

# Promising Strategies for Advancement in Knowledge of Suicide Risk Factors and Prevention

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Suicide is an important public health problem. Although there have been advances in our knowledge of suicide, gaps remain in knowledge about suicide risk factors and prevention. Here, we discuss research pathways that have the potential to rapidly advance knowledge in suicide risk assessment and reduction of suicide deaths over the next decade. We provide a concise overview of the methodologic approaches that have the capacity to rapidly increase knowledge and change practice, which have been successful in past work in psychiatry and other areas of medicine. We suggest three specific pathways to advance knowledge of suicide risk factors and prevention. First, analysis of large-scale epidemiologic surveys and administrative data sets can advance the understanding of suicide. Second, given the low base rate of suicide, there is a need for networks/consortia of investigators in the field of suicide prevention. Such consortia have the capacity to analyze existing epidemiologic data sets, create multi-site cohort studies of high-risk groups to increase knowledge of biological and other risk factors, and create a platform for multi-site clinical trials. Third, partnerships with policymakers and researchers would facilitate careful scientific evaluation of policies and programs aimed at reducing suicide. Suicide intervention policies are often multi-faceted, expensive, and rarely evaluated. Using quasi-experimental methods or sophisticated analytic strategies such as propensity score-matching techniques, the impact of large-scale interventions on suicide can be evaluated. Furthermore, such partnerships between policymakers and researchers can lead to the design and support of prospective RCTs (e.g., cluster randomized trials, stepped wedge designs, waiting list designs) in high-risk groups (e.g., people with a history of suicide attempts, multi-axial comorbidity, and offspring of people who have died by suicide). These research pathways could lead to rapid knowledge uptake between communities and have the strong potential to reduce suicide.

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## Introduction

Suicide is an important cause of death throughout the world.<sup>1</sup> Suicide rates in the U.S. have increased rather than decreased in the last decade.<sup>2</sup> There is an urgent need for research that rapidly advances

knowledge and has rapid uptake by policymakers and clinicians to reduce suicide deaths.

One of the major challenges in advancing knowledge around suicide prevention is that deaths by suicide are relatively infrequent events. Although the gold standard test of an intervention is an RCT, conducting RCTs that are powered for detecting impact on suicides are expensive, difficult to coordinate, and require long periods of follow-up.<sup>3</sup> Here, we discuss three key research pathways (analysis of existing data sets that include suicide variables, networks and consortia focused on suicide prevention, and researchers working with policymakers to address important questions related to suicide) that we believe can advance the field of suicide prevention in a manner that will reduce suicides over the next 10 years. To guide the current discussion, we list the well-established suicide risk factors<sup>4</sup> and prevention strategies

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**Table 1.** Selected suicide risk factors and interventions: individual, family, and community levels

Risk factors	Interventions
<b>Individual level</b> <ul style="list-style-type: none"> <li>● Sex/gender</li> <li>● Occupation</li> <li>● History of suicide attempts</li> <li>● Mental disorder (anxiety, mood)</li> <li>● Addictions</li> <li>● Physical illness</li> <li>● Financial stress</li> <li>● Personality disorders/impulsivity/aggression</li> <li>● Legal problems</li> <li>● Lack of religious affiliation</li> </ul>	<ul style="list-style-type: none"> <li>● Timely access to evidence-based interventions in various settings: college, workplace, justice, primary care, organized faith settings, specialty care (S/I)</li> <li>● Postdischarge follow-up contact for patients hospitalized for suicidal behavior (I)</li> </ul>
<b>Family level</b> <ul style="list-style-type: none"> <li>● Childhood maltreatment</li> <li>● Intimate partner violence</li> <li>● Addictions, mental disorders, suicide in family members</li> </ul>	<ul style="list-style-type: none"> <li>● Positive parenting programs (U/S)</li> <li>● Family-based interventions (U/S)</li> <li>● Peer support for young mothers (S)</li> <li>● Support for the bereaved (S)</li> </ul>
<b>Community level</b> <ul style="list-style-type: none"> <li>● Suicide in peers</li> <li>● Sensational media reporting of suicide</li> <li>● Specific cultural factors (e.g., Native Americans, immigrants, refugees)</li> <li>● Access to lethal means: guns, pesticides</li> </ul>	<ul style="list-style-type: none"> <li>● School-based evidence based programs (U)</li> <li>● Media education of safe reporting (U)</li> <li>● Culturally grounded interventions (U/I/S)</li> <li>● Means restriction (U)</li> <li>● Crisis lines (U)</li> </ul>

Note: IOM-defined prevention programs: I, indicated; S, selective; U, universal.

I programs target groups that have already developed the disease and aim to reduce severe problems.

S programs target groups at high risk for the outcome or disease.

U programs include all people in a certain community in the intervention.

at the individual, family, and community levels (Table 1) and describe the limitations of the current knowledge in these areas.

### Limitations of the Current State of Knowledge on Suicide Risk Factors

Suicide is, fortunately, a relatively rare event. Unfortunately, this makes it hard to study for a variety of reasons.<sup>4</sup> First, empirical data on optimal screening and prediction tools for suicide are lacking.<sup>5</sup> Many suicide risk assessment tools (e.g., SAD PERSONS scale) have good sensitivity but poor positive predictive value in their ability to forecast future suicide attempts.<sup>5,6</sup>

Second, there is a lack of understanding of suicide risk in vulnerable groups (e.g., military personnel, ethnic minorities, socially deprived individuals). For example, depending on the group studied, social markers such as income and marital status have been shown to be both suicide risk and protective factors.<sup>7,8</sup>

Third, with the recent increase in use of social media, information is lacking on the impact of exposure to suicide in social media on suicide contagion. Fourth, although there has been an increase in prevalence of non-suicidal self-injury,<sup>9</sup> the longitudinal course and risk for

death by suicide among people with non-suicidal self-injury remains unknown. Fifth, most epidemiologic studies of suicidal ideation and attempts have been cross-sectional, may be affected by recall bias, and are not generalizable to death by suicide.

### Limitations of Evidence in Suicide Prevention

Although a wide range of suicide prevention strategies are suggested in guidelines worldwide (Table 1), it is important to underscore that most of the suicide prevention strategies, with the exception of means restriction policies,<sup>10</sup> training of physicians in treating depression,<sup>11</sup> and postcards after hospitalization for suicide attempts,<sup>12</sup> lack strong empirical evidence for reducing suicidal behavior. There is, therefore, an urgent need to rigorously test promising suicide prevention strategies.

Owing to the low base rate phenomenon of suicide, extremely large sample sizes (thousands of people) often followed over relatively long periods of time are required to test whether interventions are effective. The most-cited studies in the field of suicide prevention to date are quasi-experimental designs in high-risk adult groups (e.g., Air Force personnel,<sup>13</sup> regions of Hungary<sup>14</sup>) where

improving/increasing gatekeeper training for suicide and treatment of depression by primary care physicians reduced suicide rates.

Furthermore, large-scale clinical trials for mental disorders often exclude people with a high risk of suicidal behavior. Thus, there is little information available from RCTs regarding effective interventions in high-risk adults. Even less data are available for optimal methods of intervention in culturally diverse groups.<sup>15</sup> Finally, given the complex multifactorial and heterogeneous etiology of suicide, large-scale public health interventions may be expensive and typically have small effect sizes.<sup>16</sup> In the context of limited funding for research, investigators often face significant obstacles in designing fundable studies.

### **Suggested Research Pathways**

In order to advance knowledge of suicide risk factors and evaluate suicide prevention strategies, the following three main research pathways are suggested (Table 2).

#### **Pathway 1: Analyses of Existing Epidemiologic, Clinical, and Administrative Data**

Although there has been a large increase in knowledge around risk factors for suicide, existing large, longitudinal mental health surveys and clinical trial databases are

publicly available and can be analyzed to further increase our understanding of risk factors for suicide and suicide attempts.<sup>17</sup> There is also a need for developing predictive algorithms for suicide similar to those developed in the Framingham Heart study<sup>18</sup> for development of a core set of predictors for cardiovascular disease. This would require identifying a select group of key, potentially modifiable risk factors that could be targeted among individuals at high suicide risk. However, such large-scale intervention studies are time consuming and costly.

In the medical field, there has been an increase in the use of propensity score-matching analysis to determine if certain interventions (e.g., pharmacotherapy) have impact on outcomes.<sup>19,20</sup> Although these types of observational methodologies may not entirely remove residual confounding issues, they are economically feasible and overcome the ethical concerns about randomization of high-risk groups.<sup>21</sup> Propensity score-matching analyses have been used, for example, to understand the impact of antidepressants during pregnancy on fetal and neonatal outcomes where randomization is clearly not acceptable because of ethical issues.<sup>22</sup>

The analysis of large-scale epidemiologic surveys and administrative databases has been instrumental in increasing our understanding of suicide risk. Much of our understanding of risk factors for suicide attempts

**Table 2.** Strengths and limitations of proposed research pathways

Research pathways	Strengths	Limitations
<b>1. Analysis of existing epidemiologic samples and clinical trial databases</b>	Data already collected Inexpensive to conduct analysis  Large sample size	Limited by what is already collected in data sets Observational studies, causal inferences cannot be made
<b>2. Networks and consortia of researchers</b>	Multi-site prospective cohorts (history of suicide attempts, family history of suicide) Sufficient sample sizes to examine biomarkers, genetics, and imaging work to understand biological factors related to suicide Understand the natural trajectory of suicidal behavior	Large infrastructure support required Observational studies  Substantial effort to create the network and develop partnerships
<b>3. Evaluation of current or new policies and programs</b>	Creates partnerships between policymakers and researchers in suicide  Bidirectional knowledge exchange leads to rapid uptake of new knowledge in suicide prevention Careful evaluation of large-scale policies leads to an understanding of which suicide policies have an impact on suicide Multi-site clinical trials with high-risk samples Sufficient sample size to detect impact of interventions on suicide attempts or deaths	Large-scale policies are heterogeneous and it may be difficult to discern which parts of the policies are associated with reductions in suicide Quasi-experimental designs preclude causal inferences  Ethical issues of conducting RCTs in high-risk groups

comes from cross-sectional and longitudinal epidemiologic surveys, whereas understanding of suicide deaths comes from administrative database studies from the U.S., Europe, and Canada. Examples of secondary analysis of existing data sets includes the examination of controversial topics such as the relationship between anxiety disorders and risk of suicidal behavior among adults.<sup>23</sup> Based on a series of studies using several epidemiologic data sets, there has been an expansion of the understanding of the importance of anxiety,<sup>24</sup> specifically posttraumatic stress disorder and panic disorder, as triggers for suicide attempts.<sup>23</sup>

Administrative data sets that link vital statistics databases with de-identified health information (e.g., physician contacts, prescription drug use) have rapidly advanced the understanding of suicide risk factors suicide.<sup>25</sup> They also provide the opportunity to objectively assess factors such as treatment seeking and overcoming the recall bias inherent in survey data. Using this method, Olfson et al.<sup>26</sup> have shown the gaps in follow-up care of patients after they present to emergency departments for suicide attempts.

This strategy is relatively inexpensive and can rapidly yield novel findings. However, observational studies (the use of techniques such as propensity matching notwithstanding) do not provide the same strength of evidence for cause and effect as data obtained in randomized trials.

## Pathway 2: Need for Networks and Consortia

Given the low base rate phenomenon of suicide, a consortium of researchers across multiple sites is needed to generate findings backed by sufficient statistical power. These team endeavors also have the advantage of bringing together a diverse, highly expert group of researchers. This strategy enhances knowledge transfer opportunities both within the consortium and more broadly with the scientific community and public stakeholders, given the greater number of connections inherent in a larger team. Together, these factors enhance the potential for both rapid knowledge advancement and dissemination, increasing the likelihood of uptake in clinical and policy domains. Similar consortia have been necessary and successful in the field of genetics<sup>27</sup> where large sample sizes and diverse research expertise are also needed.

In suicide research, networks of researchers are needed to overcome the lack of understanding of the neurobiology and genetics of suicide. We suggest that networks could rapidly advance knowledge in suicide prevention by using longitudinal epidemiologic studies of high-risk samples. Prospective cohorts are required, where data on

family history of suicides or previous suicide attempts, as well as multiple mental and physical illnesses, can be “concentrated” for the highest likelihood of attempting suicide.

Weissman<sup>28</sup> discussed the concept of *translational epidemiology*, where population-based samples are recruited and their biological factors are examined (genetics and biomarkers) to increase knowledge of the biological underpinnings of suicidal behavior. Such efforts are essential in advancing the understanding of suicide biomarkers that have the potential to transform suicide risk assessment and personalized treatments.

Owing to the increase in suicide rates in the U.S. military in the mid to late part of the past decade, U.S. government agencies have funded consortia such as the Military Suicide Research Consortium ([msrc.fsu.edu](http://msrc.fsu.edu)) and the Army Study to Assess Risk and Resilience in Service members (Army STARRS; [armystarrs.org](http://armystarrs.org)).<sup>29</sup> These consortia bring together a large group of investigators to conduct a series of studies to rapidly increase the knowledge of suicide risk factors among service members. In civilian samples, there are also examples of these networks on suicide prevention in Europe and Canada. Each network often has a particular focus. For example, some networks focus on genetics, whereas others, like our team in Manitoba, have focused on cultural factors related to suicide risk and culturally grounded universal suicide prevention strategies.<sup>15</sup>

We encourage the development and funding of more suicide prevention networks across civilian populations. Lessons learned include the fact that it can take months to years for a consortium to coalesce in terms of policies and procedures; hence, any investment in such an entity must have a long-term perspective. Once up and running, however, the ability to harness the brainpower and person-power of a large co-operative group of committed researchers focused on a problem can jump-start the generation of new knowledge. In addition, networks that engage policymakers can have important collaborative efforts in creating new knowledge on suicide prevention (see Pathway 3 below).

The strengths of this approach are that there can be a synergy in creating new knowledge, with the potential for multi-site intervention studies and collection of high-risk cohorts that are sufficiently powered to test the impact of interventions on suicide attempts and deaths. However, limitations of this approach include the need for substantial funding to create such a consortium, combined with the challenge of coordinating large research groups. Moreover, a large team of researchers can lead to synergistic efforts, but in some cases may inhibit the individuals within a team to innovate and create novel

strategies or approaches to suicide prevention that are not agreed upon by the leaders of the network.

### Pathway 3: Researchers and Policymakers Working Together to Evaluate Policies of Suicide Prevention Programs

All too frequently, governments implement far-reaching and, at times, very expensive policy changes intended to have specific effects (e.g., reduction of suicide deaths) but fail to put in place in advance the means to evaluate such interventions. Collaboration between policymakers and researchers, prior to the implementation of the intervention, can facilitate the optimal evaluation of suicide prevention programs. We argue that there is a need for further work on examining policies using existing administrative data, quasi-experimental designs, or RCTs if possible.

There are several examples of high-quality evaluations of suicide policies using observational studies. Similar efforts are needed across different countries, health systems, and cultural contexts. A seminal paper<sup>13</sup> in the field of suicide prevention demonstrated the impact of policy changes in suicide prevention for U.S. Air Force personnel. The authors used a quasi-experimental design to demonstrate a reduction in suicides associated with a multi-layered program implemented in a cohort of more than 5 million U.S. Air Force personnel.

Similarly, in a high-risk region in Hungary,<sup>14</sup> education of primary care providers in the treatment of depression was associated with a reduction in suicides in the intervention area compared to surrounding regions that did not receive the intervention. Recently, While and colleagues<sup>30</sup> examined the impact of several suicide policies in the United Kingdom and found that certain policies were associated with reduction in suicides (e.g., 24-hour crisis lines, multi-disciplinary review of suicides) whereas other policies were not.

Finally, healthcare reform is currently an enormous public health concern in the U.S. Sommers et al.<sup>31</sup> examined the impact of expansion of Medicaid in certain U.S. states using a quasi-experimental design and demonstrated that the states with expanded Medicaid coverage had an associated decrease in mortality. Similar methods could be used to examine the impact of Medicaid expansion (or other broad policy changes) on suicide rates.

In addition, with the recent gun violence in the U.S., there has been increasing concern about the need for stronger policies on firearm regulations. Analysis of U.S. state data showed an association between higher state-level regulations of firearms and a lower likelihood of suicides and homicides.<sup>32</sup> Although these types of ecologic data preclude inferences about causality, this

recent paper suggests that means restriction policies may have the capacity to reduce suicides. Rapid analysis of policy-relevant questions could be conducted efficiently with these types of administrative data analyses.

To overcome the limitations of the quasi-experimental designs of the aforementioned studies, it would be ideal to conduct RCTs (e.g., cluster randomization, waiting list designs) when governments initiate new suicide prevention programs that have not been previously tested in RCTs. The Canadian government has, for example, partnered with researchers to implement a large-scale pragmatic RCT of Housing First consisting of case management for more than 2,000 homeless individuals with mental illness. This trial provided the opportunity to evaluate a promising intervention across five cities in Canada and engaged policymakers throughout the process.<sup>33</sup>

Our team is also working with policymakers to facilitate the evaluation of promising suicide prevention programs that are being implemented (gatekeeper training) in Canada. Gatekeeper training involves coaching people (adults and youth) in the community who have primary contact with those at risk for suicide in identifying and assisting them in getting care.<sup>34</sup> Similar clinical trials are required for testing interventions among individuals at high risk for suicide (i.e., previous suicide attempters, those with multi-axial comorbidities, and offspring of people who have died by suicide).

Systematic evaluation of large-scale public health interventions has the potential to show an impact on relatively infrequent outcomes such as suicide and suicide attempts. Researchers benefit from this approach because they do not need to acquire funding for or deliver the expensive large-scale interventions (governments are already funding the roll-out of these untested programs).

Instead, researchers can focus on acquisition of funding to conduct thoughtful evaluation of the interventions. Policymakers can benefit from working with researchers who evaluate the interventions on suicide to ensure that programs and funding are doing what they are supposed to do (i.e., reducing suicides). However, strong partnerships between government and researchers are required to ensure clear roles and effective administration of both the intervention and evaluation of the program.

As many suicide prevention strategies are multi-layered, it may be difficult to discern the effective “ingredient” of the intervention. Also, evaluation of the process of policy implementation is essential in large-scale studies to ensure fidelity to the intervention. Although cluster randomization would be ideal, it may not be possible given that governments may be reluctant to “withhold” a potentially helpful intervention from a given community. Although this is politically

understandable, from a scientific perspective it is equally unjustified to subject a community to an unproven intervention that could do harm.

Thus, although quasi-experimental designs have been used to evaluate policies, these designs preclude strong causal inferences. Randomization may be more acceptable if a “proven” treatment is compared against a new, potentially better treatment. Finally, governments might not wish to evaluate the implemented programs because of fear of finding that the program is ineffective, which may lead to negative media attention and other political hazards.

## Conclusions

In conclusion, we suggest three specific and complementary pathways to rapidly advance knowledge in suicide risk and reduce suicides: (1) increasing the analysis of existing databases to further our knowledge of risk and protective mechanisms in suicide; (2) creation of networks and consortia that have the platform for cross-site studies in suicide risk and suicide intervention; and (3) forging of partnerships between policymakers and researchers to rapidly test the impact of current and new policies in suicide prevention.

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