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Review

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Smartphone applications for mindfulness interventions with suicidality in Asian youths: Evidence is lacking

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Abstract

Background: The advent of mobile technology has ushered in an era where smartphone applications can be used for intervention for suicidality.

Objective: Review recent research relevant to smartphone application that can be used for mindfulness intervention for suicidality in Asian youths.

Methods: The inclusion criteria for this review is papers published in peer reviewed journals from 2007 to 2017 with usage of search terms namely ‘smartphone application’, and ‘mindfulness’, assessed against the inclusion criteria and screened by an experienced Asian clinician to be of clinical utility for mindfulness intervention for suicidality with Asian youths.

Results: Initial search on databases yielded 375 results. 14 Full text papers that fit the inclusion criteria were assessed for eligibility and 10 papers were included in the current review.

Conclusions: This review highlighted the paucity of evidence-based and empirically validated research into effective smartphone applications that can be used for mindfulness interventions for suicidality with Asian youths.

Keywords: Suicidality; Asian youths; smartphone applications; mindfulness

Introduction

Suicide rates increase with age from adolescence to young adulthood [1,2], with corresponding heightened rates of suicidal ideation and attempts [3]. Both Western and Asian studies have highlighted the prevalence of youth suicidality, and youth suicide rates have been rising faster compared to other age groups [4,5], with a peak in those between 15 and 24 years old [3,6,7]. In a recent large study on Asian suicide attempters in Singapore, a prominent peak in suicide attempts over a 3 year period was observed in youths aged between 15-24 years, as compared to other age groups [4].

In recent decades, the advent of smartphone technology has transformed the mode of delivery of psychological treatment [8] for patients suffering from chronic medical illnesses [9,10] and psychiatric illnesses [11], as well as their caregivers [12]. The demand for electronic health applications across the world is mirroring larger societal trends wherein consumer acceptance of technology has grown [13,14].

Common psychiatric illness such as depression is associated with high direct and indirect costs [15]. Psychiatric illness results in functional impairment, leading to lost wages and work impairment, with related personal, societal and economic burdens [16,17]. Smartphone applications have potential to reduce healthcare cost for treating psychiatric illnesses in Asia [18,19]. In comparison to Western countries, there is a shortage of mental health professionals in Asia, yet a high penetration of mobile phone usage throughout Asia [20]. Over 50% of the Asian population use smartphones, with Singapore alone reporting that the smartphone adoption rates far exceeded the population [21]. There is a critical need for comprehensive research to inform the development of evidence-based smartphone applications that can be made widely available for the public, to ameliorate symptoms and improve well-being in Asian populations.

As younger demographics are more likely to access online information relating to mental health problems [22-24], mobile technologies can enhance patient-centered care for youths in an increasingly technology savvy society [25], highlighting a growing need to offer electronic interventions [26,27]. Evidence base for use of smartphone applications has been demonstrated in many areas [28-33], and internet-based interventions have been found to be efficacious for mental health issues [34] in young adults [23,26,35] to enhance support [36], help them to cope, and to aid in recovery [37,38]. Positive outcomes were shown in overall motivation [39], and with ethnically diverse populations [40]. Smartphone applications have been used to deliver therapies which are relevant for young adults, such as cognitive behaviour therapy [10], addiction treatment [41] and virtual reality therapy [42]. This holds promise for mental health professionals who are not technical experts to develop smartphone applications as an alternative platform to deliver interventions, in view of the recent advances in technology [43]. However, it should not be assumed that smartphone applications delivering interventions demonstrated to be effective in Western cultures will be similarly effective in Asian cultures [44]. Cultural adaptations may be needed for Asian youths [45].

Some clinics in Australia have implemented conjunctive treatment modalities in guided programs such as Cognitive Behavioural Therapy and psychoeducation applications alongside face-to-face therapy sessions [40]. One example is the Dialectical Behavioural Therapy (DBT) Coach, which was an application that was designed after extensive feedback from experts [46]. The application aimed at cultivating emotional regulation

skill, to change negative emotions [47]. The users gave ratings and identified the current emotions. After which, users were directed to specific coaching.

Such developments are currently lacking in Asia. As aforementioned, it should not be assumed that interventions demonstrated to be effective in Western cultures will be similarly effective in Asian cultures, especially when it concerns suicidality. Culture plays an important role in determining risk and protective factors for suicidality, which informs targeted assessment and intervention strategies [44]. Asian suicide attempters are more likely to overdose on prescribed and over-the-counter medications instead of using firearms in their suicide attempts [48], as compared to Western samples, and Asian suicide attempters also endorse different views on the lethality of suicide methods [49].

Mindfulness interventions have been used to treat various psychological problems such as anxiety and depression [50-52]. Mindfulness practice reduces psychological distress while optimizing psychological functioning and among young adults [53] by enhancing positive affect and lowering negative affect [51]. Large scale empirical research investigating the evidence base for mindfulness interventions in Asian samples seems to gain momentum in the last few years within the current decade [52]. Depression is a common psychiatric illness in Asian. Asians suffering from depression often experience maladaptive ruminations [54], and would be suitable for mindfulness-based therapy, which have been shown to contribute to significant reduction in maladaptive rumination [55]. Furthermore, youths are often affected by problems including low self-esteem [56], poor weight control [57], eating problems [58], internet addiction [59] and chronic diseases including dermatitis [60] and asthma [61]. Mindfulness-based therapy shows evidence in improving self-esteem [62], weight control [63,64], eating problems [65], internet addiction [66] and chronic diseases in Asian youths [67], and holds promise for use with Asian youths to enhance their overall wellbeing, resilience and reduce their vulnerability to suicidality [45]. Recent studies have drawn links between resilience, suicidality [44, 68], and mindfulness practice for Asian populations [45,68]. In Asia, the stigma related to mental illness and suicidality may hinder help seeking behavior in youths. This further increases their vulnerability to suicide risk [4]. These at-risk youths might prefer to access community interventions such as self-help on electronic platforms delivered using smartphone applications [20] rather than face-to-face therapy. Such applications offer an alternative delivery medium that is also cost effective [53]. The accessibility of such applications may enhance our efforts in primary prevention, and mental health promotion, aligned with recent research in Singapore. A recent study in Singapore highlighted the need for mental health promotion to reduce stigma related to psychiatric illness and enhance psychological wellbeing [45]. Recent research indicate that preventative mental healthcare involves enhancing resilience and promoting protective factors which includes mindfulness based interventions for emotional regulation [44,45,53].

There are many smartphone applications currently available that are marketed as mindfulness applications. Using the search term “mindfulness-based iPhone Applications” from November 2013 yielded 808 results. This number is consistent with earlier research informed by a search for “mindfulness” conducted on iTunes and Google Applications for mindfulness training [36]. Such applications were reviewed by experts. However, the utility among Asian youth consumers remains unclear. Widespread implementation of self-help mindfulness interventions could be premature without salient evidence and scientific scrutiny for use by the intended population [69]. Youths can be impressionable consumers, and principles of rigorous scientific enquiry should be applied to explore therapeutic

benefits [70] of such applications. Unfortunately, the utility of such applications for suicidality in Asian youths remains largely unexamined. Research aimed at examining low-cost smartphone applications that are efficacious as a therapeutic tool for suicidality in Asian youths would add significantly to the current literature [71]. Considering the heightened suicide risk uncovered by recent research with Asian youths [4], and the need for early prevention [45], research is much needed to explore alternative ways to deliver effective interventions which are also cost effective and easily accessible. The aim of this paper is to review research relating to evidence base for smartphone applications that can be used for mindfulness intervention for suicidality in Asian youths.

Methods

The inclusion criteria for this review are publications in peer-reviewed journals from 2007 to 2017 with usage of search terms namely 'smartphone application', and 'mindfulness'. Databases included PSYCINFO, SCOPUS, Google Scholar, and PubMed. The papers were retrieved if they related to interventions via smartphone application for mindfulness interventions. The structured proforma for evaluating eligibility for inclusion involved the following: recent papers that contain original work published in peer-reviewed journals after the year 2007; related to usage of smartphone application by clinicians for therapeutic purposes and considered by an experienced Asian clinician to be of clinical utility with suicidal youths in Asia.

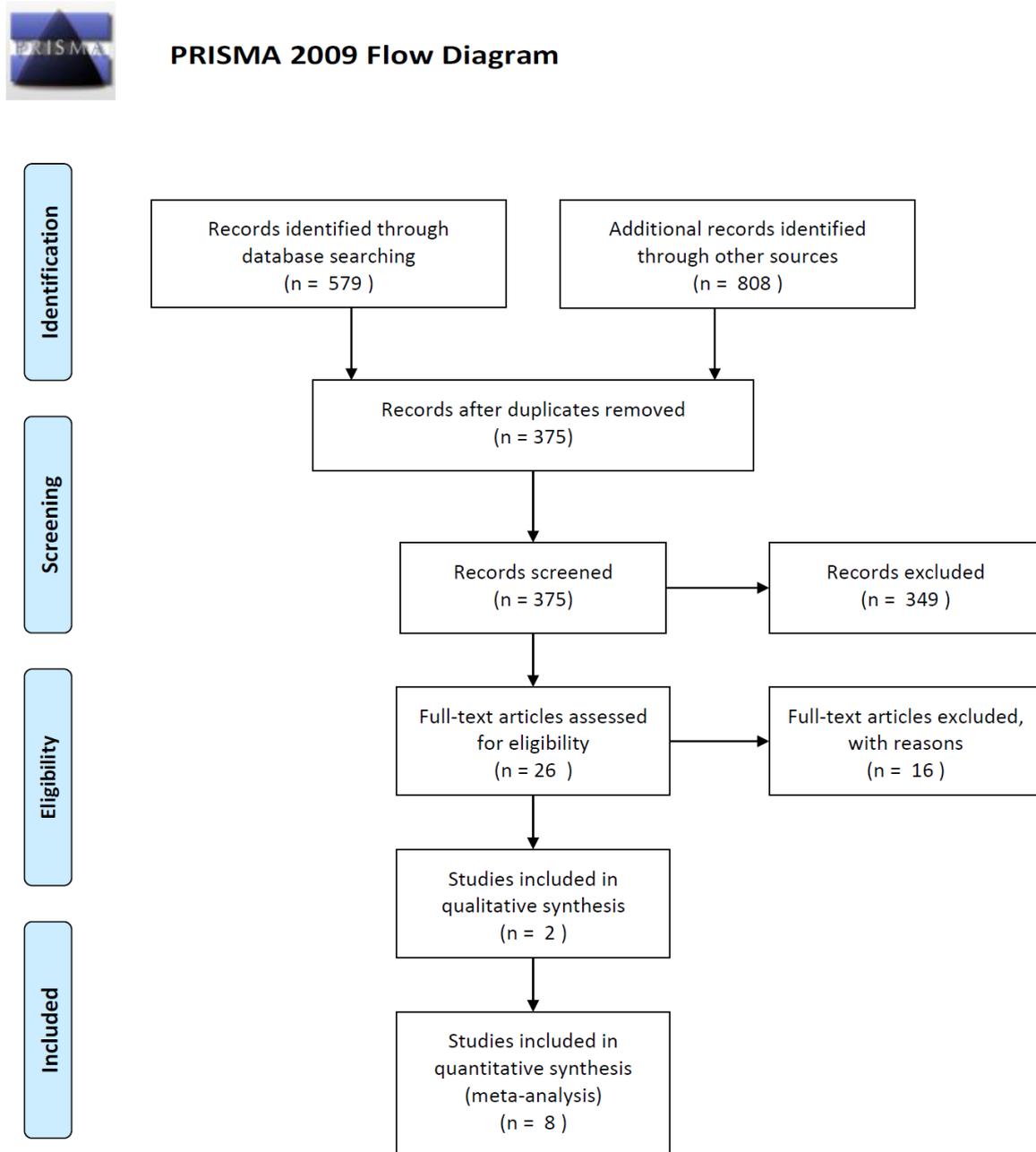
The focus was on recently published papers in peer reviewed journals that fit the inclusion criteria, and relevant to smartphone applications that can be used for mindfulness intervention for suicidal youths in Asia.

The main reasons for exclusion were articles that did not refer to the use of smartphone applications by clinicians for therapeutic purpose.

Results

The *PSYCINFO* database was initially used to identify peer-reviewed papers with the inclusion criteria named above, this yielded 375 results, using all search terms. From the original search results, the abstracts were screened, and 14 full text papers from peer-reviewed journals were then downloaded and assessed against the inclusion and exclusion criteria. See Figure 1 for the PRISMA flow chart [72].

Figure 1. PRISMA flow diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Ten recent papers deemed to be suitable were included in the current review, with a focus on papers published in the last 5 years. The results of the review are presented in Table 1.

Table 1. Summary of evidence

Author/Year	Level of Evidence/Study Design/Participants/Inclusion Criteria	Outcome Measures/Study objectives	Results
Aggarwal (2012)	Level IV Narrative review	The study aimed to review the use of smartphone applications in South Asia.	There is a shortage of mental health professionals in South Asia, yet a high penetration of mobile phones throughout South Asia.
Brian & Ben-Zeev (2014)	Level IV Narrative Review	Primary objective of the study was to review the reach of mobile technology in Asia, and consider the integration of smartphone applications into the study, diagnoses, and treatment of mental disorders in Asia	Asian countries have smartphone usage over 50% of the populations, with several countries (e.g. Maldives, Singapore and Vietnam) reporting smartphone adoption rates that far exceed the number of people in the population.
Cavanagh, Strauss, Forder & Jones (2014)	Level I Systematic review and meta-analysis Fifteen Randomized Controlled Trials (including 4 mindfulness-based interventions) were identified and reviewed.	The aim of the study was to evaluate the effectiveness and acceptability of low-intensity interventions with mindfulness features or acceptance components. Primary outcomes included measures of mindfulness, depression and anxiety.	Interventions that included mindfulness and/or acceptance-based components produced significant benefits in comparison to control conditions on measures of mindfulness/acceptance, depression and anxiety with small to medium effect sizes. Engagement with the self-help interventions varied but on average two-thirds of participants completed post-intervention measures. There were high drop-out rates and few trials were adequately powered.
Mak, Chan, Cheung, Li & Ngai (2015)	Level I Randomized controlled trial N=321 university students and staff (Chinese ethnicity, Mean age = 24 years)	The aim of the study was to evaluate the efficacy of Internet-based mindfulness interventions that can be accessed by digital interface platforms such as smartphones and tablets.	The mindfulness intervention had a significant effect on overall mental well-being ($p=.02$) and mindfulness ($p=.27$)

<p>Mani, Kavanagh, Hides & Stoyanov (2015)</p>	<p>Level I Systematic Review 23 applications reviewed</p>	<p>The study aimed to conduct a systematic review of current mindfulness based smartphone applications for mental health and to evaluate their quality and efficacy</p>	<p>Of the 700 applications that were initially screened, 23 applications met the inclusion criteria and were reviewed. Main features across mindfulness based applications include: breathing, body scanning, sitting meditations, walking meditations, loving kindness meditations, thoughts and emotion focus, mountain meditation, lake meditation and three minute breathing spaces.</p>
<p>Hoswells, Iytzan & Eiroa-Orosa (2016)</p>	<p>Level I Randomized Control Trial N=194 97 participants were assigned to the experimental condition and 97 to the control condition. Only 1.7% of the sample was Asian.</p>	<p>Objective was to measure the efficacy of a mindfulness based smartphone application designed to enhance well-being</p>	<p>The findings on the mindfulness meditation application 'Headspace' found that it significantly increased positive affect ($p=.003$) and decreased depression ($p=.05$). No statistically significant difference in satisfaction with life or negative affect was found and may be attributable to the limited time duration of the research (intervention only lasted for 10 days) and there was only one post-intervention measurement.</p>
<p>Larsen, Nicholas & Christensen (2016)</p>	<p>Level IV 123 applications referring to suicide were reviewed</p>	<p>The primary objective of the study was to review the content of publicly available applications for suicide prevention.</p>	<p>49 applications contained at least one interactive suicide prevention feature. Most applications focused on obtaining support from friends and family ($n = 27$) and safety planning ($n = 14$). Of the different suicide prevention strategies contained within the applications, the strongest evidence in the literature was found for facilitating access to crisis support ($n = 13$). All reviewed contained at least one strategy that was broadly consistent with the evidence base or best-practice guidelines.</p>

			Applications tended to focus on a single suicide prevention strategy although safety planning incorporated a greater number of techniques (mean = 3.9). Potentially harmful content, such as listing lethal access to means or encouraging risky behaviour in a crisis, was also identified.
Spijkerman, Pots & Bohlmeijer (2016)	<p>Level I</p> <p>Review and meta-analysis</p> <p>Fifteen randomised controlled trials were included in this study.</p> <p>Representation of Asian populations was limited. (Only a small fraction less than 15% were of Asian ethnicity)</p>	The meta-analysis aimed to examine the effects of online Mindfulness Based Interventions on mental health	The results found that online interventions are a promising strategy to alleviate psychological symptoms and reduce the prevalence of severe mental health problems. Across the studies, the mindfulness based interventions were found to have significant effects on well-being ($p < .001$), stress ($p < .001$), anxiety ($p = .010$), depression ($p < .001$) and mindfulness ($p < .001$)
Garcia, Sanchez, Espilez, Magarino, Guillen & Garcia-Campayo (2017)	<p>Level II</p> <p>$N=3,951$</p> <p>3977 users were involved in this study: 26 in the first trial during an 8-week usage period and 3951 in the second trial during 17 months (7.7% of the sample were below the age of 29 years)</p>	The aim of the study was to examine a first prototype of a smartphone application with Spanish features for the training and practice of mindfulness. The outcome measures were acceptance and perceived quality of the application as well as data about the usage	The applications 'Mindfulness' and 'Mindfulness Sci' were designed in consultation with licensed health professionals. 3,951 people downloaded the application. In the first study, participants assessed the application and considered it as a helping tool for mindfulness practice, and user-friendliness. In the second study, weak associations were found between usage time and age, nationality and educational level. The mindful level showed a weak positive correlation with the session accomplished ($p = 0.051$). Videos and information stood out as

			the most accessed resources.
Kumar & Mehrotra (2017)	Level I Review Paper 33 interactive self-care smartphone applications were reviewed	Primary objective was to identify the mindfulness related mobile applications available to Indian android phone users	Information on coping with depression screening tools formed the two largest types of free applications. Interactive self-care applications were reviewed further and less than 10% of the applications incorporated explicit delineation of their scope or initial screening for suitability. Guidance regarding managing suicidal crisis were incorporated in only about 12% of the interactive applications. About one third of these included content aimed at encouraging professional help seeking or had an explicit mention of the theoretical or empirical basis. Mindfulness techniques, monitoring moods, thoughts and behaviors were the most common therapeutic strategies incorporated in these applications, namely behavioral activation, identifying and correcting cognitive errors, cultivation of gratitude, and medication management.

Discussion

A review of papers presented in Table 1 shows lack of convincing evidence of the efficacy of smartphone applications that can be used for suicide interventions for Asian youths. A review of 15 randomized controlled trials including 4 mindfulness based interventions indicate that mindfulness interventions significantly improve levels of mindfulness and depressive symptoms [69]. However, effect sizes were small to medium. There were high drop-out rates and few trials were adequately powered. Another recent study examined an application with Spanish features with a large sample size [73] but employed statistical analysis which did not produce convincing evidence. Other studies only reviewed applications [53,74,75] and did not test them on the intended users. Another study which examined mindfulness based interventions found significant effects on well-being, stress, anxiety, depression and mindfulness but with low representation of Asian youths [76]. Another study found that there was significantly increased positive affect and decreased depression but no statistically

significant difference in satisfaction with life or negative affect, with low representation of Asian youths in the sample [77]. A study on Chinese youths [78] found that online mindfulness intervention had a significant effect on overall mental well-being and mindfulness with no specific mention to suicidality. Except [75], the applications in other studies were developed to address symptoms of mental disorders related to suicidality. These include depression, and anxiety. In summary, the extent of generalizability of such findings to suicidality in Asian youths remain questionable.

The research reviewed in Table 1 indicated that considerations for future research should include intervention lasting more than 10 days, with more than 1 post-intervention measurement [77]. To reduce drop-out rates, reminders should be sent to users [69]. Researchers should carefully consider power and sample size and ensure robustness in statistical analysis.

Currently there is a lack of interactive self-care applications available to Asian users incorporating explicit delineation of the scope or initial screening for suitability or offering targeted guidance regarding management of suicidal crisis [74]. Few of the applications currently in the market included content aimed at encouraging professional help seeking or had an explicit mention of the theoretical or empirical basis of interventions. This gap needs to be addressed by partnerships between scholars with software engineers and specialists in biomedical informatics to develop, test, and refine appropriate interfaces and applications. When designing such an application, features to be considered include: evidence base supporting use of mindfulness techniques in Asia. Mindfulness features in the application may include: breathing, body scanning, sitting meditations, walking meditations, loving kindness meditations, thoughts and emotion focus, mountain meditation, lake meditation and three-minute breathing spaces [53]. The content of applications for suicidality should contain at least one interactive suicide prevention feature, e.g., safety planning, facilitating access to crisis support and contain at least one strategy consistent with the evidence base or relevant best-practice guidelines [75]. Potentially harmful content, such as listing lethal access to means or encouraging risky behaviour in a crisis, should be carefully screened and eliminated. Psychoeducational components to reduce the stigma related to suicidality and mental illness could be incorporated [44], together with monitoring of moods and stressors or other suicide triggers [45]. Youths are adversely affected by many psychosocial stressors, such as interpersonal stress which triggers suicidal ideation [79], such triggers should be carefully assessed and addressed [4].

Another consideration is that suicidal Asian youths are not a homogenous group [4]. Suicide risk assessment needs to be conducted with consideration of risk and protective factors [45]. Therapeutic needs must be considered before clinicians decide on suitability for use of a mindfulness application with their patients. Clinicians should carefully examine the prevailing code of ethics in working with suicidal clients to ensure best practice is observed [4,44]. This may include a comprehensive suicide risk assessment before deciding on the best intervention for the client [45]. Another factor to consider is to define the primary therapeutic goal and outcome, e.g. reduced intensity or frequency of suicidal ideation, or reduced lethality [4,44] or reduced frequency of repeated suicide attempts [45], and monitor the therapeutic gains progressively. It is unclear if suicide risk screening and monitoring using a smartphone application could replace face-to-face assessment conducted by an experienced clinician, but it will seem that prevailing code of ethics and professional best practice currently does not support this [4,44,45], especially when the evidence base is not clearly demonstrated.

A limitation of the review stems from the inconsistencies of the study types included in the review. Narrative reviews were included to inform the context but should be excluded as it is challenging to compare across study types. This further highlights the paucity of research in this area. Future research could focus on empirical studies and randomized controlled trials that conform to CONSORT guidelines [80], with Asian samples. Further research is also needed to examine the parametrization of the characteristics of the application, and its quantitative analysis with Asian samples. In addition, it is unclear if discrepancies exist between Asian samples from developing and developed countries, which could be explored in future research. The strength of the review includes the investigation of an important clinical issue, and highlights the need for more research on this pertinent topic.

In summary, there is consensus that suicidal risk in youths is a rising concern, especially in Asia in recent years [4]. The potential use of smartphone applications in the delivery of mindfulness intervention tailored for suicidality in Asian youths remains promising, but evidence base to support its use is lacking. More research is needed to address the current gaps in knowledge and to provide an evidence base for the implementation of smartphone technologies. Developing mobile tools for young suicidal users requires careful ethical consideration regarding the patient-practitioner relationship, the logic of self-surveillance, prevailing code of ethics, and overall best practice. More rigorous research and evaluations are needed to ascertain the efficacy and establish evidence for best practice for usage of such smartphone applications [40].

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Conflicts of interest

The authors declare no conflict of interest.

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