



IMPACT OF TECHNOLOGY ON CURBING SUICIDE IN AFRICA

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ABSTRACT

Suicide continues to be a leading cause of death and has been recognized as a significant public health issue in the world. Rapid advances in data science can provide us with useful tools for suicide prevention, and help to dynamically assess suicide risk in quantitative data-driven ways in Africa. This paper highlight the most current research in digital suicide prevention, including the use of machine learning, smartphone applications, and wearable sensor driven systems. The author also discusses the clinical implication of technology based suicide prevention in the Africa continent.

Keywords: Mhealth, suicide, depression, technology, apps, machine learning, data science, wearables, digital health.

INTRODUCTION

Suicide is the leading cause of death in people aged 19 to 29 years globally. Each year, the World Health Organization (WHO) estimates that almost a million people die from suicide worldwide [1] highlighting suicide as a serious global public health concern. The contribution of suicide to the global burden of disease is predicted to increase over future decades [2]. Data from the WHO mortality database indicate that 85% of the world's suicides occur in low and middle income countries (LAMIC) [3]. Worldwide it is estimated that there are up to 20 suicide attempts for every suicide death [4] but across much of the African continent, the ratio of deaths to attempts appears to be much lower than this. Whilst this ratio does vary globally by country and suicide method, it could indicate that the true incidence of suicide in Africa is underestimated. In many African countries, suicidal behaviour carries negative religious and cultural sanctions and therefore may be under-reported, hidden or deliberately misclassified. In addition, the uncertainty in establishing suicidal intent may lead some suicidal acts to be misclassified as unintentional. There is some evidence from South Africa to suggest that suicide deaths by poisoning, jumping and railways are more likely to be misclassified than those by firearms or hanging [5]. Africa is the world's largest and second most populous continent, with a population of over one billion people. The continent is heterogeneous, comprising rural, semirural and urban areas, a diverse range of religions, ethnic groups and cultures and several regions affected by war, political and economic instability.

Suicide research in Africa is limited by a lack of systematic data collection. With less than 10% of African countries reporting mortality data to WHO, official statistics are available for only 15% of the continent's total population. Much of the available published suicide data are based primarily on small studies conducted in different regions and populations. Moreover, reported suicide mortality statistics are likely to underestimate the true magnitude of the problem as religious and cultural sanctions may lead to suicide being under-reported, misclassified or deliberately concealed.

Even less is known about attempted suicide across the African continent. It is estimated that for every suicide that occurs worldwide there are up to 20 suicide attempts [4]; however reliable data are not available for most countries. Data are often obtained from hospital records which underestimate the number of cases, as many individuals are only admitted to hospital if in a critical condition. Moreover, a lack of access to medical facilities, particularly in rural areas of Africa, means that many suicide attempters are unlikely to present to hospitals. As with suicide, socio-cultural factors also contribute to under-reporting.

Any current estimates of suicide in Africa need to be interpreted with great caution given the absence of data for many countries, the variability of estimates and the lack of national-level statistics. Moreover, the huge cultural and religious diversity found both within and across African countries together with geographic (i.e. rural/urban), economic and political differences mean results based on data from one population or region are unlikely to be generalizable to another.

Worldwide, three to four more men die by suicide than women. The ratio is much lower in Asian countries [6] and in China, more women die from suicide than men, particularly in rural areas [6]. Available evidence from Africa suggests that sex differences in suicide are broadly consistent with international trends, with all countries reporting a male predominance, typically at a ratio of 3.0:1 or higher. However, most studies have been conducted in urban areas and it is not clear whether this pattern would also be seen in rural areas of Africa. The sex discrepancy identified in this review may in part be explained by a propensity for men to use more lethal methods such as hanging and firearms, whereas the most common method used by women was poisoning.

Clear conclusions cannot be made regarding sex differences in attempted suicide in Africa as some studies reported a male predominance, some a female predominance, and others no clear sex differences. These findings contrast with international trends where suicide attempts tend to be 2–3 times higher in women than in men [7].

Knowledge of the most prominent methods used for suicide in Africa is vital for the development of prevention strategies, as restricting access can be an effective way of reducing suicide rates [2]. Findings suggest that pesticide poisoning is a prominent method in Africa. Moreover, the proportion of suicidal acts involving pesticides is likely to be underestimated as data are largely absent in rural areas where pesticides are easily accessible and likely to be a commonly used suicide method.

Given their high lethality, it is not surprising that rates of hanging and firearms were higher for suicide than for suicide attempts. The use of firearms as a method for suicide varied considerably across studies [range 0-32%], probably reflecting differences in the availability of this method.

A greater understanding of the antecedents to suicide is important in order to identify high-risk groups and to develop effective prevention strategies. Suicide is multifactorial, involving a complex interplay of biological, social, cultural and psychological factors. Information about suicide risk factors in Africa is typically obtained retrospectively, either from medical records which are often incomplete, or from relatives' reports which may be biased. Case control and cohort studies are required to better characterize risk factors for suicidal behaviour in Africa. For example, several studies reported high rates of unemployment amongst those who had died by suicide; however, as rates of unemployment are generally high within the population, the absence of a suitable comparison group means that these data are not informative.

PREDICTING SUICIDE USING DATA SCIENCE

One of the key roles of a psychiatrist is to assess the risk of suicide in his or her patients. While we know of many risk factors for suicide, psychiatrists have to rely on clinical acumen to assess suicide risk. This assessment carries with it a degree of subjectivity, and we have not yet been able to create an automated system to model and predict suicide risk objectively. Suicide risk is also highly fluid, with the potential for rapid fluctuations based on biological, social, and psychological factors.

Additionally, suicide risk has both chronic and acute elements: someone may be chronically at high risk of suicide, although a more immediate life event may rapidly escalate that risk further. People who are at relatively low risk may also become at high imminent risk due to an acute life event. While negative life events and stress have been linked to suicide, some have argued that even neutral or positive life events can result in stress and an increased suicide risk. The impact of positive life events on suicide risk appears to be complicated and poorly elucidated at present [8].

By collecting and analyzing large amounts of population and/or patient data, technology that digitally predicts suicides could help us to objectively quantify

- 1) the general impact of each of the many different risk factors and how they interact,
- 2) the specific risk profile of a given individual, and
- 3) an individual's instantaneous risk at any given moment with consideration of any newly acquired information.

Such a technology would help us more effectively target our limited resources across a much larger population. While these prospective interventions may seem optimistic, a range of research is giving us hope that they could be possible.

COMPUTERIZED SPEECH AND FACIAL EMOTIONS ANALYSIS

Speech and facial emotions may also provide a window into detecting suicidal thinking. Through the use of computerized speech analysis, researchers are able to find differences in how depressed and/or suicidal people talk. People who become suicidal may have differences in the sound frequency of their speech, either going from high frequency to low frequency or vice versa. Research has also shown that people with depression exhibit a reduced acoustic range to their speech [9].

Other researchers are using computerized real-time facial emotion monitoring to also detect subtle changes in the facial expressions of people with suicidal thoughts. For example, researchers at University of Massachusetts and Affectiva are attempting to identify people with suicidal thoughts based on how they respond to various video vignettes.

They are using a specialized computer program to analyze facial expressions, in addition to measuring body measurements such as skin conductance and heart rate. They hope to demonstrate differences in how people with suicidal thoughts react emotionally and physically to various videos in comparison to those without. Such research could allow us to develop a rapid way to assess suicidality, especially in high risk individuals who may not verbally disclose the presence of suicidal thoughts or plans [10].

Psychiatrists and other mental health clinicians are routinely trained in performing a mental state examination (MSE), a systematic, but subjective, method of assessing and documenting a person's physical and mental presentation [11]. The history and MSE are recognized as being some of the most important diagnostic and assessment tools for a clinical psychiatrist [11]. The MSE includes an assessment of an individual's mood, speech, thought patterns, and behavior. We propose the development of a digital mental state examination (dMSE) that assesses a patient's presentation by utilizing a range of technologies including motion tracking, natural language processing, and speech analysis to produce quantitative, objective data that may be superior to the subjective reporting of the standard clinical MSE.

COMPUTERIZED THERAPY AND SMARTPHONE APPS SOLUTION

There has been some emerging evidence to suggest that computerized suicide prevention approaches may also be useful; an example is the use of automated cognitive behavioral therapy (CBT). Automated CBT can deliver a course of this particular type of talk therapy without the involvement of a human therapist. Unfortunately, while there is some evidence to suggest the utility of such approaches in affective disorders, the evidence for its use in suicide is far more limited [12].

There is even less research available on smartphone applications (apps) for suicide. Some would argue that smartphones and other wearable devices maybe ideal platforms to assess and even treat mental health conditions.

The research team at Brain Power recently conducted a review of suicide-related smartphone apps, and their conclusions were quite worrying. The vast majority of apps were little more than checklists of symptoms or resources. Some apps contained information that could be potentially harmful or may worsen a person's condition. In general, these apps did not leverage the complex inbuilt sensors and hardware capabilities of smartphones to collect behavioral data or incorporate any significant data analysis. Prior research on suicide related apps supports our team's findings, with up to 13 percent of apps containing content that could be potentially harmful, and over half having no interactive features [12]. A recent systemic review of suicide and self-harm apps highlighted similar concerns [13]. This suggests that we are at the very beginning of leveraging technology that can be delivered via an app platform. This may change as large technology companies are getting more interested in impacting healthcare.

Researchers have created a suicide prediction system that combines data from mood-focused smartphone apps, and also genetic blood tests (biomarkers) [14]. These researchers have found that by combining the results of both of these approaches, they can predict suicidality and also hospitalizations from suicide attempts. Interestingly, the smartphone apps ask participants questions about their mood and life, but did not directly ask about suicidality. This contrasts to the current standard of clinical care, where directly asking about suicidal ideation is essential. The notion that people will be promoted to commit suicide through such questioning has long been dismissed. The researcher's system has been found to predict suicidality in women, a historically understudied group. Despite this research, it appears that considerably more research and development needs to be done before mental health apps play a significant role in suicide prevention [14].

We also propose that there is potential to detect and monitor suicidal ideation through the use of cloud computing to generate a personalized computer model of an individual's real-time emotional state.

Some researchers have proposed some basic elements of this technique, such as using interconnected non-invasive sensors to monitor electro-dermal activity and electroencephalogram (EEG) [14]. We believe that a more robust model would leverage a combination of physiologic measurements from biosensors, proxy measurements of social interaction from smartphone sensors, and a patient's baseline demographic and clinical data.

Through the use of data analytics and cloud computing, we believe that a personalized real-time mental state and suicide risk model can be developed for the user of such a system. This system would be able to give real-time feedback to the user, psychiatrists, and other clinicians, and also the wider health system. Such a system could allow for remote monitoring, early identification of suicidal states, and beneficial changes in treatment plans. Privacy and confidentiality concerns will be paramount in the development of such systems given the sensitive nature of the collected data, and users will have to carefully weigh up the risks and benefits of these systems before consenting to their use.

CONCLUSION

Will a new generation of connected devices help us detect and prevent suicide? It may seem like science fiction to some. Today's multitude of wireless devices may help us finally improve the bleak statistics and subjective clinical approaches we've utilized thus far in suicide prevention. Yet we must immerse ourselves in the population to see the nuances of suicidality. For instance, the most at risk, or those at their riskiest moments of life, may never charge their phones nor motivate to check in with an online service, thus passive monitoring that does not require batteries must be a part of any solution. There has been an increase in research that focuses on predicting and understanding suicide using new technologies, yet there remains a considerable need for caution, given the severity of any potential oversight or error. Many of these preliminary results are positive and give us hope that these initiatives may end up being an important part of our suicide prevention armamentarium.

Mental health clinicians will continue to play a central role in suicide prevention, and early use of these technologies will augment the work of human clinicians, not replace them. It is also imperative that people with psychiatric illness, including suicidal thoughts, are actively involved in the design and development of these technologies. This approach will ensure that the technology has a suitable user interface and results in high levels of user engagement, thus is acceptable in real-world situations and is effective.

CLINICAL IMPLICATIONS

The results of this research showed that new technologies are useful resources that can offer possibilities in the field of suicide prevention. We found new technologies to be well accepted and well-valued by the various stakeholders (MHPs, DPMs, and NGOs). As such, they should be used in suicide prevention programs. Placing greater importance on resources that are accessible, free, can guarantee anonymity, incorporate training for mental health professionals, and reduce the time required for suitable management through automation, would facilitate and possibly increase the use of these resources in Africa.

REFERENCES

1. World Health Report 2004. WHO, Geneva 2004.
2. Public health action for the prevention of suicide. A framework. WHO, Geneva 2012.
3. Krug EG, Dahlberg TT, Mercy JA, Zwi AB, Lozano R: World report on violence and health. 2002, World Health Organization, Geneva.
4. Suicide prevention (SUPRE).
[http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/]
5. Burrows S, Laflamme L: Assessment of accuracy of suicide mortality surveillance data in South Africa. *Crisis* 2007, 28(2):74–81.
6. Hendin H, Phillips MR, Vijayakumar L, Pirkis J, Wang H, Yip P, Wasserman D, Bertolote JM, Fleischmann A: Suicide and suicide prevention in Asia.

Mental Health and Substance Abuse, World Health Organization. Suicide and suicide prevention in Asia. Mental Health and Substance Abuse, World Health Organization: Suicide and suicide prevention in Asia. Mental Health and Substance Abuse, World Health Organization; 2008.

7. Schmidtke A, Bille Brahe U, DeLeo D, Kerkhof A, Bjerke T, Crepaf P, Haring C, Hawton K, Lönnqvist J, Michel K: Attempted suicide in Europe: rates, trends and sociodemographic characteristics of suicide attempters during the period 1989–1992. Results of the WHO/EURO Multicentre Study on Parasuicide. *Acta Psychiatr Scand* 1996, 93(5):327–338.
8. Cornette, M, Busch A. Stress and suicide, The Charles E. Kubly Foundation website. <http://charlesekublyfoundation.org/resource-center/resourcearticles/stress-and-suicide>. 2016. Accessed April 15, 2016
9. Larsen ME, Cummins N, Boonstra TW, et al. The use of technology in suicide prevention. Presented at 37th Annual International Conference of the Engineering in Medicine and Biology Society. August 26–29, 2015. Milan, Italy.
10. Vannoy S, Gable S, Brodt M, et al. Using affect response to dangerous stimuli to classify suicide risk. Presented at CHI 2016 Computing and Mental Health Workshop. San Jose, CA. 8 May 2016.
11. Brannon GE, Bienenfeld D, Talavera F, Schmetzer AD. History and mental status examination. Medscape website. 31 Mar, 2016. <http://emedicine.medscape.com/article/293402-overview#a3>. Accessed June 15, 2016.
12. Lai MH, Maniam T, Chan LF, Ravindran AV. Caught in the web: a review of web-based suicide prevention. *J Med Internet Res*. 2014;16(1):30.
13. Larsen ME, Nicholas J, Christensen H. A Systematic assessment of smartphone tools for suicide prevention. *PLoS One*. 2016;11(4): e0152285.
14. Levey DF, Niculescu EM, LeNiculescu H, et al. Towards understanding and predicting suicidality in women: biomarkers and clinical risk assessment. *Mol Psychiatry*. 2016;21(6):768–785.