanian*, 2010.
- [5] C. Smith, "ExpandedRamblings.com," *online*, 2013. .
- [6] R. González-ibáñez and N. Wacholder, "Identifying Sarcasm in Twitter : A Closer Look," no. 2010, pp. 581–586, 2011.
- [7] B. Liu and S. M. Street, "Opinion mining," no. 1, pp. 1–7.
- [8] M. D. Hoffman, D. M. Blei, C. Wang, and J. Paisley, "Stochastic Variational Inference," vol. 14, pp. 1303–1347, 2013.