



Innovations in the science of suicide



ARTICLE INFO

Keywords:
Suicide
Suicide prevention
Innovation
Special issue

ABSTRACT

Globally, close to 800,000 individuals die by suicide each year. A scientific understanding of suicidal thoughts and behaviors have been slow to emerge owing to a number of challenges including low base rates, complexity and nonlinearity, low precision and accuracy of identification and detection methods, and variability across social and environmental contexts. To overcome these challenges, researchers have developed increasingly innovative and creative methods to overcome these challenges. These innovations hold considerable promise for advancing the science of suicide via large leaps forward rather than incremental steps. In this special issue of *Behaviour Research and Therapy*, we highlight several such efforts.

Globally, an estimated 800,000 people die by suicide each year, which translates to a worldwide suicide rate of 10.6 per 100,000 (World Health Organization [WHO], 2018). Although suicide rates have declined in many nations since 2000, suicides have steadily increased in others (WHO, 2018). In the U.S., for instance, the general population suicide rate has increased by approximately 33% to 14.5 per 100,000 in 2017 (Stone et al., 2018). In recent years, several high-profile celebrity suicides and suicides of mass shooting survivors and their family members have contributed to increased awareness about suicide and led to calls for improved suicide prevention research funding. In this special issue of *Behaviour Research and Therapy*, entitled “Innovative Methodologies to Advance the Science of Suicide,” we highlight both basic and applied research studies that use a range of contemporary and nontraditional designs and methodologies employed specifically to improve our understanding of suicidal thoughts and behaviors. Given the considerable consequences of suicide on family members, communities, and society at large, when selecting contributions for this special issue, we gave priority to studies and papers that reported “high risk, high yield” methodologies. Thus, the articles featured in this special issue have the potential to advance the field's understanding of suicidal behavior and suicide prevention by taking large jumps rather than taking incremental steps.

Historically, suicide prevention research has been faced with several key challenges. First, suicidal behavior's low base rate with respect to low prevalence within the population as well as infrequent occurrence during specified periods of time renders the phenomenon difficult to study. Second, traditional data analytic methods are not well-suited to model or describe the complex interactions among numerous variables and complex time course that eventually lead to suicidal behavior. Third, the strongest correlates of emerging suicidal behavior, such as suicide ideation, are denied by many individuals who attempt suicide or die by suicide leading up to their suicide attempt/death. Fourth, the emergence of suicidal behavior is influenced and shaped by social context and environmental forces (e.g., interpersonal conflict, financial strain), but the ways in which these contexts can influence suicidal behavior remain poorly understood. We have organized the special

issue to elucidate novel, innovative empirical avenues for addressing these four challenges.

Beginning with the problem of low base rates, as well as the separate but also important problem of identifying causal risk factors for suicidal behaviors, the issue's first contribution (Franklin, Bastidas, & Huang, 2019) investigates the potential utility and safety of virtual reality technology for researching suicidal behaviors. “Virtual” suicide—engaging in suicide-like behavior within the context of the virtual reality environment (e.g., jumping from a simulated height, shooting oneself with a virtual firearm)—may provide an analog of actual suicidal behaviors, thereby providing researchers with a potential solution to the historic challenge of studying a low base rate phenomenon. Although virtual suicide certainly is not the same as actual suicide, the quality and sophistication of modern-day virtual reality technology can nonetheless provide such a highly immersive experience that the decision-making processes and sensory experiences involved in a virtual suicide attempt may be similar, if not identical, to those associated with actual suicide. If true, the procedure introduces new considerations regarding the ethical and responsible conduct of research with human subjects. Recognizing this, Franklin and colleagues examined safety and the potential for harm associated with virtual suicide scenarios and concluded that research methodology should employ choice-based paradigms that emphasize the participant's right to *not* engage in virtual suicidal behaviors.

The next series of papers addresses the problem of suicide's complexity from two different perspectives: structure and time. Regarding structural complexity, De Beurs et al. (2019) use network analysis to model the associations among multiple correlates of suicide ideation, resulting in a “map” of the web of some of the key risk and protective factors for suicide ideation. Network analysis may provide important clues about the associations among the heterogeneous risk factors for suicide ideation that could help to understand how and why such different factors might influence suicidal thoughts and behaviors. To the extent that these associations may be causal (an open question), such results could help to develop new strategies to prevent suicide and to refine or improve empirically-supported strategies that already exist.

<https://doi.org/10.1016/j.brat.2019.103451>

Regarding temporal complexity, accumulating evidence shows that suicide risk is dynamic, such that suicidal thinking fluctuates over time, sometimes rapidly and dramatically. This property of suicide risk is apparent only when suicide ideation and other variables are repeatedly assessed over time. Coppersmith, Kleiman, Glenn, Millner, and Nock (2019) use ecological momentary assessment (EMA) to model these fluctuations in near real-time. Such fine-grained measurements are now easy to obtain due to the ubiquity of smart phones, which enable researchers to quantify and measure psychological phenomena with a degree of precision among representative samples that simply was not possible prior to the past decade. Using this approach, Coppersmith et al. (2019) show that perceived social support (a construct typically measured cross-sectionally) varies concurrently (and inversely) with day-by-day with suicide ideation suggesting it is a time-varying protective factor for ideation, but in this study social support was not a prospective predictor of changes in suicide ideation.

EMA holds a number of advantages for understanding the ebb and flow of suicide risk over time, but it is not the only way to capture these dynamics. In clinical settings, for instance, suicide risk is often repeatedly assessed on a session-by-session basis using empirically-supported symptom checklists and suicide risk screeners. Bryan, Rozek, Butner, and Rudd (2019) show how nonlinear modeling of these session-to-session scores, using a data analytic approach informed by dynamical systems theory, can be useful for identifying patients who are vulnerable to making a suicide attempt during or after treatment. Their results suggest that patients who eventually attempt suicide demonstrate distinct nonlinear change patterns characterized by large within-person fluctuations in suicide ideation. Between-person analyses did not distinguish those who eventually attempted suicide, however, which suggests that consideration of patient-centered patterns of change may be a more useful suicide risk monitoring strategy than simply focusing on a patient's overall score during a given session.

Unfortunately, the majority of individuals who engage in suicidal behaviors deny suicide ideation—the third major challenge of suicide prevention research. New methods for identifying high risk individuals who deny suicidal thoughts are therefore needed. To address this problem, Bernecker et al. (2019) use a multistage data analytic approach to better identify individuals likely to engage in suicidal behavior despite denying suicidal thoughts. Out of 27,501 participants, 87% ($n = 23,854$) denied a lifetime history of suicide ideation. Bernecker and colleagues used machine learning to rule out the subgroup of “non-ideators” (i.e., those who deny suicide ideation) who were unlikely to attempt suicide, and then used machine learning to identify the highest risk subgroup of those who “non-ideators” were not ruled out. The resulting algorithm identified 30% of “non-ideators” as high risk, and these individuals accounted for more than 80% of suicide attempts in the full sample. Approximately 10% of this high risk subgroup accounted for nearly half of all suicide attempts in the full sample. These results highlight the potential value of machine learning and multistage analyses for identifying very high risk subgroups within a population.

Hamed, Colborn, Bell, Chalker, and Jobs (2019) provide an alternative and simple method for identifying high risk patients that does not depend on the self-disclosure of suicide ideation. In their study, Hamed and colleagues analyzed patients' responses to several open-ended prompts that direct patients to describe several aspects of psychological pain and distress; for example, to identify the most painful, stressful, and hopeless parts of their lives. Patients who repeatedly described a particular topic across multiple prompts had much higher levels of suicide risk, suggesting that a relatively straightforward method for quantifying behavioral perseveration may signal elevated risk for suicide.

The special issue concludes with several papers addressing the challenge of understanding the contexts and situations within which suicidal thoughts and behaviors emerge and are maintained. Zhang, Szanto, Clark, and Dombrowski (2019) show that decision-making among individuals who have attempted suicide may be less sensitive to contextual information, especially information regarding the intentions and psychological state of others. These findings provide a unique perspective regarding decision-making processes associated with suicidal behaviors, and suggest that individuals who attempt suicide may be influenced less by the emotional or psychological state of others. Rogers, Hom, Stanley, and Joiner (2019) find that psychological closeness (i.e., sense of attachment or familiarity) with a suicide method can influence the extent to which an individual thinks about suicide. These findings suggest the potential benefit of creating and/or reinforcing psychological distance between an individual and their preferred suicide method as an adjunct to reducing an individual's physical proximity to the preferred suicide method. This may be especially relevant when working with individuals who are unwilling to remove potential methods for suicide from their home or immediate environment.

The final paper in our special issue (May, Crenshaw, Leifker, Bryan, & Baucom, 2019) considers another important social context for suicide: romantic relationships. Romantic relationships provide an especially interesting problem within suicide prevention because they simultaneously serve as a protective factor for suicide but, when strained, serve as a risk factor. The results of May and colleagues indicate that, although romantic partners are often aware of each other's current emotional distress and history of suicidal thoughts, very few may be aware of a partner's previous suicidal behavior and current risk for suicide. These results suggest that suicidal individuals often conceal or withhold information about suicide risk from those with whom they have close and intimate relationships.

Taken together, we still have much to learn about the complexity of individual and contextual processes that lead to suicide risk. We hope that the innovative and novel research approaches featured in this special issue will stimulate more critical, creative, and meaningful clinical science focused on understanding suicidal thoughts and behaviors. This issue ultimately aims to lead new advances and discoveries that can prevent this tragic manner of death.

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