A Prioritized Research Agenda for Suicide Prevention:

An Action Plan to Save Lives

Research Prioritization Task Force

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**National Action Alliance for Suicide Prevention
Research Prioritization Task Force**

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An Action Plan to Save Lives**

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Message from the Research Prioritization Task Force

As co-leads of the Research Prioritization Task Force (RPTF), we would like to acknowledge all of the people who have contributed their knowledge, energy, and time to this project. Their efforts over the past three years have made this comprehensive research agenda possible. For years to come, it will guide research resources aimed at reducing the incidence of suicide in the U.S.

We are thankful for the many people who participated in the research, conducted analyses, helped shape the design of the agenda, and shared their aspirations for a society less burdened by suicide. These participants include researchers, National Institute of Mental Health (NIMH) staffers, the leadership of the National Action Alliance for Suicide Prevention (Action Alliance), members of the National Council for Suicide Prevention, and the many other stakeholders supporting this vital effort.

With publication of *A Prioritized Research Agenda for Suicide Prevention: An Action Plan to Save Lives* and its accompanying document—*Suicide Research Prioritization Plan of Action*—we move together to the next phase of the project. While the publication of this agenda is a significant accomplishment, there is much yet to be done to achieve the goal we share. This involves disseminating the agenda, encouraging its adoption and implementation by all of those working in this field, updating the agenda's goals as progress is made, and conducting the additional research that will be needed.

For today, however, it is important to acknowledge that we would not be in the position to bring this project to its next phase without the dedication and help of all those involved. We are grateful.

Phillip Satow *(Private Sector Co-lead)*
Representative
National Council for Suicide Prevention
Chair of the Board
The Jed Foundation

Thomas Insel, MD *(Public Sector Co-lead)*
Director
National Institute of Mental Health
National Institutes of Health
U.S. Department of Health and Human Services

Action Alliance — NATIONAL — FOR SUICIDE PREVENTION
The Public-Private Partnership Advancing the National Strategy for Suicide Prevention

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PART 1: Executive Summary and Overview

I.) Executive Summary

A.) Need for a Suicide Research Agenda

The 1999 Surgeon General's *Call to Action to Prevent Suicide* (U.S. Public Health Service, 1999) called for a national research agenda on suicide prevention to mobilize the scientific community to systematically identify research gaps and address prevention challenges. In 2001, Objective 10.1 of the *National Strategy for Suicide Prevention* (NSSP; U.S. Department of Health and Human Services, 2001) called for development of a national suicide prevention research agenda, and the Institute of Medicine (IOM) was subsequently commissioned to review existing scientific literature and to suggest a way forward (Goldsmith et al., 2002). In spite of continued public (approximately $40 million per year from the National Institutes of Health) and private (approximately $20 million from American Foundation for Suicide Prevention since 2002) investment in research over the past decade, there is no evidence of an overall decrease in suicide deaths or attempts in the U.S. In 2010, the National Action Alliance for Suicide Prevention was established as a public-private partnership to explore opportunities for and barriers to progress. The Action Alliance published the 2012 National Strategy for Suicide Prevention (NSSP), including among its goals the need to prioritize research with a new agenda for research to reduce suicide. The Research Prioritization Task Force (RPTF) of the Action Alliance set out to develop this new research agenda. This step meets Goal 12 of the 2012 *NSSP*.

Responding to the challenge of addressing such an important societal problem, the RPTF directed its planning efforts using the following strategy:

> **Develop a prioritized approach for allocating funds and monitoring future suicide research to ensure that available resources target research with the greatest likelihood of reducing suicide morbidity and mortality.**

B.) The Research Prioritization Task Force Goal

Overall, U.S. rates of suicide deaths have not decreased appreciably in 50 years. In 2010 (the most recent data available at the time of this publication), there were more than 650,000 hospital visits related to suicide attempts, and more than 38,000 individuals died by suicide. The RPTF developed its agenda for research with the stated goal to reduce morbidity (attempts) and mortality (deaths), each by at least 20% in five years and 40% or greater in 10 years, *if implemented fully and successfully*. This approach is consistent with the Action Alliance goal to save 20,000 lives in five years. Asking Action Alliance members, and the RPTF stakeholders in suicide research, to consider these aspirational targets in their efforts has never been tried at a national level before. While such reductions in a relatively short amount of time may not be fully met, the intent of these targets is to inspire new ways of thinking of how the many suicide prevention efforts can all be a part of the solution. A research document alone cannot reduce suicide deaths or attempts; rather, its intent is to identify the research needed to guide practice and inform policy decisions across many areas—for example, health care, criminal justice, education, and social media-- which will cumulatively contribute to the 20% and 40% reduction goals.

Future reductions in suicide burden will require multiple actions, and research can determine the potential benefits of suicide prevention efforts. The RPTF intended that research should fill gaps identified by the agenda itself, in order for these optimized models to reach substantial reductions in

suicide deaths and attempts. To illustrate that the goal to reduce suicide deaths and attempts by 20% in the next five years is possible if multiple and effective approaches are applied, members of the RPTF sought information on where suicidal individuals are seen in boundaried systems (i.e., settings such as health care, education, workplaces, incarceration, probation, and parole; see Glossary), and estimated the number of people who could be reached by an intervention and the number of attempts and deaths that could be prevented. The RPTF also considered the various suicide methods used by high-risk individuals, where interventions related to the methods could reduce fatalities.[1] Figure 1 illustrates one approach to identifying subgroups of suicide decedents (acknowledging that a number of subgroups likely overlap), where intervention efforts could be applied to reduce suicide burden. Appendices C and D provide further information on this approach.

Figure 1. Identifying 38,000 Suicide Decedents in the United States

Data Sources:
1. CDC WISQARS 2010
2. CDC WONDER 2010
3. Bureau of Justice Statistics 2008-2009
4. DoDSER CY 2011 Report
5. Trofimovich et al 2012
6. Department of Veterans Affairs 2012
7. CDC WISQARS 2010 & Owens et al, 2002
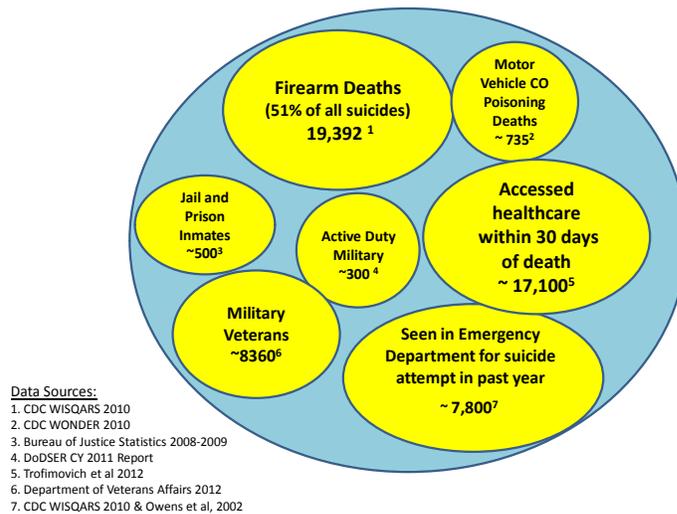
The RPTF used modeling exercises to gage the scope of what might be possible for reducing suicides in one, as well as five years and longer (see Appendix G). The models examined five different approaches to suicide prevention, and used population estimates to project reduced suicide attempts and deaths if the interventions were fully implemented. The approaches included implementing parity coverage for mental health care, adding a car safety feature, improving firearm safety, providing brief psychotherapy treatments in emergency care, and implementing a school-based prevention program. As an example, the figure below shows that a combination of just three approaches, if fully implemented, could save many thousands of lives in **one year** (see Figure 2; this only reflects adult populations).

Figure 2. Suicide Deaths Prevented by Proposed Interventions

Approximating a 20% Reduction in 2010 Suicide Deaths

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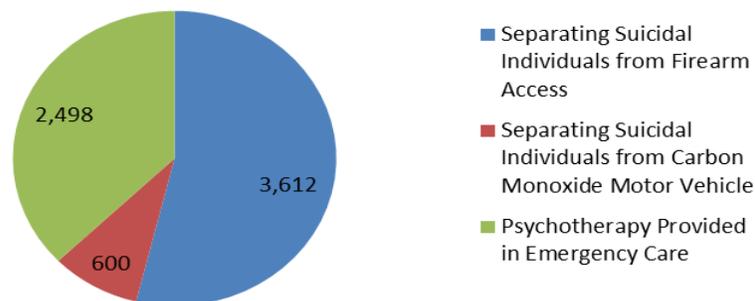
[1] For a complete discussion of boundaried populations and suicide means analysis, see Section V.

Additional interventions that could also make an impact in reducing suicide attempts and deaths include: effective psychotherapy offered in non-emergency settings to those who have attempted suicide; limiting access to other lethal means, such as through changes in packaging and dispensing of medications; and several other healthcare service system interventions that show similar promise, such as 24-hour access to crisis care. When considering the benefits of these interventions together, it is evident that the Action Alliance goal of preventing 20,000 suicide deaths over five years, and the RPTF goal to reduce 20% of all suicide deaths at the end of five years (7,673 [20% of 38,364 suicide deaths in 2010]) could be attained if existing preventive interventions were research informed, and fully and successfully implemented. Significant advances in other prioritized areas of research could produce much larger reductions in a ten-year timeframe.

C.) Key Questions

The following questions were explored to identify the state of the science, pathways for progress, and specific objectives:

Key Question 1: Why do people become suicidal?

Key Question 2: How can we better or optimally detect/predict risk?

Key Question 3: What interventions are effective? What prevents individuals from engaging in suicidal behavior?

Key Question 4: What services are most effective for treating the suicidal person and preventing suicidal behavior?

Key Question 5: What other types of preventive interventions (outside health care systems) reduce suicide risk?

Key Question 6: What new and existing research infrastructure is needed to reduce suicidal behavior?

D.) Cross-cutting Themes

Several cross-cutting themes emerged throughout the agenda-development process. These themes are primarily methodological issues that, if addressed, would facilitate progress in multiple research areas:

- Enhance and extend surveillance measures of suicide burden of both national and community-level scope. This information must be timely and useable to determine suicide burden. Information on the natural history of when and how individuals move through low- and high-risk states is a critical need.
- Leverage investments by encouraging the use of: a) common data elements in all suicide research; b) plans for data banking (e.g., brain banks, imaging, and genetic repositories) as appropriate; and c) data sharing with appropriate consent and privacy protections (e.g., consistent approaches to self-reports, neurocognitive assessments, core biological markers).
- Use patient registries and rigorous designs to test the feasibility of fast-acting medications. Consider community strategies to reduce access to lethal means. Test new technologies (e.g., imaging, neuropsychology approaches, peripheral blood marker) for prediction of risk and/or intervention response.
- Field studies of practical, randomized trials to determine the benefits of quality improvement in health care systems. Adapt and test appropriate components within other systems that have

responsibility for housing or managing at-risk populations (e.g., justice, education, services for older adults).

- Use multi-disciplinary approaches to understand and harness media influence (e.g., social, entertainment, and gaming sectors) and community values on individual means preferences and behaviors.
- Test approaches to initiate and maintain healthy behaviors and/or interventions that are aimed at reducing risk factors, including technological enhancements to facilitate social connections and help-seeking.
- Include measures of suicidal behavior outcomes into studies targeting known risk factors (e.g., interpersonal violence, depression, substance abuse trends) to test the putative role of the risk factors. This will leverage other investments in prevention and treatment studies to inform suicide research. Given the higher non-suicide mortality observed among people who attempt suicide, suicide prevention efforts may reduce other mortality outcomes.
- Determine how to improve the adoption, fidelity of implementation, and sustainability of effective suicide prevention programs, with attention to efficient ways of training various types of providers (from lay providers to specialists).

E.) Conclusion

By asking a variety of stakeholders—including those at risk, family members, suicide attempt survivors, suicide loss survivors, advocates, and research experts—to consider the potential impact of approaches to suicide prevention in reducing suicide deaths and attempts, the RPTF sought the best ideas for an actionable research agenda tied to a suicide burden reduction goal. By focusing on suicide means and suicide mortality and morbidity among populations identified by various settings, and the potential impact of existing interventions, the RPTF validated this prioritized agenda as a strategic guide for research. More refined estimates of burden and modeling that focus on risk factor abatement, resilience enhancement, and intervention effects will further identify opportunities for reducing suicide burden and more effectively direct future suicide research expenditures.

F.) How the Prioritized Research Agenda Can Be Used

Scientists
The RPTF's agenda gives scientists an opportunity to explicitly link their work to the reduction of suicide burden. Scientists whose work can make a contribution to this effort are encouraged to pursue research indicated in the research pathways and in the short-term and long-term objectives of the agenda.

Funders
The RPTF's agenda identifies research applied to multiple approaches, and provides examples of optimal models that illustrate how suicide could be reduced by 20% in five years and 40% in ten years. The RPTF hopes that public and private funders will consult the agenda when allocating expenditures. A potential common focus also allows for improved cooperation among funders and possible collaborative funding efforts.

Survivors of Suicide Loss, Suicide Attempt Survivors, Those at Risk, and Concerned Family Members
The work of the RPTF provides those bereaved by suicide loss, suicide attempt survivors, those at risk, and all concerned family members an opportunity to be better informed about the research necessary to reduce the burden of suicide in the U.S. This can be the foundation for individual efforts to educate

and inform both public and private entities, whose support is needed to accomplish the RPTF's vital primary objective.

Public Health, Health Care Delivery, and Other Organizational and Community-Based Leaders
The agenda is a guide to shape the research so it is relevant and actionable for organizations and other sectors that can benefit individuals at risk (e.g., public health, health care, education, justice, large employers). By seeking effective approaches that can reduce suicide burden, these leaders can help change the way people think about suicide (its incidence *can* be reduced), and be catalysts for research-informed, life-saving actions.

Clinicians and Other Care Providers
The agenda supports the work of clinicians and care providers in this field to create a culture that no longer sees suicide as an unavoidable outcome, and to further improve risk identification, treatment, and prevention approaches to suicide reduction.

In addition to the agenda, an accompanying document—*Suicide Research Prioritization Plan of Action*—was developed in order to clearly outline the relationship between the Key Questions, Aspirational Goals, Research Pathways, and Short-term and Long-term Objectives, which are detailed in the agenda. The Plan of Action document can be accessed online at www.suicide-research-agenda.org.

II.) Research Objectives

The table below outlines the Short-term and Long-term Objectives for each Key Question. These Objectives are discussed in more detail in Section IV of this document.

Table 1. Key Questions and Research Objectives

Question	Short-term Objectives	Long-term Objectives
Question 1— Why do people become suicidal?	1.A.—Discover models that explain contagion as well as resilient healthy social connections among at-risk groups. 1.B.—Identify biomarkers (e.g., genetic, epigenetic, immune function, neuropsychiatric profiles) and their interactions that are associated with current and future risk status. 1.C.—Identify cognitive dysfunction/neural circuitry profiles (e.g., anhedonia, impaired executive functioning) associated with suicide risk that may be amenable to current interventions.	1.A.—Determine how to improve and sustain beneficial social connection processes that reduce suicide risk. 1.B.—Identify multiple risk models based on integrated data sources (genetic, epigenetic, life event exposure, health conditions, traits, brain circuitry, neuropsychological profiles, etc.) for future intervention development. 1.C.—Determine if processes that reduce risk conditions (e.g., insomnia, addiction, agitation, pain, etc.) also mitigate suicide risk.
Question 2— How can we better or more optimally detect/predict risk?	2.A.—Develop risk algorithms from health care data that can be used for suicide risk detection. 2.B.—Improve care efficiencies and decision making tools by identifying screening approaches with concurrent and predictive validity with multiple care settings. 2.C.—Develop screening approaches using multiple methods that identify risk over time (e.g., activity monitors, mood assessments).	2.A.—Overcome base rate challenges and response bias by identifying innovative bio-statistical and other research methods. 2.B.—Determine low, moderate, and high lifetime-risk screening approaches for individuals so that appropriate preventive efforts can be sought. 2.C.—Find a valid, feasible suicide risk screening approach that can be used across care settings, such as the Healthcare Effectiveness Data and Information Set (HEDIS).

Question	Short-term Objectives	Long-term Objectives
Question 3—What interventions are effective? What prevents individuals from engaging in suicidal behavior?	3.A.—Identify feasible and effective, fast acting interventions (e.g., new medicines with properties similar to certain fast acting anesthetics; treatment engagement interventions). 3.B.—Determine if adjunct interventions (e.g., safety planning; adherence interventions) focused on suicidal crises for patients receiving usual care for health conditions (psychiatric, substance use, physical illness conditions) are effective. 3.C.—Find interventions for the highest risk groups in care settings or community settings (e.g., substance abuse specialty; jails, prisons, and courts; American Indian reservations) that reduce the risk of suicide.	3.A.—Determine whether treatment of risk conditions (e.g., insomnia, psychosis, agitation, parental psychopathology), including optimal adherence and complete response, mitigates suicide risk. 3.B.—Identify biomarkers (neurocognitive profiles; genes; traits) that point to promising treatments (new, repurposed); and/or predict treatment response. 3.C.—Refine treatments for different high risk populations (demographic groups; disease groups) by identifying prognostic variables/ moderators of response and associated mechanisms from secondary analyses.
Question 4—What services are most effective for treating the suicidal person and preventing suicidal behavior?	4.A.—Identify efficient ways to increase the number of providers who implement adequate suicide assessment and management skills that improve care. 4.B.—In randomized practical trials, along with possible moderators (e.g., financial stress; patient gender) and intermediate outcomes (e.g., disengagement from care; functional limitations), find quality improvement components associated with reduced suicide risk. 4.C.—In at-risk populations, substantially increase effective help seeking and treatment engagement (e.g., involve family members, peers, information disseminated by media).	4.A.—Prevent suicide crises and injuries through effective novel care system practice approaches matched to at-risk patient needs (e.g., alternatives to inpatient care). 4.B.—Reduce suicide attempt and death outcomes through multiple, synergistic components of quality improvement within and across responsible systems (e.g., health care; justice systems, military installations, older adult care settings). 4.C.—Sustain effective quality improvements (e.g., stakeholder feedback mechanisms such as service ratings and 'report cards,' quality improvement collaborative involvement, etc.) that include input from those affected by those systems (e.g., patients, providers, family members, policy leaders, and funders).

Question	Short-term Objectives	Long-term Objectives
Question 5— What other types of prevention interventions (outside health care settings) reduce suicide risk?	5.A.—Conduct research to identify effective, feasible approaches to reducing access to lethal means for suicidal individuals through community partnership agreements. 5.B.—Determine if policies that affect risk factors in the populations (e.g., tobacco and alcohol advertising; medication prescribing practices) also reduce suicide risk. 5.C.—Determine mechanisms of risk and resilience for suicidal behavior outcomes. Determine how these mechanisms operate in other types of mortality (e.g., accidents) as well.	5.A.—Reduce suicide risk through effective and durable means safety approaches that include multiple steps and/or synergistic components (e.g., social media images and messages; packaging; counseling; storage; barriers). 5.B.—Reduce suicide risk and intermediate outcomes (e.g., isolation, depression) within organizations (e.g., schools; worksites; court systems) through successful applications of technology (e.g., phone apps) for monitoring and intervention delivery. 5.C.—Maximize intervention effects at a community level by combining suicide surveillance and prevention efforts with other effective community programs, such as prevention of substance abuse and child abuse and neglect.
Infrastructure Needs	
Question 6: What new and existing research infrastructure is needed to reduce suicidal behavior?	- Develop standard definitions, common data elements, and processes for harmonization efforts to enhance clarity of research findings - Expand biobanking (e.g., brain tissue banks; genetic repositories) - Develop patient registries - Expand data sharing and warehousing; supplement existing studies - Establish a clearing house for policy research opportunities - Develop communications partnerships for public messaging/media research and best practices - Conduct periodic reviews and updates of surveillance data/databases - Facilitate health care organization-researcher partnerships to field studies - Support research workforce development	

III.) Overview

A.) The Research Prioritization Task Force

The RPTF was created to develop a research agenda which, if fully implemented, would provide multiple, research-informed approaches that will lead to a reduction in suicide attempts and deaths by at least 20% in five years and 40% or greater in 10 years.

This agenda will advance the suicide prevention efforts of the Action Alliance (National Action Alliance for Suicide Prevention, 2013a). The Action Alliance is the public-private partnership advancing the *NSSP* by championing suicide prevention as a national priority, catalyzing high-priority objectives of the *NSSP*, and cultivating the resources needed to sustain progress. Its vision is a nation free from the tragic experience of suicide.

Members of the RPTF were volunteers from the Action Alliance and advocacy field, and included representatives from the following government entities and private organizations:

Government	**Private Organizations**
Centers for Disease Control and Prevention (CDC)	American Association of Suicidology (AAS)
National Institute on Drug Abuse (NIDA)	American Foundation for Suicide Prevention (AFSP)
National Institute of Mental Health (NIMH)	
National Institutes of Health (NIH)	Group Health Research Institute
(U.S. Department of Health and Human Services)	The Jed Foundation
Veterans Health Administration	Kaiser Permanente
(U.S. Department of Veterans Affairs)	Suicide Awareness Voices of Education (SAVE)
	United Behavioral Health

The RPTF's mandate is to produce a research agenda in which the very best science is represented as the highest priority. The RPTF sought to do this by using procedures that promote inclusiveness, innovation, and accountability.[2]

B.) Suicide in the United States

In 2010, suicide was the 10th leading cause of mortality in the U.S., claiming more than 38,000 lives annually and affecting many more, including family members, friends, neighbors, and colleagues.

To put the annual U.S. death toll from suicide into perspective, every year it claims more than twice as many lives as homicide. Deaths resulting from suicide are greater than those attributed to prostate cancer and just slightly fewer than those resulting from breast cancer. Suicide claims more lives than many diseases, including Non-Hodgkin's lymphoma and leukemia. The annual death toll from suicide is greater than that from automobile and other transportation accidents (Centers for Disease Control and Prevention, 2012).

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[2] The Core Values and Operating Principles of the RPTF can be found in Appendix A.

Public health leaders often describe and prioritize a public health problem in terms of burden, which can include deaths, as well as how the problem affects people's daily functioning (see Appendices C and D). The burden of suicide reaches beyond the deaths themselves. A study conducted in 2010 shows that in excess of 1.1 million people reported making a suicide attempt in the prior year (Substance Abuse and Mental Health Services Administration [SAMHSA], 2010). Surveys conducted in 2009 and 2010 indicate that an estimated 8.6 million U.S. adults reported having serious thoughts of suicide in each of the prior years (SAMHSA, 2012). And the burden extends to the loved ones, family, friends, and colleagues of these millions of people who have considered or attempted suicide, or have taken their own lives.

C.) A Prioritized Research Agenda to Reduce Suicide

This document summarizes the work undertaken by the RPTF to identify the research steps and methods that reflect the thinking of experts and organizations working to reduce suicide. The work of the RPTF considered other approaches to injury and disorder reduction, and consulted other developers of strategic suicide research prevention plans to determine a process appropriate for U.S. suicide prevention research (Claassen et al., 2013). The RPTF conducted literature and research reviews, burden calculations among subpopulations, analyses of methodological barriers to breakthroughs in suicide prevention research, and integration of these inputs to enable prioritization of the research pathways and objectives most likely to reduce suicides and suicide attempts.

This document describes research methods that Thomas Insel, MD, director of NIMH and co-lead of the RPTF, described as essential to "bend the curve of suicide rates and ensure that suicide deaths decrease dramatically in the next decade" (Insel, 2011).

D.) Audience for the Agenda

Many stakeholders took part in this research prioritization process. This agenda is intended for their use. These stakeholders include:

- Scientists whose work can make a contribution to this effort
- Agencies and organizations that support and fund suicide research
- Survivors of suicide loss
- Suicide attempt survivors
- Those at risk for suicide
- Concerned family members
- Interested leaders of organizations and sectors that can reach individuals at risk
- Clinicians and care providers

PART 2: The Prioritized Research Agenda

IV.) The RPTF Prioritized Research Agenda

This section presents the complete Prioritized Research Agenda, that:
- *Is organized around six Key Questions that reflect the breadth of the science needed to reduce suicide burden.*
- *Integrates the 12 Aspirational Goals[3] into the Key Questions.*
- *Includes discussion of what the experts say is the state of the science and what we need to know in order to reduce the problem of suicide.*
- *Presents the proposed research pathways and recommends short- and long-term research objectives most likely to lead to substantial reductions in suicide deaths and attempts.*

Key Question 1: Why Do People Become Suicidal?

> **Aspirational Goal 1**, *Know what leads to, or protects against, suicidal behavior, and learn how to change those things to prevent suicide.*

State of the Science

Diverse Groups at Risk; Complex Contributing Factors

Why do people become suicidal? The 2002 Institute of Medicine report—*Reducing Suicide: A National Imperative* (Goldsmith et al., 2002)—provides a comprehensive review of the sociological, cultural, psychological, and biological risk factors. The Aspirational Goals offered by the stakeholders in this research prioritization process address many of these factors, which continue to be a part of the public conversation. For example,

- Mental and substance use disorders are considered the most common risk factors for suicide. Yet, why do the vast majority of individuals with mental disorders and/or substance use never engage in suicidal behavior?
- Many American Indian/Alaskan Native communities suffer higher suicide burden, while others do not. What helps some of these communities to be more resilient in the face of similar stressors?
- Stressful life events are often precipitating factors in suicide risk. The recent economic downturn has been associated with increased suicide rates. With so many Americans facing home foreclosure, why do certain individuals experiencing economic stress take their own lives?
- Military servicemembers have historically had lower suicide rates than the civilian population. Why has the suicide rate among service members increased in the past few years (Medical Surveillance Monthly Report, 2012)?

Models of suicidal behavior have evolved over the past 25 years (see O'Connor, 2011 for a summary); many are psychologically based and assume some type of cognitive dysfunction in the suicidal process. The cognitive dysfunction serves as the symptom target for many psychosocial interventions (see Key Question 3). Many of the risk constructs considered here have been proposed as the precursors for

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[3] For more information on the 12 Aspirational Goals, see page 63.

cognitive dysfunction. But the ultimate answer to the "why" question may prove to be multi-factorial and complex, without yielding a single or predictive explanation.

Social Determinants

Social isolation has been associated with increased risk of suicide. Connectedness is protective when it occurs within and between multiple levels of the social ecology—between individuals, families, schools and other organizations, neighborhoods, cultural groups, and society as a whole. The types of connections seen as protective against suicide include youth attachment to family and schools, with "school connected" adolescents exhibiting decreased risk for suicidal behavior over time (e.g., Borowsky et al., 2001). Increasing healthy connections to others in the community has been related to reduce suicide risk among elders in Japan (Oyama et al., 2004). Social support was considered a critical factor in a multiple-pronged, successful suicide prevention program of the U.S. Air Force (Knox et al., 2003).

Yet, connectedness also has been examined as a risk enhancing influence. That is, it can be considered part of the "contagion" process, making suicidal behavior "normal." Individuals can identify with peers or celebrities with regard to suicidal behavior, running the risk of imitating the behavior. Suicide pacts also may serve to promote suicidal behavior. There is a substantial evidence base that certain media coverage contributes to suicide risk among vulnerable individuals (e.g., Niederkrotenthaler & Sonneck, 2007; Pirkis, 2009).

Clinical Factors

Across clinical syndromes, suicide has been associated with specific symptoms such as hopelessness and impulsiveness. However, there is limited understanding—either phenomenological or mechanistic—as to why suicide risk co-occurs with mental disorders beyond the reactions to the functional impairment of mental illnesses. In addition, our understanding of the role of physical health conditions or injuries—such as insomnia (e.g., Fawcett, 2006), traumatic brain injury (e.g., Skopp et al., 2012; Teasdale et al., 2001), pain, and post-traumatic stress disorder (PTSD) (e.g., Bachynski et al., 2012)—in suicide risk is limited. Many of these limitations are, in part, attributable to limited linkage of epidemiologic, surveillance, and vital statistics data. For example, research on how various physical illnesses increases the risk of suicide has been conducted primarily in European countries, where longitudinal health care registries linked to death records allow for such analyses (e.g., Berman & Pompili, 2011; Qin et al., 2013). Work beginning to address mechanistic explanations is described below.

Neurocognitive Factors

Those people who attempt suicide show deficits in basic cognitive functions (e.g., attention, memory), executive performance (e.g., conceptual processes, reversal learning), impulse control, decision making (e.g., gambling tasks, delay discounting), and implicit processes (e.g., implicit associations). The list of neurocognitive findings include motor impulsivity, decision making, response inhibition, flexibility of response generation, self-monitoring/error-processing, sensitivity to others' anger, and impaired response to positive emotional stimuli, hopelessness, harm avoidance, and delayed rewards. None of these are entirely specific to suicide, nor are they actionable as clinical predictors.

Biomarkers

Across medicine, there is increasing interest in biomarkers that predict risk or resilience. Several biological tests have been suggested as potential predictors, but none has clinical utility at this time. These measures span immune factors (e.g., Pandey et al., 2008; Sublette et al., 2011), patterns of brain activity observed with imaging (e.g., summarized by Jollant, et al., 2011), and genetic variants (see Clement et al., 2012, for a review). While genomics has proven transformative for other complex

conditions, the promise of genetic predictors of suicide needs to be tempered by the data on heritability. Twin studies report 36–43% heritability; and non-fatal suicide attempts have heritability estimates of 17–45%, even after controlling for psychiatric disorder (Mann et al., 2009). Higher rates of suicidal behavior are found among relatives of suicide decedents and people who attempt suicide, compared to relatives of non-suicidal controls (e.g., Brent et al., 1996).

It is estimated that 10–40% (depending on abuse and suicidal behavior definitions) of individuals who experience suicidal thoughts and behavior have a child abuse history (Brezo et al., 2008). Early life stress is found to alter gene expression within the brain and modify hypothalamic-pituitary-adrenal (HPA) axis function, which, later in life, results in abnormal molecular and hormonal responses to stressful events (e.g., Courtet et al., 2011; Schmidt et al., 2011). Epigenetics is a mechanism by which early experience can confer enduring effects on gene expression. Epigenetic marks and altered patterns of gene expression can be examined in specific tissues. Research that has examined brain tissue among suicide decedents, and comparisons among people who attempt suicide and depressed controls, has further refined our knowledge about the possible biological pathways that early abuse affects the brain.

- The expression of micro ribonucleic acids (microRNAs) is altered in human postmortem brains of suicide decedents with abuse history compared to non-abused and healthy matched controls; methylation of the glucocorticoid receptor in the hippocampus of suicide decedents also is reduced (Labonté et al., 2012).
- Depressed, suicidal decedents show a distinct microRNA expression pattern compared to healthy controls, indicating their role in disease pathogenesis (Pandey et al., 2008). Metallothionein proteins, which act to decrease cortisol, have also been found to be down regulated in suicide decedents, suggesting that suicidal patients have less protection against stress (e.g., Sequeira et al., 2012).
- Polymorphisms in the brain-derived neurotrophic factor (BDNF) gene (e.g., the Val66Met polymorphism) are more frequent among depressed patients and people who attempt suicide, particularly those who have experienced childhood abuse (as manifested through decreased serum BDNF levels). The splice variant of tyrosine kinase B (TrkB-T1) has been found to be lower among suicide decedents (Ernst et al., 2009). This has implications for treatment response because antidepressant treatment increases TrkB-T1 expression (in cultured astrocytes) (O'Leary et al., 2009).

What Do We Need to Know?

More Uniform Definitions

What does it mean to be "suicidal?" Most researchers consider current ideation, and/or having attempted suicide within the past year, as being suicidal. Depending on the research question, others consider any past suicidal behavior (e.g., an attempt during one's lifetime) as counting as a case of being at suicide risk, since past suicidal behavior increases the risk for future behavior. As described in the burden of suicide section (see Appendices C and D), not all U.S. surveillance or clinical studies are consistent with current nomenclature recommendations (Crosby et al., 2011), and broader definitions of self-harm (with or without intent to die) are often used in the international literature. Current surveillance and clinical epidemiologic tools vary in their definitions of suicidal behavior (National Action Alliance for Suicide Prevention, 2013b), as do efforts among biological, psychological, social risk, and protective factor research, making comparisons of populations and understanding of suicidal thoughts and behavior trends often a challenge.

What is the Interplay among Biological, Psychological, and Social Risk and Protective Factors?

Limited linkage of epidemiologic, surveillance, and vital statistics data for recognized risk factors (e.g., psychiatric and substance use disorders; physical disorders; stressful life events) makes it difficult to assess what population subgroups (e.g., age, racial, ethnic, sexual minorities, military veterans) or geographic regions of the country may be more or less experiencing suicide risk or its possible precursors. For example, cyber bullying is an example of harmful social messaging that has been associated with lesbian, gay, bisexual, transgender, questioning (LGBTQ) youth suicide deaths, yet the lack of national data prevents researchers from determining the scope (towards whom and how frequently) of the problem.

Stressful life events are associated with increased suicide risk, particularly among those with substance use and/or personality disorders (e.g. Foster, 2011). Moreover, particular events affect critical periods in development. A recent meta-analysis concluded that individuals who have experienced early emotional and physical childhood abuse are three times more likely to have made a suicide attempt (Norman et al., 2012). The 2002 IOM report estimates the portion of attributable risk (PAR) for child sexual abuse to be 9–20% of suicide attempts (Goldsmith et al., 2002). Questions about how these experiences interact with other risk factors remain. For example, for the population that has experienced early childhood sexual abuse, what percent of the population has polymorphisms in genes and modified HPA functioning, placing them at risk for suicidal behavior?

The Army Study to Assess Risk and Resilience in Service members (Army STARRS, 2013) [see Figure 3] will serve as a future public resource to examine variation in experiences of past and more current stressful events among soldiers' "phenotypes" (characterizations in terms of traits and selected neuropsychiatric profiles) and potential biomarkers (including peripheral blood markers) to determine their contributions to suicidal behaviors. The Department of Veterans Affairs (VA) health care system (2013) and Mental Health Research Network (2013) could be additional resources for surveillance information on histories and health conditions (including biomarkers) that are associated with suicide.

Approaches to Reduce Suicide Burden—What is the Potential Benefit?

Example Models:

- Reducing child abuse and neglect may be one approach to reducing suicide risk throughout the life course. Controlled trials of approaches to preventing abuse and neglect that also include measures of resilience and suicide behavior (attempts, deaths) as outcomes would be a resource for etiologic research as well as a resource for better estimating benefits of various mechanistic processes (e.g. how are HPA dysfunction or neurocognitive measures related to suicidal behaviors?).
- Establishing risk status through family history (and valid biomarkers).
- Establishing resilience through social connections.
- Determining risk in the absence of mental or substance use disorders.

Gaps in Burden and Modeling Information

How can each of the risk and resilience factors be better characterized and more consistently defined so that current findings can be translated into population estimates? Harmonization of measures could allow for more rapid translation and opportunities for interventions (see Key Questions 3 and 5). What is the stability of epigenetic factors within individuals, as well as in the population? Are there imaging

markers for people who attempted suicide? What are the population characteristics for neuropsychological deficits and cognitive styles for individuals who have or have not attempted suicide? How can "cases" of individuals with suicide risk be more uniformly defined (e.g., lifetime attempt versus recent attempt), so that clearer conclusions can be drawn across studies? Are there reliable markers that can be translated into practical use for life-time or near-term risk assessment (see Key Question 2)?

Proposed Research Pathways

Experts considered the many risk and protective research areas under Aspirational Goal 1. The following represent a summary of research pathways proposed from discussions.

Connectedness and Contagion
- Examine how positive connections can mitigate various stressors such as interpersonal loss (e.g., death, divorce), health events (e.g., sudden critical illnesses, loss of mobility), legal problems, or shame and bullying. Determine how positive attachments can mitigate the negative effects of childhood trauma.
- Apply network analysis approaches to understanding suicide acceptance and contagion, or resilience.
- Determine whether the anonymity of online games or other social media affects expression of suicidal thoughts and how online reactions to suicidal content are helpful or harmful.

Develop Common Measures of Risk Events, Traits, and Psychopathology
- Examine cognitive styles or traits and psychopathology constructs (e.g., chronic insomnia, aggression, impulsivity, complicated grief, executive dysfunction) in conjunction with reports of stressful events (e.g., early childhood versus current interpersonal traumas, recent job loss) to refine ways to identify subgroups more or less at risk for suicide. Identify reliable neural circuitry markers of suicidality (e.g., ideation, intention, lethality of attempts).

Physical and Mental Health Conditions
- Determine whether the "active ingredients" of interventions that reduce risk conditions (e.g., depression, addiction, insomnia, psychosis, agitation) also reduce suicide risk.
- Determine how the meaning of illness (as a stressful event) and mental and physical illnesses and their treatments affect brain functioning to contribute to suicide risk.
- Conduct traumatic brain injury studies to determine what aspects of brain dysfunction link injury to suicide risk
- Determine the role of inflammation and immune response in pathways to brain dysfunction, physical illness, and suicide risk. Explore the role of inflammation and determine the specificity of peripheral and central nervous system (CNS) cytokines as potential biomarkers for depression and suicide risk.

Neurocognitive and Cognitive Style Approaches
- Determine if there are neurocognitive deficits common to all types of suicidal behavior and which are associated with specific types of suicidal behavior (e.g., impulsive, chronic/ruminative, depressive).
- Explore how neurocognitive deficits can serve as targets for genetic, neurobiological, and brain imaging studies.
- Evaluate the mechanisms by which neurocognitive deficits interact with social and environmental processes to influence suicidal behavior.

- Field integrated studies that combine multiple assessment approaches in large samples stratified for various characteristics of suicidal behavior and linked to daily experience of those at risk (e.g., are some neurocognitive deficits state-related just prior to an attempt?).

Biomarker Studies
- Investigate different brain areas and cell populations to determine what brain systems/circuits and cellular fractions are affected by epigenetic changes associated with increased suicide risk.
- Conduct prospective studies of epigenetic changes as a function of environmental stressors in longitudinal cohorts representative of the general populations. Determine the effects of possible covariates—such as gender, age, socioeconomic environment, and substance of abuse—on epigenetic changes.
- Confirm the findings with microRNA sequencing and examine whether novel epigenetic regulations occur, or if there are any risk-conferring single nucleotide polymorphisms in microRNA sequences in patients with suicidal ideation.
- Characterize microRNAs in various fractions of blood cells and examine whether microRNAs that are expressed in the brain are also expressed in blood cells for potential diagnostic and suicide risk value. Seek to identify practical, peripheral biomarkers.
- Identify genetic mechanisms associated with the neural circuitry and suicidal behaviors that could elucidate molecular targets for interventions.

Research Opportunities

Experts reviewed proposed research pathways in light of available information on the burden of suicide attempts and deaths and also considered the value of addressing specific research gaps in Aspirational Goal 1. While it appears that an important segment of the population that experiences abuse and neglect is at increased risk for suicidal behavior, there remains limited information on how heritability, exposure factors, and epigenetic processes all may contribute to later risk. While it may be useful to isolate the unique contributors to suicide risk, it is clear that our understanding of the evolution of suicide risk is determined by the interaction of multiple factors.

Short-Term Objectives
The resulting short-term research objectives are considered the most likely, if fully implemented, to help identify mechanisms for risk that can be applied to most rapidly reduce the burden of suicide attempts and deaths.

A. Discover models that explain contagion as well as resilient, healthy social connections among at-risk groups.
B. Identify biomarkers (e.g., genetic, epigenetic, immune function, neuropsychiatric profiles) and their interactions that are associated with current and future risk status.
C. Identify cognitive dysfunction/neural circuitry profiles (e.g., anhedonia, impaired executive functioning) associated with suicide risk that may be amenable to current interventions.

Long-Term Objectives

The resulting long-term research objectives are considered necessary to devote sustained efforts to reduce the burden of suicide attempts and deaths.

A. Determine how to improve and sustain beneficial social connection processes that reduce suicide risk.
B. Identify multiple risk models based on integrated data sources (genetic, epigenetic, life event exposures, health conditions, traits, brain circuitry, neuropsychological profiles, etc.) for future intervention development.
C. Determine if processes that reduce risk conditions (e.g., insomnia, addiction, agitation, pain) also mitigate suicide risk.

Figure 3. Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS)*

Army STARRS Neurobiological Protocol

Army STARRS is the largest study of risk and resilience factors for suicide in the military—more than 100,000 soldiers already have provided data. STARRS includes all appropriate confidentiality safeguards, and participation is voluntary. This project is currently funded through 2014 and will offer opportunities for secondary data analyses to address many research pathways posed by Aspirational Goal 1. The Army STARRS research team is developing a better understanding of the factors that help make soldiers more resilient to or at risk for a variety of outcomes. In two components, the New Soldier Study (NSS) and the Pre Post Deployment Study (PPDS), the team will pair biological analyses of soldiers' blood with the rich data set constructed (including phenotypic information from surveys). In both the NSS and the PPDS, genome-wide association studies will be performed (analyzing approximately 8,000 people in each study) to look for novel genetic markers associated with a history of mental illness. Within a smaller subsample of the PPDS, Army STARRS investigators also will conduct epigenetic (methylation) analyses and look for potential changes in expression of RNA as a result of deployment and potentially traumatic combat experiences. Although in several subgroups of active duty soldiers from Army STARRS (e.g., NSS, PPDS) the rates of suicide for the timeframe in which collections are made are low for current biomarker analyses, the information collected is expected to be invaluable going forward to shed light on factors that may have predisposed or have been an early sign of illness as, unfortunately, more soldiers die of suicide in the future.

Data Sharing Plans Relevant to Biomarkers:

It is estimated that biomarker data from Army STARRS will be available starting in March 2015. The biomarker data most likely to be released first is the genome-wide association/exome data from 8,000 PPDS and 8,000 NSS soldiers. As analyses are completed over the remaining project period, additional data will be shared with the scientific community. Pending federal funding with Army and NIMH approval, additional projects may be possible.

* http://www.armystarrs.org/

Key Question 2: How Can We Better or Optimally Detect/Predict Risk?

> **Aspirational Goal 2**, *Determine the degree of suicide risk (e.g., imminent, near-term, long-term) among individuals in diverse populations and in diverse settings through feasible and effective screening and assessment approaches.*
> **Aspirational Goal 3**, *Find ways to assess who is at risk for attempting suicide in the immediate future.*

State of the Science

Imminent versus Near-Term Risk

With regard to formulating imminent risk (Aspirational Goal 3), some experts and RPTF members recommended that this research goal be restated to be 'immediate future' rather than imminent risk. The rationale for this change is that a broader, immediate future timeframe is more empirically defensible and will encourage more research on acute risk factors or warning signs. As discussed below, some of the expert consultants thought that suicide risk screening may be more practical if it is approached from the framework of detecting whether there is a treatable condition that can be acted upon. Other experts thought that research on imminent risk was critical. Indeed, frontline clinicians who work with high-risk patients and family members desperate to keep their loved one safe, have little choice but to make significant health care decisions when faced with formulating risk for an episode of suicidal behavior in the near-term future. The following section describes the state of the science on imminent/near-term risk assessment and formulation.

Anxiety, Panic, Insomnia

- Severe anxiety, panic attacks, and insomnia have been described as proximal correlates of suicidal behavior (Fawcett, 2006). Life events are likely to be a part of the diathesis stress process, where events are triggers among the significant subgroup of people who attempted suicide with personality traits associated with personality and other mental disorders (Blasco-Fontecilla et al., 2010).

Emergency Care Settings

- High-risk suicidal patients often are seen in hospital emergency departments (EDs), making effective triage in EDs particularly critical (Gairin et al., 2003). Current practice recommendations for ED providers are not evidence based, so assumptions from best practices suggesting that patients with serious mental health problems—in particular psychotic features—and those with suicidal plans are at highest risk (Cooper et al., 2003), remain to be tested in U.S. populations.

Crisis Lines

- Telephone crisis counselors often must determine if an individual is likely to engage in suicidal behavior, initiating outreach to first responders to locate the caller. Ongoing work by the VA that utilizes a crisis telephone line will allow the VA to examine crisis counselor approaches, decisions to engage in emergency response, and all types of mortality outcomes (e.g., Knox et al., 2012).

Active versus Passive Ideation
- Current approaches to assessing risk are heavily weighted toward identifying active ideation with a plan, versus passive ideation (e.g., desire for death). However, some studies have found passive ideation just as strongly associated with morbidity as active ideation (Baca-Garcia et al., 2011).

Patient Denial
- A clinical dilemma exists where a subgroup of patients most at risk for lethal behavior will deny suicide ideation and plans when it is actually present in order to avoid intervention. A number of clinical interview techniques (e.g., Shea, 2002), as well as voice analyses (e.g., Ozdas et al., 2004), and cognitive implicit association tasks (Nock et al., 2010), are all designed to overcome patient denial of imminent suicide intent. However, none of these approaches have been prospectively validated.

Screening
Screening that can identify individuals earlier in a suicide trajectory (Aspirational Goal 2), long before they act, is a goal of multiple national suicide prevention strategies. Experts summarized the state of research in the following ways:

- Screening for suicide does not lead to iatrogenic effects of increasing suicidal thoughts in youth (e.g., Gould et al., 2005).
- While the natural history of suicide is not yet well defined, youth and young adults who have suicidal ideation have greater lifetime risk for suicide attempts (Fergusson et al., 2005; Kessler et al., 1999) so that detection of youth at any point on the continuum of suicide (i.e., ideation, plans, behavior) is important for intervening.
- However, the notion of a continuum of suicide risk—and its assumed progression of suicide ideation, plans, and eventual behavior—has been debated (DeLeo et al., 2005); multi-national surveys have found that about a third of ideators make a plan and about a third of ideators go on to attempt suicide. Another subgroup reports making an attempt with little or no ideation or planning. Moreover, because suicide ideation is a frequent phenomenon, the association between expressed suicide ideation and death by suicide is weak (e.g., Large et al., 2011).

There is great urgency to finding adequate suicide screening approaches for various sectors of medical care. In addition to the individuals seen in emergency care for self-harming behavior, broader screening in EDs outside of psychiatric crises may be critical for many (Claassen & Larkin, 2005). The Joint Commission—the primary health regulatory agencies in the U.S.—recommends suicide screening in all medical care settings to prevent suicide attempts and deaths (The Joint Commission, 2010). However, the science of screening is lagging behind the practice demand in a number of ways.

- Several brief suicide-screening instruments for youth in medical settings have been published (Horowitz et al., 2012) and have shown concurrent validity with self-report suicide measures that are typically longer in length. None have been prospectively tested to determine their value for assessing risk for suicidal behavior.
- Depression screening efforts often employ the Patient Health Questionnaire-9 (Kronenke et al., 2001), which includes an item on suicidal thoughts and behaviors (Valuck et al., 2012). However, screening for suicide that is associated with depression alone may miss a significant portion of those at risk for suicide.

- Given the difficulties in assessing and formulating near-term risk, and limited understanding of how to best characterize or "stage" risk on a continuum, some researchers have recommended that screening may be best used to determine who is at lower risk for suicide (i.e., true negatives), which can facilitate triage situations in some settings.

There are many other settings that have been considered screening opportunities for case finding and suicide prevention. Because of the relatively high frequency of visits to primary care compared to other health care settings prior to suicide death (e.g., Luoma et al., 2002; Trofimovich et al., 2012), many in the suicide prevention community have advocated for screening in primary care. However, the evidence base for efficiencies of universal screening for a relatively low base rate event is lacking. This indicates that the burden of false positives (referring and treating someone not truly at risk) for patients and providers could be significant. A recent Canadian Task Force on Preventive Health Care (2013) recommends screening only in the presence of depressive symptoms. A recent systematic review for the U.S. Preventative Services Task Force found few validated screening measures adequate for primary care (O'Connor et al., 2013). Even if screening measures were found adequate, the treatment studies showing efficacy for reducing suicide risk were focused on the highest risk patients identified through emergency care settings, rather than lower risk individuals who would benefit from intervention prior to attempting suicide (see Aspirational Goal 4, Interventions for Ideators).

Some of the challenges in testing screening approaches in these settings are related to the ethical and safety needs for those individuals identified as at risk—specifically finding referral sources that are accessible and competent (see Aspirational Goal 7, Provider Training). Additional settings where screening could occur include the following:

- The Military Suicide Research Consortium recently reviewed risk factor and risk assessment tools that could be effective for evaluating risk of suicidal behavior in veteran and military populations. No risk assessment tools were found that accurately stratified risk among veteran and military populations (Gutierrez, 2012).
- Screening measures for jails (e.g., National Action Alliance for Suicide Prevention's Youth in Contact with the Juvenile Justice System Task Force, 2013; Steadman et al., 2007) have concurrent validity, but their effectiveness as a component of suicide attempt or death reduction has not been evaluated.
- College screening efforts that have not been evaluated include The Jed Foundation's online ULifeline that refers college youth to a library of mental health information and can be customized to various campus settings. Haas and colleagues used the PHQ-9 to develop an anonymous online screen for college students. The online outreach also includes an interactive component with a campus counselor's personalized feedback to encourage help seeking. The online dialogues appeared feasible for engaging at-risk college youth (Haas et al., 2008).
- Screening for Mental Health, Inc., developed the Signs of Suicide (SOS) program that teaches students how to identify the symptoms of depression and suicidality in themselves or their friends using a screening scale, and encourages help-seeking. The program also prepares school staff to develop community referrals. Aseltine and colleagues evaluated SOS in a randomized control study, and found the youth exposed to the SOS program experienced a decrease in self-reported suicide attempts (Aseltine et al., 2007). Screening for Mental Health, Inc., also provides mental health screening programs for multiple settings (e.g., colleges, military, workplace) but data are not publicly available on outcomes for those screening programs.

Based on these findings of screening approaches, and the significant practical challenges facing researchers, the experts and the RPTF considered what was needed to move the field forward in this area.

What Do We Need to Know?

What is the Suicide Burden Relevant to Detecting/Predicting Risk?

Until specific biomarker tests or approaches that do not require self-reports are found, family members and health professionals will need to continue to make judgments regarding near-term risk. The burden related to inadequate detection of near-term risk could include cases seen in health care settings (e.g., EDs, primary care, specialty care) with "false negative" and "false positive" outcomes. The false negative outcome is tragic. In terms of a system outcome, it may appear as a "sentinel event" for The Joint Commission, or a "never event" under Medicare or Medicaid. If the outcome was a false positive event, a person may be subject to unnecessary involuntary commitment to treatment, with significant social and financial costs.

The most straight-forward way of considering the lack of detection is to examine the prevalence of suicide attempts and deaths among individuals not otherwise identified, and who are not receiving a potentially life-saving intervention. The burden that could be considered in this approach is vast—how many more unidentified, at-risk individuals in EDs and general medical care could be detected if screening approaches were in place? Similarly, how many individuals in schools or colleges, jails, prisons and court settings, worksites, congregate care for older adults, etc. could be detected? As reviewed here, determining thresholds for "positive" cases and defining "at-risk" are far from uniform, and improvements in the efficiencies of screening carry morbidity, mortality, and health care cost benefits.

Detection/Prediction to Reduce Suicide Burden—What is the Potential Benefit?

The potential benefit of screening tools has not been evaluated. While many emergency medicine sites may be incorporating screening efforts to comply with The Joint Commission recommendations, the best opportunities to examine benefits of screening are likely to come from closed health care systems that are of a sufficient size to examine suicide attempt and death outcomes. If members of such care systems, and their medical records, can be linked to national death records, missed opportunities for screening and provision of treatment and lifesaving benefits could be projected.

Opportunities for Modeling the Benefits of Assessing and Formulating Risk

Existing epidemiologically defined longitudinal studies that include early experiences and periodic measures of suicide ideation could be combined and examined for subgroup pathways and trajectories for resilience and risk.

The Army STARRS' New Soldier Study will provide a brief longitudinal window on predictors of suicidal behavior for approximately 50,000 soldiers over 16–38 months. Predictors of events to analyze will range from social and work-related experiences (e.g., physical and psychological trauma, death exposures), to administrative actions (e.g., legal problems) to mental health concerns. Contextual factors also will be examined (e.g., unit cohesion, mission).

Proposed Research Pathways

Research pathways for better detecting risk through feasible and effective screening and assessment include:

- Field screening studies with capacity for referral. Consider adapting programs such as Screening, Brief Intervention and Referral to Treatment (SBIRT) that have been used successfully in alcohol abuse detection and treatment (see Moyer, 2013, for a review of SBIRT).
- Determine the relative value of screening approaches (within and/or separate from depression screening; passive and active ideation), and whether patient denial of ideation and plans are related to types of approaches.
- Consider alternative validations for screens other than suicidal behaviors, including protective as well as risk factors. For example, a practical question could be to determine whether any clinical action is necessary, and the screen becomes an initial step in a clinical decision rule. Determine when acute risk trumps protective factors. Other validity outcomes could be suicide outcomes and service use.
- Determine how clinical decision rules can help inform approaches to determine screening programs that are site-specific (e.g., VA, primary care, school-based clinics), and have recommended steps for identifying referral resources.
- In emergency care settings, research the effectiveness of documenting suicidal ideation that is expressed by intoxicated individuals (who may deny ideation when sober) as a component of treatment engagement (see Aspirational Goal 10, Stigma Reduction and Help-seeking).
- Develop safe and fair approaches for obtaining collateral information from family members/ guardians/significant others that can be explored through suicide risk screening and assessment. Develop methods for reporting results of screening back to family members/guardians/ significant others as appropriate.
- Explore clinical decision-making methods to address disagreements between patient, family, and clinician impressions for suicide risk.
- Find and test approaches that would translate screening programs into core performance measures, such as the Healthcare Effectiveness Data and Information Set (HEDIS; see Glossary).
- Determine the benefits of online screening approaches for various at-risk groups. What screening approaches are safe and helpful for individuals who prefer to share information with a provider who is based in health care services? What screening approaches are safe and effective for those who wish to avoid health care or are unable to seek health care services, such as through telehealth systems?
- Develop alternative or complementary screening methods that are less vulnerable to response bias or motivational demands (e.g., biological tests, behavioral tests, cognitive tests).
- Test the benefits of routine brief screening of suicide risk factors in later life (e.g., distress, loss of function, chronic disease) at annual physical exams. Research could address the predictive validity of various risk or protective factors, while assessed risk information may provide opportunities to identify treatable morbidity.
- Consider adaptive screening and testing software that shapes itself based on age, gender, circumstance, and experience, and look for changes over time as a monitoring system for someone's mental health status.

Research pathways relevant to detecting near-term risk, include:

- To understand current clinical practices and determine what needs to improve, analyze current health services data (e.g., electronic records, existing clinical notes) to examine factors or characteristics of individuals that may be markers or points in decision making for who gets hospitalized or discharged.
- Develop intensive monitoring of lifetime high-risk patients (e.g., positive family history for suicide, prior attempts, history of early abuse) to determine acute risk factors associated with suicide attempt/death, as well as factors that confer resilience (e.g., self-protective behaviors).
- Develop tools to leverage information obtained from multiple assessments to inform clinicians' ability to identify an individual who may be likely to attempt suicide. Information could include self-reports of suicidal thoughts and biomarker tests.
- Test a combination of potential markers for near-term suicide risk (e.g., self-report, implicit association task, neuropsychological tests, biomarkers) within a treatment study with long-term follow-up and eventually link to death records.
- Encourage bio-statistical and other methodological developments aimed at predicting low base rate outcomes in discrete time periods.
- Explore the roles of patterns of care that are associated with increased risk, such as poor patient treatment adherence, patient-care provider "ruptures in trust," or other therapeutic relationship changes.

Research Opportunities

Experts reviewed proposed research pathways in light of available information on the burden of suicide attempts and deaths, and also considered the value of addressing specific research gaps in Aspirational Goals 2 and 3.

Short-Term Objectives

The resulting short-term research objectives are considered the most likely, if fully implemented, to most rapidly reduce the burden of suicide attempts and deaths.

A. Develop risk algorithms from health care data that can be used for suicide risk detection.
B. Improve care efficiencies and decision making tools by identifying screening approaches with concurrent and predictive validity within multiple care settings.
C. Develop screening approaches using multiple methods that identify risk over time (e.g., activity monitors, mood assessments).

Long-Term Objectives

The resulting long-term research objectives are considered necessary to devote sustained efforts to reduce the burden of suicide attempts and deaths.

A. Overcome low base-rate challenges and response bias by identifying innovative bio-statistical and other research methods.
B. Determine low, moderate, and high lifetime-risk screening approaches for individuals so that appropriate preventive efforts can be sought.
C. Find a valid, feasible suicide risk screening approach that can be used across care settings, such as the Healthcare Effectiveness Data and Information Set (HEDIS).

Key Question 3: What Interventions Are Effective? What Prevents Individuals from Engaging In Suicidal Behavior?

> **Aspirational Goal 4**, *Ensure that people who are thinking about suicide but have not yet attempted, receive interventions to prevent suicidal behavior.*
> **Aspirational Goal 5**, *Find new biological treatments and better ways to use existing treatments to prevent suicidal behavior*.
> **Aspirational Goal 6**, *Ensure that people who have attempted suicide can get effective interventions to prevent further attempts.*

State of the Science

Medications
With regard to the status of medications that could prevent individuals from attempting suicide:

- There are few randomized control trials (RCTs) that have addressed medication benefits for reducing suicide risk among youth or older adults (O'Connor et al., 2013). (Aspirational Goal 5)
- Existing FDA-approved medications used with suicidal persons are all intended to treat "underlying" psychiatric conditions, and often take weeks to become effective. To date, there is *no Food and Drug Administration (FDA)-approved medication with a primary indication of reducing the risk of suicide behavior.* (Aspirational Goal 5)
- It is not clear how effective treatments for patients' underlying psychiatric and substance use problems (e.g., depression, mania, command hallucinations, insomnia, agitation) are in reducing near-term suicide risk. Suicide events are not included as routine targets or outcomes of treatments in research studies or industry sponsored trials and suicidal individuals are typically excluded from efficacy trials (Zimmerman et al., 2002). (Aspirational Goals 4, 5, and 6)
- Investigational studies have found N-methyl-D-asparate receptor agonist compounds are promising, fast-acting treatments for severe depression and suicide ideation. This has opened new approaches to studying other compounds with potential to be first line rapid treatment with implications for care in acute care settings (DiazGranados et al., 2010; Larkin & Beautrais, 2011; Price et al., 2009; Zarate et al., 2012). Important work remains to determine the safety, administration feasibility, dose, and duration of effects.
- Clozapine is the only medication with an indication of reducing the risk of recurrent suicidal behavior in at-risk patients with schizophrenia or schizoaffective disorder. (Aspirational Goal 5)
- The mood stabilizer lithium has been examined in cohort and case-controlled studies where protective effects against suicide attempts among individuals with bipolar illness, and in some cases mixed affective disorders, are reported (Baldessarini et al., 2006). However, adequately powered RCT evidence to support this claim is limited (Cipriani et al., 2013; Lauterbach et al., 2008; Oquendo et al., 2011). (Aspirational Goal 5)
- Medications are frequently prescribed without an evidence base to treat at-risk individuals (current ideation, history of an attempt), with current guidelines recommending treating the disorders present, specifically Axis I and II psychiatric disorders (American Psychiatric Association Practice Guidelines, 2003). (Aspirational Goals 4, 5, and 6)
- The FDA has indicated that a number of approved medications carry the risk for new incidence or increased suicidal thoughts and behaviors. Outside of specific warnings regarding serotonin re-uptake inhibitors for youth, providers have limited information on the risks and benefits of pharmacologic interventions for individuals who may experience new or elevated suicide risk as

a treatment side effect among a wide range of disorders (e.g., psychiatric, substance use, neurological, obesity-related).

Psychotherapy

With regard to the state of psychotherapy research for preventing suicide attempts:

- Several reviews have found outpatient psychotherapies reduce suicidal thinking and re-attempts among high-risk adult patients (O'Connor et al., 2013; National Institute for Health and Clinical Excellence, 2012). (Aspirational Goals 4 and 6)
- Outpatient psychotherapies for youth with multiple problems (e.g., mental disorders, substance use) are showing promise (Esposito-Smythers et al., 2011). (Aspirational Goals 4 and 6)
- There is a range of intensity of psychotherapeutic interventions (e.g., monthly postcards, follow-up phone calls, multiple weekly in-person psychotherapy sessions) for people who attempted suicide. Little is known about approaches to optimizing intervention type with patient needs or preferences. Little systematic information is known about possible harms of psychotherapies (e.g., poor matching between patient needs and intensity of treatments).

Intervention Research Quality

With regard to the state of intervention research in care settings considered more broadly:

- There have been few trials in inpatient/outpatient specialty (e.g., mental health, substance abuse treatment), primary care, or rehabilitation settings, and few trials with patients who have multiple comorbid conditions (e.g., Voss et al., 2013). (Aspirational Goals 4, 5, and 6)
- There is limited generalizability of the current evidence base for broad age groups (O'Connor et al., 2013). (Aspirational Goals 4, 5, and 6)
- Of the existing interventions, many are resource-intensive and few have been replicated outside of developers' hands (O'Connor et al., 2013). (Aspirational Goals 4 and 6)
- The mechanisms underlying interventions for suicidal persons are poorly understood. Research focused on addressing changes in neuropsychological impairments and dysfunction—and cognitive style—as the result of intervention response and recovery, are needed to refine and personalize interventions. (Aspirational Goals 4, 5, and 6)
- Many of the more recent intervention approaches are theoretically-based, but moderators and mediators of effects are infrequently identified. (Aspirational Goals 4 and 6)
- There are very few studies examining medication and psychotherapy as sequenced or combination treatments. (Aspirational Goals 4, 5, and 6)
- Many clinical trials, in particular the psychotherapy trials, lack rigorous methodological design. (Aspirational Goals 4, 5, and 6)

What Do We Need to Know?

What is the Suicide Burden Relevant to Intervention in Health Care Settings?

For Aspirational Goals 4, 5, and 6, the RPTF considered the following surveillance burden data and research findings:

- Approaches to treatment improvements can evolve out of understanding what doesn't work. More routine, root cause analyses (RCA [see Glossary]) and psychological autopsies after suicide deaths that focus on particular types of treatments and settings (e.g., medications,

psychotherapy, and inpatient care) may reveal problems in dosage, medication interactions, side effects, and adherence monitoring. (Note that other systems of care processes are addressed in Key Question 4.)

- Initial efficacy data for psychotherapy effectiveness with individuals with recent attempts can be modeled for various care settings, including inpatient and outpatient settings (emergency care is modeled below).
- Access to medication trials with harmonized measurement of suicidal behaviors (making measures comparable) would allow for further analyses to estimate the frequency and possible etiology of suicide ideation and behavioral side effects among CNS medications.

Interventions to Reduce Suicide Burden—What is the Potential Benefit?

If treatments currently delivered to individuals with mental disorders and substance use disorders could be improved to reduce suicide risk, how many lives could be saved? How many attempts averted? If a new, fast acting medication were available to individuals who receive emergency room or inpatient care for suicide risk, how many attempts could be averted and lives saved? These questions could be asked for the provision of clozapine among individuals who are suicidal and experiencing their first episode of psychosis, and for the provision of lithium for suicidal individuals with bipolar disorder. One example model is provided here to illustrate the upper limits of a population benefit of psychotherapy for people who attempt suicide and are seen for emergency care.

Example Model: Psychotherapy to Prevent Reattempts for Adults in Emergency Care

Because there are effective psychotherapy interventions to prevent re-attempts, the RPTF staff, in consultation with Dr. Frances Lynch, developed a model to examine the potential intervention benefits of evidence-based psychotherapy for the U.S. population of adults (ages 18–64) seen in emergency care (see Appendix G).

Reduction in Attempts

In 2010, there were 390,359 adults, ages 18–64, seen in emergency care settings for self-harm (U.S. Consumer Product Safety Commission National Electronic Injury Surveillance System, 2010 data). Based on estimates using Model 1 in Appendix G (the intervention being accepted by all those who attempted suicide), the number of attempts averted would be 8,737, or a reduction of about 5% of this cohort. In five years, adding each one-year cohort of people who attempted totals 1,952,895 attempts. Adding together one-year effects for five cohorts, the attempts averted in five years are 109,306 (again, 5%). This is an underestimate of the intervention benefits, as earlier cohorts might continue to have benefits over the five-year period (see Model in Appendix G).

Reduction in Deaths

Because there were no readily accessible U.S. estimates of 12 month risk for suicide death among individuals seen for emergency care for self-harm, the model used fatality estimates from the literature. Over a one-year timeframe, the intervention was estimated to decrease the number of deaths by about 2,498. This is an 8% decrease in suicide deaths among persons aged 18–64 (2,498/31,354).

In five years, adding each one-year cohort of 2010 suicide decedents ages 18–64 is 156,770. Adding together one-year effects for five cohorts, the suicide deaths averted are 9%, or 13,928. This is an underestimate of the intervention benefits, as earlier cohorts might continue to have benefits over the five-year period (see Model in Appendix G).

Gaps in Burden and Intervention Modeling Information
Fatality rates for people who attempt suicide and have been treated in various care settings are absent from the U.S. literature. Longitudinal data are available on people who attempt suicide and are treated for acute care in the emergency department in the U.S. Healthcare Cost and Utilization Project (Owens et al., 2010) but are not readily useable. This limits the ability to make burden estimates (e.g., case fatality rates of re-attempts) over time, and makes it difficult for health care organizations that may wish to identify this burden and reduce it. Future modeling efforts could consider opportunities in health care systems (e.g., the VA, Mental Health Research Network, states with aggregated ED and hospital discharge data and adequate E-Coding) that are able to track patients over time.

Fatality rates for individuals who had ideation and were treated in various settings are not known, although the VA and Mental Health Network may have estimates soon. Without knowing the likely course/trajectories of ideation, attempts, and re-attempts, it is challenging to refine estimates of the benefits of effective interventions. This information is particularly lacking for youth and older adults.

Other Opportunities for Modeling Benefits of Interventions
Other modeling efforts could consider alternative health care settings (e.g., substance abuse treatment, mental health outpatient care, residential care, long-term care, rehabilitation), and interventions for youth and older adults, where the benefits of various effective interventions could be estimated.

Proposed Research Pathways

Topic Experts were asked to propose research pathways for preventing suicidal behavior among those with ideation (Aspirational Goal 4), how biological treatments can prevent suicidal behavior (Aspirational Goal 5), and how treatments can be used to prevent reattempts (Aspirational Goal 6). The following describe the research pathways considered:

- Expand pharmaceutical industry trials so that new and repurposed medication trials target suicidal symptoms and related cognitive dysfunction (e.g., anhedonia, hopelessness, impulsivity) in order to increase the number of available pharmacological treatment options that might mitigate suicidal risk. Consider policies to encourage safe and fair recruitment of suicidal patients in trials, including consistent approaches to assessing adverse events. (Aspirational Goal 5)
- Determine whether approaches that reduce risk conditions (e.g., insomnia, psychosis, agitation) also mitigate suicide risk, and whether more adherent and complete responses to these conditions are sufficient to mitigate risk. (Aspirational Goals 4, 5, and 6)
- Determine if there are neurocognitive profiles and cognitive styles/patterns of thinking (e.g., endophenotypes) among psychiatric and substance use patients that can predict response and/or are responsive to intervention. (Aspirational Goals 4, 5, and 6)
- Use imaging techniques to study the effects of interventions on the neural circuitry of adults and youths; elucidate factors and neural circuitry associated with resilience, recovery, and non-response to treatment. (Aspirational Goals 4, 5, and 6)
- Design interventions that address rapid fluctuations in suicidal thoughts or behaviors. (Aspirational Goals 4, 5, and 6)

Clinical trial designs relevant to Aspirational Goals 4, 5, and 6 should be improved in a number of ways to increase their value for application (see Figure 4 at end of this section).

Across Aspirational Goals 4, 5, and 6, it was noted that intervention trials have not addressed a number of high risk groups; knowing the effectiveness of interventions for these groups is necessary for action among communities that have high risk members. The following describes additional research pathways:

- Develop interventions to address the needs of the highest risk groups (e.g., recently discharged, multiply comorbid conditions, family history of suicide, individuals with near lethal attempts).
- Conduct medication and psychotherapy trials in populations who have substance use or dependence (e.g., nicotine, alcohol, opioid). Test treatments in settings where the high-risk individuals can be found (e.g., emergency departments, inpatient units, jails, detoxification units, residential care). Across diverse settings, test interventions that can be managed by providers and supported by family members and/or peers.
- Measure inclusion of potential high-risk demographic groups (e.g., veterans, American Indian/Alaskan Natives, survivors of suicide loss, individuals with frequent stressful events) and examine mediators and moderators of response to determine if refinement or adaptation of interventions is necessary.
- Determine whether interventions require adaptation to address unique mediators or moderators of response for specific high risk communities (e.g., American Indian Reservations, substance abuse patients).
- Include standard measures in studies of natural experiments of targeted efforts to treat high-risk individuals (e.g., clozapine treatment in schizophrenia in the presence of suicide risk; Office of Mental Health, New York State, 2012) to examine clinical response among more diverse patients.

Research Opportunities

Experts reviewed proposed research pathways in light of available information on the burden of suicide attempts and deaths, and the value of addressing specific research gaps in Aspirational Goals 4, 5, and 6 with regard to the cross-cutting questions in suicide prevention.

Short-Term Objectives
The resulting short-term research objectives are considered the most likely, if fully implemented, to most rapidly reduce the burden of suicide attempts and deaths.

A. Identify feasible and effective, fast acting interventions (e.g., new medicines with properties similar to certain fast acting anesthetics, treatment engagement interventions).

B. Determine if adjunct interventions (e.g., safety planning, adherence interventions) focused on suicidal crises for patients receiving usual care for health conditions (e.g., psychiatric, substance use, physical illness) are effective.

C. Find interventions for the highest risk groups within care settings or community settings (e.g., substance abuse specialty, jails, American Indian Reservations) that reduce the risk of suicide.

Long-Term Objectives

The resulting long-term research objectives are considered necessary to devote sustained efforts to reduce the burden of suicide attempts and deaths.

    A. Determine whether treatment of risk conditions (e.g., insomnia, psychosis, agitation, parental psychopathology), including optimal adherence and complete response, mitigates suicide risk.

    B. Identify biomarkers (e.g., neurocognitive profiles, genes, traits) that point to promising treatments (new, repurposed) and/or predict treatment response.

    C. Refine treatments for different high-risk populations (e.g., demographic groups, disease groups) by identifying prognostic variables/moderators of response and associated mechanisms from secondary analyses.

Figure 4. Research Pathways Using Clinical Trial Designs Should Be Improved to Increase Their Value.

- Conduct secondary analyses of previous trials focused on reducing suicidal behavior to better understand the sequencing and timing of outcome response and related clinical symptom changes.

- Conduct secondary analyses of previous trials focused on reducing suicidal behavior to better understand dropouts and attrition.

- Test sequenced approaches that can produce safe and rapid treatment response (e.g., new medicines with properties similar to certain fast acting anesthetics) followed by interventions that provide relapse prevention.

- Require common data elements across treatment trials to examine moderators, mediators, and subgroup responses. Seek common approaches to outcomes (e.g., weighting of different types of suicidal behaviors), as well as defining safety concerns and adverse events.

- Develop more rigorous design methods with adequate statistical power (e.g., including assessment of outcomes blind to condition).

- Consider assessments and interventions that work for various provider groups (ranging from trauma surgeons to community mental health social workers to emergency medical technicians and family members) so that effective interventions are more likely used.

- Consider validity checks for propensity for suicide ideation and drug use to address under-reporting (e.g., implicit association tasks).

- Design control conditions that are better defined and standardized.

- Add measures of suicide trajectories to trials (recall and follow-up), add neurocognitive and imaging measures on selected subgroups to understand mechanisms of change, and gather biomarker data to predict and follow treatment response (e.g., speed of response, degree of response, relapse rates).

- Develop a set of widely-accepted quality indicators for measuring the effectiveness of treatment for suicide risk to determine if at-risk individuals have received appropriate care.

- Learn why retention rates in suicide risk treatment studies are higher outside the U.S. in order to determine whether interventions can be developed to improve intervention research retention rates.

- Include informed consent for long-term follow-up, including mortality outcomes. Where appropriate, encourage family members to consider brain tissue donation.

Key Question 4: What Services Are Most Effective for Treating the Suicidal Person and Preventing Suicidal Behavior?

> **Aspirational Goal 7**, *Ensure that health care providers and others in the community are well trained in how to find and treat those at risk.*
> **Aspirational Goal 8**, *Ensure that people at risk for suicidal behavior can access affordable care that works, no matter where they are*.
> **Aspirational Goal 9**, *Ensure that people getting care for suicidal thoughts and behaviors are followed throughout their treatment so they don't fall through the cracks.*
> **Aspirational Goal 10**, *Increase help-seeking and referrals for at-risk individuals by decreasing stigma.*[4]

State of the Science

Training

- Clinicians are likely to come in contact with individuals at risk for suicide over the course of their training and careers (Feldman & Freedenthal, 2006), and such individuals are regarded as among the most challenging (Jobes et al., 2008). Yet few clinicians are formally and adequately prepared to work with individuals at risk for suicide (Schmitz et al., 2012).
- Time series studies from Europe indicate that training primary care providers to improve their treatment of depression may lower suicide attempts and deaths (Szanto et al., 2007; Rihmer et al., 1995). Similarly, the Perfect Depression Program—a behavioral health care program in the Henry Ford Health Care system that trained providers to deliver cognitive behavior therapy to depressed patients (Coffey, 2007)—also has reported reduced suicide deaths.
- A Canadian study of gatekeeper training deployed in an occupational group (police) found lower suicide rates among the trained group over time (Mishara & Martin, 2012).
- Increased staffing of mental health providers has been found to be related to lower suicide rates within care systems (Katz et al., 2013; May et al., 2005).
- Initial efforts in training and education for suicide prevention were limited to improving attitudes toward helping suicidal individuals, and knowledge of risk factors or warning signs, but not skills-based training (Pisani et al., 2011). More recent research designs assessing suicide training and education programs often suffer from weak designs (e.g., Hershell et al., 2010, noted few employing vignettes or standardized patients, few measures of clinician behavior or individual outcomes, lack of a control or comparison group, and small samples).
- Current training models for evidence based treatment exist within the mental health field (e.g., VA efforts to deploy evidence-based psychotherapy for depression and PTSD; Karlin et al., 2010). Comparable training efforts for reducing suicide risk are in the initial stages. It is not clear how effective the training is for providers with variable backgrounds (e.g., paraprofessionals and community gatekeepers [see Glossary]).
- Train-the-trainer efforts are commonly used for cost efficiency reasons. However, fidelity dissipates rapidly and new approaches to maintain fidelity and maximize training effectiveness

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[4] Both self- and other-stigma beliefs can reduce help-seeking for suicide risk. The RPTF worked to illustrate this Aspirational Goal through a complex logic model (see Appendix F). However, using the term 'stigma' in public messages when describing the challenges that individuals and families face when seeking mental health or substance abuse treatments may reinforce negative attitudes and be counter-productive (e.g., see Langford et al., 2013).

(e.g., read-ahead material, matching training to trainee needs, periodic skills check with booster training) need to be tested (Hershell et al., 2010).

Seeking Care

The intent of Aspirational Goal 8 is to develop research pathways that will encourage development or design of innovative, evidence-based suicide prevention strategies that could make care more affordable/accessible and effective. The aim of Aspirational Goal 10 is to develop a research pathway that will increase help-seeking, engagement, and referrals for at-risk individuals by decreasing stigma and addressing negative beliefs and other barriers. For Question 4, aspects of Aspirational Goal 10 most relevant are those where systems of care improve help-seeking through outreach efforts. The following outlines what is known about more affordable and accessible care and suicide risk (Aspirational Goal 8), and why an individual may or may not seek care (Aspirational Goal 10):

- Mental health benefits legislation improves financial protection and increases appropriate utilization of mental health services for people who require them. It also is associated with increased access to care, increased diagnosis of mental health conditions, and reduced prevalence of poor mental health and reduced suicide rates (Community Preventive Services Task Force, 2012).
- The National Suicide Prevention Lifeline, which is 'toll-free' and has 24/7 available crisis lines, is beneficial with regard to reducing callers' distress and linking them to referrals to health care services (Gould et al., 2012). The Veterans Crisis Line is being studied for its potential to mitigate suicide risk through telephone and online counseling and referral (Knox et al., 2012).
- Primary care is the largest setting where suicide decedents (e.g., 25% of suicide decedents in the armed forces; Trofimovich et al., 2012) visit within 30 days of their deaths. Health care systems with primary care supports for collaborative care can improve depression treatment and reduce suicide ideation (Thota, et al., 2012).
- The lack of rapid access to trauma services can increase fatality risk in suicide attempts (MacKenzie, et al., 2006).
- Most adolescents who attempt suicide have had prior lifetime mental health treatment (Nock et al., 2013); however, many youth have not received treatment within the past 12 months of their attempt (Husky et al., 2012).
- Most youth and young adults at risk for suicide (experiences of ideation and/or self-harm) do not seek medical help; instead, they seek the support of peers (e.g., Michelmore & Hindley, 2012).
- Few theoretical models have been tested to enhance help-seeking (see Glossary), such as reduction of burdensomeness (e.g., Joiner, 2005), shame related to events (e.g., home foreclosure, legal problems, romantic rejection), and anticipated negative reactions by others.
- Reluctance to seek help is often multi-faceted (e.g., belief that treatment is not needed, not effective, difficult to obtain, inconvenient, unpleasant, detriment to career path [Hoge et al., 2004; Moskos et al., 2007]). Individuals in distress who are reluctant to seek care should be appropriately assessed so that barriers can be addressed (Stecker et al., 2011).
- Motivational interviewing, found to be effective in engaging individuals in substance use treatment, may be feasible and effective in engaging individuals at risk for suicide (Britton et al., 2012).

Continuity of Care

The aim of Aspirational Goal 9 is to develop a research pathway that will encourage development or design of innovative, evidence-based models of care for suicidal persons which specifically meet the needs of this clinical population while facilitating continuity, improving linkage, and directing utilization toward sites equipped to handle these needs. With regard to what is known about continuity of care and suicide risk (Aspirational Goal 9) (see Knesper, American Association of Suicidiology, and Suicide Prevention Resource Center, 2010, for a review):

- Veterans' health care research has indicated that care transitions (e.g., inpatient to outpatient) or treatment changes (e.g., changes in medications) are among the highest risk periods for individuals treated for suicide risk (Valenstein et al., 2009).
- Lack of outpatient care following acute emergency medicine treatment increases risk for repeat suicide attempt and suicide death (e.g., Meehan et al., 2006).
- An international, randomized, multi-site trial demonstrated that for people who attempted suicide, brief contact in emergency care settings and a brief follow-up (phone or in home visit) reduced suicide deaths, but not attempts (Fleischman et al., 2008).
- Repeated follow-up contacts after emergency department or hospitalization appear to reduce suicidal behavior, but the mechanisms for the benefit (e.g., reduced feeling of isolation, improved treatment adherence) needs further refinement (Luxton et al., 2013).

What Do We Need to Know?

What is the Suicide Burden Relevant to Services for the Suicidal Person?

- Rates of suicide ideation, attempts, and deaths among individuals seen in primary care and other health care settings and the types of services they have received (e.g., medications, psychotherapy, case management) are not known. A recent review by Hawton and colleagues (2013) noted an absence of information on the rates of suicide for depressed primary care patients.
- The proportion of patients in trauma services with self-inflicted injury who have not received adequate mental or substance abuse care is not known (e.g., how many of the trauma patients are specialty care treatment failures?).
- As indicated above, there are a number of components of health care systems that are known to affect the risk of suicide. The National Action Alliance's Clinical Care and Intervention Task Force (www.actionallianceforsuicideprevention.org/task-force/clinicalcare), and the National Action Alliance's Clinical Workforce Preparedness Task Force (www.actionallianceforsuicideprevention.org/task-force/clinicalworkforce) have been fielding provider need and interest surveys in suicide assessment and management skills in a number of large health care organizations (both state- and private-run). If these in-the-field surveys were standardized, they could serve as indicators of service provider perceptions of low quality care for suicidal individuals.
- Surveys are needed to determine which providers received training in suicide assessment and management in their degree programs.
- Surveys of licensing bodies could indicate which skills for assessment and management of suicidal behavior are required.
- Surveys that address specific care system components considered relevant in reducing suicides (such as those listed by While et al., 2012) could be tracked and monitored as intermediate indicators of burden in a sufficiently large health care system (e.g., Mental Health Research

Network, 2013). These include making root cause analyses after a suicide death a required process by the 'responsible system' of care, where appropriate.

- Expanding the National Violent Death Reporting System to include all states and territories could inform what care systems decedents' accessed prior to their deaths and what services they received.
- Surveys to assess patient and family views of care services (e.g., ineffective, traumatizing, difficult to access, other reasons for not returning to care) could identify areas to improve service quality.
- Surveys could determine who prefers access to technology-based care (e.g., online, phone applications) instead of 'in-person' care if it were available for addressing suicidal thoughts and behaviors.

Services to Reduce Suicide Burden—What is the Potential Benefit?

Example Analysis—Levels of Implementation of State Mental Health Insurance Laws
Because most individuals in the U.S. who access health care for suicide risk are not a part of a comprehensive care system, it is difficult to estimate the benefits of improved health care services on suicide attempts or deaths. In 2011, Dr. Matthew Lang reported analyses of state suicide rates through 2004 by variation in state laws that differed by insurance package requirements for mental health care coverage (Lang, 2013). The assumption was that psychotherapy and prescription drugs are needed to effectively treat mental disorders related to suicide, so that increased opportunities to obtain such services would reduce suicide rates. Dr. Lang concluded, "The results indicate that if laws had not been enacted, the suicide rate would have been 0.37 points higher at a rate of 10.61. This equates to approximately 592 suicides prevented per year as a result of the mental health laws" (see Appendix G).

The RPTF staff asked Dr. Lang to update these analyses through changes in state laws through 2010. A summary of these analyses are provided in Appendix G. "The results show that mental health parity laws significantly decrease suicide rates when analyzed between 1990 and 2010. Suicide rates decrease significantly the year after the parity law is enacted, but return to their pre-enactment levels in the following years. Additional enactment of parity laws was estimated to have prevented approximately 713 suicides in the year after enactment, despite the onset of the recession. He also noted a dose-response association: "When a state enacts a weak law, there is no impact on the suicide rate."

A landmark study in England and Wales (While et al., 2012) was able to identify particular types of services that appeared to be associated with fewer suicide deaths (see Figure 5). In an observational study of 91 health services, suicide rates prior to full implementation of recommended mental health services (in 1998) and suicide rates after different regions implemented different practices (in 2006), were examined. While and colleagues were able to estimate reductions in suicide rates associated with the provision of various mental health service components. Figure 5 lists actions taken and summarizes what was found to be most effective. A number of these practices could be estimated and tested in the U.S. in 'closed' systems that allow for tracking of patient access of services, such as the VA health care system or the Mental Health Research Network. This could determine if similar suicide prevention effects could be obtained in the U.S.

Figure 5. Health Care System Characteristics That Were Associated with Lower Suicide Rates upon Implementation

Most Effective across All Sites
    A. Providing 24-hour crisis teams

Moderately Effective across All Sites
    B. Managing patients with co-occurring disorders (mental and substance use disorder)
    C. Conducting multidisciplinary reviews
    D. Sharing information with families after a suicide and making future care improvements as a result

Most Effective for Inpatient Settings
    E. Removing ligature points

Most Effective for Noncompliance
    F. Conducting follow-up with patients within 7 days of discharge

Most Effective for People with History of Missed Appointments
    G. Conducting assertive community outreach

Overall, Largest Effects Were in Low Income Areas
    H. Providing regular training to frontline clinical staff on the management of suicide risk
    I. Responding to patients who are not complying with treatment
    J. Sharing information with criminal justice agencies

In 1998, few of the 91 mental health services in the study were carrying out any of these recommendations. By 2004, about half were implementing at least seven recommendations, and by 2006, about 71% were doing so. Over time, as more recommendations were implemented, suicide rates among patients declined. Each year, from 2004 to 2006, mental health services that implemented seven or more recommendations had a lower suicide rate than those implementing six or fewer. (While et al., 2012)

Among the few U.S. efforts described to improve systems of care to reduce suicide events, the VA National Center for Patient Safety Field Office reported steps taken to abate environmental hazards in VA health care facilities, with suicide outcomes pending as the result of the abatements (Mills et al., 2010). RCA (see Glossary) is a process used to search for causes of an event and opportunities for improvement in facility practices. Since 1995, suicide has ranked in the top five most frequently reported events to The Joint Commission. Despite The Joint Commission's issuance of the National Patient Safety Goal 15.01.01 to prevent suicide attempts and deaths, Ballard and her colleagues (2008) found limited research on ways that U.S. health care institutions could improve as the result of a suicide death in a facility.

Gaps in Burden and Services Modeling Information
Determining effective service delivery requires a health care system that can 'capture' the services provided to individuals for analyses, and also can link such records to death records. At the current time, this is only possible in the U.S. within closed health care systems, such as the VA health care system and large health care organizations (e.g., Mental Health Research Network). As the use of electronic health records increases, the RPTF anticipates increasingly greater numbers of care systems capable of examining the quality of care associated with suicide burden.

The implementation of federal mental health parity, and the Affordable Care Act (ACA), allows for innovation in health care delivery and research opportunities. The optimization of information technology also could offer multiple research opportunities.

Other Opportunities for Modeling Benefits of Services
The Mental Health Research Network (2013) and the VA could aspire to replicate the While and colleagues' study. VA researchers have already reported some success in reducing ligature availability and hospital suicide deaths through the use of a checklist. VA chart review research also has revealed the need for identifying prescription drug use in suicide risk assessment (e.g., Kim et al., 2012).

Proposed Research Pathways

Experts were asked to propose research pathways for preventing suicidal behavior through improved training of providers (Aspirational Goal 7), more accessible and affordable care (Aspirational Goal 8), greater continuity of care (Aspirational Goal 9), and improving help-seeking and use of care (Aspirational Goal 10). They were asked to consider what research would be most effective to reduce the burden of suicide attempts and deaths. The following sections describe the research pathways proposed for the four Aspirational Goals in this Question.

With regard to research pathways recommended for training providers (Aspirational Goal 7):

- Learn from the emerging literature on training providers in evidence-based psychotherapy practices. Those findings indicate the following can affect training effectiveness: characteristics of who is trained (e.g., motivation, prior training), norms for training within the organization, fidelity monitoring, and sustainability. Determine if similar components affect training in suicide assessment and management (e.g., are trainees more motivated due to legal concerns?).
- The National Institute for Health and Clinical Excellence (NICE, 2012) Guidelines on Longer Term Management for Self-Harm included the following recommendations for provider training (p. 281), which could be empirically tested when optimizing training: include education about the stigma and discrimination often associated with self-harm; include individuals who have self-harmed in training efforts; assess the effectiveness of training by using service recipient feedback as one of the outcome measures; trained providers should have access to specialists in self-harm treatment; and consider the emotional impact of self-harm on the provider when determining the capacity to practice competently and empathically.
- To translate science into practice, test models in various practice settings, across disciplines, and with diverse populations. Consider technology enhancements for standardizing training, practice opportunities for trainees, reaching trainees remotely, measuring outcomes (self-report and objective measures), and testing approaches for booster sessions.
- Develop research partnerships with those engaged in ongoing training (e.g., training programs, triage nurses, clinicians). Assess their perceptions, and patient perceptions, of the adequacy of assessments and care provided.
- Consider training community gatekeepers and professional providers simultaneously, to avoid ethical dilemma of identified at-risk individuals who are not seen by competent providers or competent providers who have too few patients to see. Consider how each group can inform and motivate the other in immediate skills training contexts, as well as in longer-term outcomes for patients.
- Consider opportunities to change trajectories for helping people in distress and at risk (e.g., depressed, anxious) before they reach the point of suicide ideation or behavior. Deploy staff

trained in engagement skills and motivation for interventions (e.g., offering hope) that can address the suicide risk factors in boundaried settings (e.g., court systems, unemployment offices, rehabilitation settings).

- Consider the research opportunity afforded by policy changes (e.g., Washington State law on requiring continuing education in suicide assessment and management for social work licensing) to assess the effectiveness of training mandates.
- Assess the potential benefit of the availability of a highly skilled clinician/assessor in primary care settings, substance use rehabilitation, etc., who can assist providers who have a high volume, but low base rate of suicidal patients—similar to the VA Suicide Prevention Coordinators (see Glossary). In addition to appropriate linkage to specialty care, determine if the skilled provider is able to reduce initial distress.

With regard to research pathways recommended for Aspirational Goal 8 that will encourage development or design of innovative, evidence-based suicide prevention strategies that make care more affordable/accessible and effective, the following were proposed:

- Determine the values and goals for a desirable health care system (e.g., accurate assessment of problems, matching care to level of patient needs, skillful providers, care management available, designation of responsible providers [who owns the problem with the patient]) and determine where suicide prevention is functionally assigned. Determine how individuals can be helped earlier in the care system (e.g., reduced depression and pain, monitoring for life changes/stressful events).
- Evaluate the effectiveness of technology-enhanced services (e.g., online, phone text messaging, phone applications) as potential expansion or improved efficiency for health care services (e.g., direct to patient care, provider training, adherence to evidence based care) for reducing suicide risk.
- Develop and test approaches learned from adult collaborative care and expand to less studied groups or settings (e.g., pediatric care, older adult assisted living) and consider technology-enhanced delivery options.
- Examine pay-for-performance reimbursement and per person payments to determine whether they are more successful in detecting and treating suicidal patients.
- Develop and assess alternative health care approaches to emergency medicine and/or inpatient care services (e.g., respite or safe house setting that offers time and social support).

With regard to research pathways that recommended facilitating continuity of care and improving care linkage (Aspirational Goal 9), and increase help-seeking and referrals for at-risk individuals (Aspirational Goal 10):

- Explore inpatient to outpatient, and emergency care to outpatient referral acceptance failures through mixed methods (interviews and longitudinal follow-up) to identify approaches to improve continuity of care (e.g., telephone support until outpatient care starts) and other network characteristics that are helpful (e.g., peer-support, perceptions that providers and care system is trustworthy and supportive).
- Test a registry approach to track clinical accountability for patients by a health care system, improve cross-platform/system care, and evaluate benefits of services/treatments.

- Test approaches to engage and retain older adult men, and those who are socially disconnected (e.g., peer navigators), in existing organizations with suicide prevention potential (e.g., Aging Services Network providers as members of comprehensive health care team).
- Test approaches that systematically address reasons why at-risk individuals do not seek care. Consider ways to avoid the risks of normalizing suicidal behavior while improving help-seeking.
- Test approaches to modifying self-stigma and/or beliefs that treatment for suicidal behavior is ineffective, blaming, embarrassing, or uncomfortable (common reasons for avoiding treatment) through various media (e.g., movie trailers on YouTube or Hulu, provide ways to link with crisis counselors).
- Study the impact of policy/law changes on help-seeking by suicidal patients.
- Test approaches focused on friend and family members' ability to facilitate help-seeking for at-risk individuals.
- Test models of successful treatment engagement for substance use problems (e.g., SBIRT) for suicidal patients. Using lessons learned from collaborative care programs that have successfully reduced depression in adults in primary care, test collaborative care approaches adapted for other at-risk subgroups (e.g., youth with substance use problems, adults with chronic pain).
- Test a case management/suicide risk manager approach that enhances engagement of patients in life-sustaining needs outside the health system (e.g., vocational training, parole supervisors).
- Test approaches that teach appropriate help-seeking to adolescents (e.g., in school settings), as adolescence is a time when many risk factors for suicide appear (e.g., depression, substance use, delinquent behavior). In the process of reaching adolescents, parents of the adolescents also could be engaged and taught approaches to recognizing when help-seeking is needed and how to access help.
- Develop rigorous randomized control designs that can be rolled out in boundaried systems with electronic records (e.g., VA, prison health systems, police departments). Use designs with staged deployment and assessment of quality of care improvements to look at within site and across site system changes and suicidal behavior outcomes.

Research Opportunities

Experts reviewed proposed research pathways in light of available information on the burden of suicide attempts and deaths, and also considered the value of addressing specific research gaps in Aspirational Goals 7, 8, 9, and 10.

Short-Term Objectives
The resulting short-term research objectives are considered the most likely, if fully implemented, to most rapidly reduce the burden of suicide attempts and deaths.

A. Identify efficient ways to increase the number of providers who implement adequate suicide assessment and management skills that improve care.
B. In randomized practical trials (see Glossary), along with possible moderators (e.g., financial stress, patient age and gender) and intermediate outcomes (e.g., disengagement from care, functional limitations), find quality improvement components associated with reduced suicide risk.
C. In at-risk populations, substantially increase effective help seeking and treatment engagement (e.g., involve family members and peers, information disseminated by media).

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Long-Term Objectives
The resulting long-term research objectives are considered necessary to devote sustained efforts to reduce the burden of suicide attempts and deaths.

A. Prevent suicidal crises and injuries through effective novel care system practice approaches matched to at-risk patient needs (e.g., alternatives to inpatient care).
B. Reduce suicide attempt and death outcomes through multiple, synergistic components of quality improvement within and across responsible systems (e.g., health care, justice systems, military installations, older adult care settings).
C. Sustain effective quality improvements (e.g., stakeholder feedback mechanisms, such as service ratings and 'report cards,' quality improvement collaborative involvement) that include input from those affected by those systems, including patients, providers, family members, policy leaders, and funders.

Key Question 5: What Other Types of Preventive Interventions (Outside Health Care Systems) Reduce Suicide Risk?

Aspirational Goal 11, *Prevent the emergence of suicidal behavior by developing and delivering the most effective prevention programs to build resilience and reduce risk in broad-based populations.*
Aspirational Goal 12, *Reduce access to lethal means that people use to attempt suicide.*

The aim of Aspirational Goal 11 is to develop a research pathway that will encourage the use of effective prevention programs that build resilience to prevent the emergence of suicidal behavior in broad-based populations, and/or reduce the risk of suicidal behavior via other, population-based approaches. The aim of Aspirational Goal 12 is to develop research pathways that would substantially reduce access to lethal means used to carry out suicide attempts.

State of the Science

Community Interventions
- There are many effective school based prevention programs that target putative risk factors (e.g., substance use, depression, delinquency). Some have shown promise in reducing hopelessness, suicide ideation, and suicide attempts (Wilcox et al., 2008). (Aspirational Goal 11)
- There are multiple, descriptive studies of self-reports by youth who engage in high risk behaviors (e.g., substance use, sexual behavior, violent behavior) who also report suicide ideation and attempts (e.g., Jiang et al., 2010). For example, a review of all male youth (ages 13 to 21) suicide decedents in Utah found nearly two-thirds had contact with the justice system (Moskos et al., 2007). (Aspirational Goal 11)
- Compared to adults, youth are more susceptible to suicide behavior modeling, social norming of suicidal behavior (contagion), and imitating suicide methods (Haw et al., 2013). The social environment has been described to have particular affects among higher risk subgroups such as LGBTQ (Hatzenbuehler, 2011) and American Indian and Alaska Native youth (Brave Heart & DeBruyn, 1998). (Aspirational Goals 11 and 12)
- As noted in Key Question 1, risk factors are known for many subgroups in youth and adults (e.g., early sexual abuse, later interpersonal violence, substance use, depression), but few interventions have been fielded that target the risk factors or approaches to building resilience against risk factors, and also measure suicide attempt or death outcomes. (Aspirational Goal 11)
- Youth who have consistent, healthy attachments to family and school are protected against suicide ideation and attempts (Borowski et al., 2001). (Aspirational Goal 11)
- High lethality of suicidal behavior in later life (one in four attempts is lethal; 71% of age 65+ suicides are by firearm) indicates reducing suicidal persons' access to means, earlier interventions in the life course, and/or selective and universal prevention efforts are needed for older adult suicide prevention (Conwell et al., 2011). (Aspirational Goals 11 and 12)
- Interventions need to build on what is known about mechanisms of resilience, as well as mechanisms and components of dysfunction in stress response (e.g., shame, detachment) to events associated with suicide risk (e.g., economic stress, interpersonal loss, onset of mental or physical illness). (Aspirational Goals 11 and 12)

Means Safety
- Ecological time series and case control studies indicate that reducing suicidal persons' access to means has been shown in multiple, national studies to be the most potent, yet under-utilized approach to suicide prevention (Miller et al., 2012). (Aspirational Goal 12)
- There are few rigorously controlled tests of interventions that reduce access to lethal means (e.g., provider counseling on limiting access to means, electronic pharmacy alerts on dosing, bridge barriers) (McManus et al., 1997). (Aspirational Goal 12)
- From population studies, attitudes that are accepting of suicide as a solution (e.g., Joe et al., 2010), broad knowledge of use of suicide methods (Niedenkrotenthaler et al., 2010) and access to lethal means (Hawton, 2007) are each associated with increased risk for suicidal behavior. (Aspirational Goal 12)
- While case fatality rates for most suicide methods are known (e.g., firearms are more deadly than medication overdoses [Miller et al., 2004]), patterns of re-attempts by type of method are not known for general populations, settings (ED versus community rates), or among particular subgroups over time (age, gender differences, types of methods). (Aspirational Goal 12)

What Do We Need to Know?

What is the Suicide Burden Relevant to Interventions based in the Community?

For Aspirational Goal 12, data on the type of suicide methods used are included in the suicide attempt and death burden tables (see Appendix D, Means Safety Table). In terms of suicide deaths by type of method, the bulk of suicide deaths in 2010 were by firearms, accounting for 19,392 deaths. The second most frequent method used was suffocation. With regard to suicide deaths due to falls, additional information that could inform future efforts to prevent suicidal persons' access to means include the incidence of deaths by jumping from buildings, bridges, and trains/subways. In 2010, there were 781 suicide deaths by jumping, but information on exact locations frequently used by suicide decedents is not readily available.

National data on suicide methods, including timing and method type, used by individuals who re-attempt are difficult to estimate nationally. Those data are critically needed to develop estimates of the potential benefits of various efforts to prevent suicidal persons' access to means, as well as alternative intervention approaches (e.g., is cognitive therapy equally effective for reducing attempts for all suicide methods?).

Surveillance gaps noted include a need for:

- Accessible, national surveillance data on patterns of repeated nonfatal and fatal re-attempts by all injury methods. Information available by geographic region also would allow for coordinated efforts by states, tribes, or other communities. (Aspirational Goal 12)
- Basic data about firearm ownership and storage, as well as prescription drug storage and use practices (e.g., add relevant questions to the Behavioral Risk Factor Survey). (Aspirational Goal 12)
- An expanded CDC National Violent Death Reporting System allowing for more complete national and regional knowledge of decedent circumstances of suicide death and suicide methods (Aspirational Goal 12) and care systems accessed prior to death. (Aspirational Goals 7, 8, and 9)

- Readily accessible surveillance data on frequently used locations for suicide deaths by jumping to determine if a physical barrier, or other intervention, is needed. (Aspirational Goal 12)

For Aspirational Goal 11, surveillance data on attempts and deaths by age group and for non-health care settings are of particular interest (see Appendix D, tables labeled Education System; Justice System). In 2009, there were 303 jail suicides and 201 prison suicides. Studies report that over half of juvenile justice involved youth had current suicide ideation (Esposito & Clum, 2002), one-third had a history of suicidal behavior (Parent et al., 1994), and youth in secure residential juvenile justice facilities have nearly three times the suicide rate of peers in the general population (Gallagher & Dobrin, 2006). Among high school students, there were over one million suicide attempts (population projections of the Youth Risk Behavior Survey [YRBS]). Of the National Survey on Drug Use and Health (NSDUH) respondents who were full time college students, 108,000 reported attempting suicide in the past year. Other data sources on suicide attempts by college students may indicate higher prevalence (1.2% of students report attempting suicide in the past 12 months; American College Health Association National College Health Assessment [ACHA-NCHA], 2012). While it is not possible to use these estimates to track trends over time, plans to do so in the future may make the ACHA-NCHA estimates a reliable burden estimate for suicide attempts among college students. A publication by Schwartz (2006), using the National Survey of Counseling Center Directors, estimated that 622 college students died by suicide between 2004 and 2009.

Interventions to Reduce Suicide Burden—What is the Potential Benefit?
If communities had surveillance capability and resources to better identify the type of suicide methods, what prevention efforts could be tested? Without baseline information that is readily accessible, it is not known how many attempts could be averted or lives could be saved.

Example Models—Firearm Reduction, Carbon Monoxide Shut-Off, Good Behavior Game
Reducing access to firearms and motor vehicle carbon monoxide has been associated with significant decreases in suicide in other countries. The benefits of early preventive interventions for mental health and substance use problems have been proposed as likely being beneficial for reducing suicide risk as well. However, none of these approaches have been rigorously pursued in research. Further study of these approaches is necessary to determine for whom such interventions might be life-saving. Modeling the potential benefits of these community interventions helped reveal what we know, and don't know about the inputs and effects of these approaches. Two examples of efforts to prevent suicidal persons' access to means were modeled by Dr. Matthew Miller and Ms. Catherine Barber, and an early prevention was modeled by Dr. Frances Lynch (see Appendix G). The effect of reduced access to firearms was modeled from both ecological (state-based) data on suicide rates and firearm ownership and case control research. Reducing suicide deaths due to carbon monoxide (CO) by having a shut-off device in cars was modeled as an illustration of lessons learned from reduced motor vehicle deaths, suggested in a publication by CDC staff. Traffic safety measures responsible for reducing motor vehicle fatalities operate at multiple levels—guard rails on highways (environmental), seat belts in cars (laws for drivers), and graduated drivers' license (laws supporting driver knowledge and skill, and family monitoring and support). The Good Behavior Game (GBG) was modeled because: 1) it did not explicitly target suicide prevention; 2) its potential to reach many elementary schools children; and 3) it is one of few early prevention programs evaluated with a randomized control design and longitudinal follow-up of the outcome of suicide attempts. Summaries of these models are provided below.

The firearm reduction model indicates that:

- There were 19,392 *adult* firearm suicide deaths in 2010; 3,941 adult suicide deaths—or 10% of all suicides—could have been prevented in 2010 (Model 1).
- In five years, adding each one-year cohort of intervention suicide deaths averted a total of 19,705 *adult* suicide deaths. This would avert 10% of all adult suicide deaths over five years (19,705/191,820). Please see Appendix G for discussion of estimates of method substitution.

The CO shut-off model indicates that:

- There were 735 CO motor vehicle (MV) *adult* suicide deaths estimated for 2010; 600 suicides— or 1.5% of all adult suicides—could have been prevented in 2010 (Model 1).
- In five years, adding each one-year cohort of suicide deaths averted a total of 3,000 *adult* suicide deaths. Multiplied by five years, this would avert 1.5% of all adult suicides over five years (3,000/191,820).

Note that in this model, the estimated five year effect is provided for one cohort, and there are somewhat fewer lives saved over time because of the likely higher death rate for people who attempt (see Appendix G). Therefore, the five year estimate of 3,000 suicide deaths prevented may be too optimistic. Because we did not model effects year-by-year considering possible increased fatality rates among COMV attempt survivors, we did not estimate a cumulative five year number of suicides averted using this lower estimate.

The GBG model indicates that:

- For one cohort of first graders, the number of medically serious suicide attempts that could be averted over a 15 year period is 96,325. The number of deaths averted would be 173.
- Combining 15 first grade cohorts, 542,096 medically serious suicide attempts could be averted. The number of deaths averted would be 687.

Other Opportunities for Modeling Benefits of Interventions
Other modeling efforts could include interventions in alternative community settings (e.g., residential care, long-term care, rehabilitation, jails and prisons) where the benefits of various approaches of restricting suicidal persons' access to means and prevention efforts could be estimated.

Gaps in Intervention Modeling Information
In addition to the surveillance gaps noted above, further intervention research is needed to determine: 1) who is willing to accept the intervention, 2) for how long, 3) to what degree effectiveness endures, and 4) whether some subgroups benefit more or less from the intervention, both initially and in the long term. Implementation research will be needed to determine the best ways to disseminate and sustain any effective efforts (e.g., are booster sessions required to maintain effects, is a second intervention needed for those who do not respond to the initial intervention). Because there are no randomized trials for interventions focused on reducing firearm and COMV suicide deaths, randomized trials are critically needed to strengthen the observational evidence of their effectiveness. Because the GBG trial was randomized, has been replicated, has longitudinal follow-up, and has examined how fidelity affects outcomes (e.g., Becker et al., 2013), more precise modeling of mediating effects could be conducted with GBG for future population benefits.

Proposed Research Pathways

Experts were asked to propose research pathways that would enhance existing or develop new, effective prevention programs that build resilience to prevent the emergence of suicidal behavior in broad-based populations, and/or reduce the risk of suicidal behavior via other, population-based approaches. They also were asked to consider the most promising research pathways that would substantially reduce suicidal persons' access to lethal means used to carry out suicide attempts. The research pathways included:

- Examine changes in suicide risk as the result of policies that affect risk factors in the populations (e.g., reduced access to firearms for people at-risk of suicide, improved monitoring of prescription medications to reduce overdose risk, reduction in smoking, reduced access to alcohol). (Aspirational Goals 11 and 12)
- Add suicide outcome measures to relevant prevention trials (e.g., youth depression, youth substance use, college binge drinking) to determine added value for both short- and long-term benefits for suicide reduction. (Aspirational Goal 11)
- Find ways to integrate programs that reduce self-directed violence (prevention and treatment) with evidence-based programs that reduce other-directed violence and assess benefits for suicide outcomes. (Aspirational Goal 11)
- Conduct community-based research on effective suicide mitigation strategies for high-risk demographic groups (e.g., American Indian and Alaskan Native youth, LGBTQ youth, older veterans, individuals with recent adjudication for driving under the influence). (Aspirational Goal 11)

With regard to reducing suicidal persons' access to lethal means, the research pathways included:

- Find useful methods (e.g., internet autopsies, web-based social media surveys) to identify risk in social media (e.g., cognitive availability of means) and processes of contagion. (Aspirational Goal 12)
- Develop and test social messaging designed to increase the use and uptake of lethal means safety actions among at-risk individuals, family members, and community leaders in responsible positions (e.g., removal of guns from home, gun locks, removal of lethal medications, designing pedestrian-safe bridges). Community leaders could include gun club leaders, campus staff, civil engineers, and heath care providers. (Aspirational Goal 12)
- Test whether the incorporation of safer designs into new building and bridge structures prevents suicidal behavior. Determine if the inclusion of safe designs in training curricula for medical and nursing, architecture, urban design, and civil engineering schools could be one process for this intervention approach (e.g., new Tappan Zee Bridge safety features). (Aspirational Goals 7 and 12)
- Test approaches to safer prescribing so that individuals at risk receive medications with therapeutic value but less toxicity. (Aspirational Goal 12)
- Conduct research to assess how suicidal individuals seek, plan (cognitive access), and gain physical access to suicide means, including where and how these acquisition pathways can be disrupted by key points of contact (e.g., gun sellers, military commanders, health care providers). (Aspirational Goal 12)
- Identify the individual, social, and ecological factors that influence public attitudes toward various ways to reduce access to suicide means. Determine how these factors can effectively be

used in traditional and social media campaigns and/or individual counseling. (Aspirational Goal 12)

- Test the synergistic effects of various combinations of efforts of cognitive means safety (social messaging), physical (actual) means safety laws (storage policies), and insurance (individual financial responsibility). (Aspirational Goal 12)
- What are the most efficient ways of delivering means safety messaging and access to crisis counseling by those who help people at risk outside the health care setting (e.g., ministers, lawyers, gun shop owners, college counselors/faculty/peers)? (Aspirational Goal 12)
- What are the most useful methods for providing safe information about suicide in traditional media? (Aspirational Goal 12)

Research Opportunities

Experts reviewed proposed research pathways in light of available information on the burden of suicide attempts and deaths, and also considered the value of addressing specific research gaps in Aspirational Goals 11 and 12.

Short-Term Objectives
The resulting short-term research objectives are considered the most likely, if fully implemented, to most rapidly reduce the burden of suicide attempts and deaths.

A. Conduct research to identify effective, feasible approaches to reducing access to lethal means for suicidal individuals through community partnership agreements.
B. Determine if policies that affect risk factors in the populations (e.g., advertising rules related to tobacco and alcohol, medication prescription practices) also reduce suicide risk.
C. Determine mechanisms of risk and resilience for suicidal behavior outcomes. Determine how these mechanisms operate in other types of mortality (e.g., accidents) as well.

Long-Term Objectives
The resulting long-term research objectives are considered necessary to devote sustained efforts to reduce the burden of suicide attempts and deaths.

A. Reduce suicide risk through effective and durable means safety approaches that include multiple steps and/or synergistic components (e.g., social media images and messages, packaging, counseling, storage, barriers).
B. Reduce suicide risk and intermediate outcomes (e.g., isolation, depression) within organizations (e.g., schools, worksites, court systems) and communities. Reduce intermediate outcomes (e.g., isolation, depression) through successful applications of technology (e.g., phone applications) for monitoring and intervention delivery.
C. Maximize intervention effects at a community level by combining suicide surveillance and prevention efforts with other effective community programs, such as prevention of substance abuse and child abuse and neglect.

Key Question 6: What New and Existing Research Infrastructure is Needed to Reduce Suicidal Behavior?

This Key Question considers the state of the existing infrastructure for suicide prevention and describes what new infrastructures are needed. The source of these recommended resources were Topic Expert presentations and discussions among Overview Experts of research pathways related to the Aspirational Goals.

Developing Standard Definitions, Common Data Elements, and Processes for Harmonization Efforts to Enhance Clarity of Research Findings

The literature review conducted by the RPTF indicated that design weaknesses in many published studies left many questions about what interventions may or may not be effective. It is possible that many intervention ideas could be effective, but due to design limitation, and often inadequate statistical power, the ideas remain untested with significant efforts and opportunities lost. By adapting the use of standard definitions of suicidal behavior, as well as common data elements, reviews and analyses across suicide research studies are more feasible, and knowledge is more likely to be accrued. Suicide prevention funders could consider policies that encourage common data element usage. Harmonizing data elements with relevant phenotyping measures (e.g., psychiatric diagnoses, measures of impulsivity) in current genetic repositories will contribute to their value (Aspirational Goal 1). Identifying and coordinating with ongoing common data element efforts, such as PhenX (https://www.phenx.org/) and the Interagency Traumatic Brain Injury Common Data Elements Project (http://www.commondataelements.ninds.nih.gov/TBI.aspx#tab=Data_Standards; see also Maas et al., 2010), would further optimize common data element efforts. Infrastructure to support meetings and processes to developing consensus in the field about common measures and approaches to harmonization are initial steps in this process.

Expand Biobanking

Through the NIH NeuroBioBank, there are existing plans to coordinate brain and other tissue sharing (e.g., brain tissue banks, genetic repositories) with appropriate consent and privacy protections through funding policies. Centralized and standardized toxicology testing is planned to facilitate common data elements and standards for tissue quality and characterization. By leveraging the efforts from the National Research Action Plan (NRAP)—which is a response to Section 5 of President Obama's August 31, 2012, Executive Order, Improving Access to Mental Health Services for Veterans, Service Members and Military Families (http://www.whitehouse.gov/the-press-office/2012/08/31/fact-sheet-president-obama-signs-executive-order-improve-access-mental-h)—the coordination among researchers focused on studying military, Veteran, and civilian postmortem data is more likely to occur. In addition, NRAP will coordinate the development of biomarkers for PTSD, traumatic brain injury (TBI), and suicidal behavior, linking genetic repositories, and potential patient registries, and evaluation of experimental treatments across NIH, DoD, and VA.

Develop Patient Registries

In some other countries, researchers have the ability to analyze data from patient health care records and link them to mortality registries to examine the role of health conditions and health services for suicide risk. The clarification of policies could help establish patient registries with appropriate consent and privacy protections in the U.S., which could allow for smaller versions of such national efforts, and also provide support for the following research pathways:

- Determine viability of biomarkers for prediction and treatment response and the feasibility of their testing and use. (Aspirational Goal 1)
- Test service delivery approaches for suicidal individuals (e.g. care management, diversion from emergency care, inpatient treatment models, enhanced telephone contacts after care transition). (Aspirational Goals 8 and 9)
- Test safety management and quality improvement practices. (Aspirational Goals 4, 5 and 6)
- Develop a common consent approach to link patient records to death records. (Aspirational Goals 2, 3, 4, 5, 6 and 9)

Expand Data Sharing As Appropriate; Supplement Existing Studies

There are a number of data sharing recommendations, as appropriate, to consider for funding policies, including how prior investments in suicide research would make data available for use. These include:

- Data from funded randomized control prevention trials that address putative risk factors for suicide risk (e.g., emotional dysregulation, depression, substance use, etc.). (Aspirational Goal 11)
- Data from funded RCTs of treatments for mental disorders and substance use disorders to facilitate examination of potential benefits for interventions that reduce suicidal behaviors. (Aspirational Goals 4, 5, and 6)
- Large health care databases (e.g., HMOs, VA, DoD) linked to mortality data as appropriate, to explore the value of existing suicide prevention practices, such as means safety effectiveness (e.g., ligature removal, safe prescribing). (Aspirational Goal 12)

Strategically identifying studies that have focused (or will focus) on under-studied, hard to reach and/or high risk communities and care settings (e.g., homeless veterans, runaway youth, Alaskan Villages, rural juvenile justice settings) is needed (Aspirational Goals 8 and 11). While this agenda has recommended that boundaried populations be an immediate research focus because of the ability to reach individuals within a system, concerted efforts also are needed to reach high-risk groups who are often outside boundaried systems.

To provide supplemental funding for the addition of measures of suicidal behavior to ongoing randomized control trials (e.g., those that address putative risk factors for suicide risk such as substance use, chronic pain, etc.). (Aspirational Goal 11)

Establish a Clearinghouse for Program and Practice Research Opportunities

Because many suicide prevention opportunities have been linked to health and safety programs and practices in the past, there are opportunities for researchers to build in research methods to learn as these programs and practices are implemented. A 'clearing house' for state and federal program and practice changes relevant for suicide prevention research, would facilitate awareness of such opportunities. Establishing bi-directional knowledge exchange and proactive partnerships between scientists and program leaders and administrators could promote more evidence-based decision making as well (Aspirational Goal 11). Examples of research opportunities around practice and program issues include:

- The expanding capacity for primary care to deliver evidence-based suicide prevention interventions through support provided by the ACA**.** (Aspirational Goals 8 and 11)

- Effects of expanded use (e.g., reimbursement, state licensure reciprocity) of telephone, internet, smart phone, and other technology-based services for crisis management, as well as acute treatment and relapse prevention. (Aspirational Goal 8)
- Changes in care practices for VA and/or DoD or specific military service units with regard to suicide prevention. (Aspirational Goals 7, 9, 10, 11, and 12)
- Changes in state laws directing individuals to report and/or act to prevent suicide (e.g., gun dealers, teachers, health care providers) often include licensing, certification and training requirements. Research is needed to inform what training programs are most effective, and for whom. (Aspirational Goals 8, 10, and 11)
- Changes in required training/curriculum for various professions that incorporate suicide assessment and management, and to continuously inform policies by evidence-based training approaches. (Aspirational Goal 7)

Develop Communications Partnerships for Public Messaging/Media Research and Best Practices

Due to contagion and normalization concerns, the development and messaging of information about suicide is not a simple endeavor. Meeting support and coordination of organizations delivering suicide prevention messaging is needed to better define research needs and research opportunities. Coordinate efforts with the National Action Alliance's Public Awareness and Education Task Force (www.actionallianceforsuicideprevention.org/task-force/publicawareness) to partner with policy makers, suicide prevention advocacy, academic community, and media groups to conduct research on outreach, and safe and effective communications efforts are required. Collaborative research partnerships are needed to understand how information that confers risk is spread online (e.g., Twitter, texting), and how protection to mitigate suicidal behavior could also be seeded online/via social media. (Aspirational Goals 10 and 12)

Conduct Periodic Reviews and Updates of Surveillance Data

In coordination with the National Action Alliance's Data and Surveillance Task Force (DSTF), review updates of national, state, and organizational available data, identified gaps, and current needs. Examples include:

- Consistent with the Institute of Medicine and National Research Council of the National Academies' report*, Priorities for Research to Reduce the Threat of Firearm Violence* (2013), collecting data on firearm ownership and storage by CDC would fill an important surveillance gap in understanding access to means. (Aspirational Goal 12)
- Suicide ideation and attempts assessed in the Minimum Data Set used by nursing homes is available but underutilized. (Aspirational Goal 11)
- Identify measures that can be used by community groups to compare prevalence with national benchmarks (e.g., aging services networks). (Aspirational Goal 11)

Facilitate Health Care Organization-Researcher Partnerships to Field Studies

Multiple health care organization partnerships (e.g., primary care, specialty care, substance abuse rehabilitation) are needed to field studies of quality improvement, screening, risk assessment (e.g., biomarkers), prevention, and treatment trials. Sufficient numbers of members are necessary to provide sufficient statistical power to determine direct—and moderated and mediated—effects on suicide deaths, as well as attempts. Opportunities for partnerships among researchers, patients, family members, providers, and health care policy leaders should be supported to enhance study relevance,

participation, and study retention. Services and suicide treatment research experts can serve as resources for design methodology, managing crisis, and other high-risk behaviors (e.g., substance use) to minimize exclusion criteria and outcome assessment. (Aspirational Goals 4, 5, 6, 8, and 9)

Support Research Workforce Development

Ongoing investment in developing research expertise and facilitating careers in suicide prevention research is needed across many research methods. Training and education opportunities that utilize data warehouses (e.g. Army STARRS, Mental Health Research Network), patient registries, and biobanks could facilitate: 1) dissemination of new statistical and analytic techniques; 2) rich resources for interdisciplinary training needs; and 3) progress towards completing the research pathways described here.

V.) Creating the Prioritized Research Agenda

This section provides detailed information on how the Prioritized Research Agenda was developed by the RPTF.[5]

A.) Illustrations of How to Reduce Suicide

To verify whether multiple approaches could reduce suicide deaths and attempts by 20% in the next five years, the RPTF analyzed data on the populations and settings in which suicide attempts occur and the means used by people who attempt suicide. The RPTF then applied intervention models for which data exist and estimated potential reductions in attempts and deaths.

1. Identifying populations of people who have attempted suicide

Suicide prevention efforts in the U.S. have been limited by the lack of, or significantly delayed information on, national and regional rates of attempts and deaths. These data are sporadic, with national and regional suicide death statistics taking two or more years to compile.

With few exceptions, it has been nearly impossible to determine potential intervention effects on suicide attempts or deaths by relying on national surveillance efforts. This has significantly hampered progress in identifying research opportunities to reduce suicide burden.

To overcome this hurdle, the RPTF sought assistance from the National Action Alliance's Data and Surveillance Task Force (DSTF). Specifically, the RPTF sought national data sets to examine reports of suicide deaths and attempts among various boundaried populations (i.e., groups of individuals that can be reached through a service setting or service). The RPTF and DSTF identified some well-known surveys (e.g., National Survey on Drug Use and Health [NSDUH]) which indicate whether individuals had attempted suicide in the past 12 months and if those individuals also had accessed various service settings (e.g., outpatient mental health, substance abuse treatment).

The RPTF considered these boundaried populations reachable because individuals could be identified as in need of help and available for a beneficial intervention. Using this strategy, the RPTF identified the burden of suicide deaths and attempts for persons accessing various systems in the community (e.g., various health care settings, full time college, probation/parole settings). Figure 6 (below) illustrates that efforts to reduce suicide attempts in adults by 20% may be aimed at Emergency Departments (where 390,000 attempts were registered); within mental health or substance use treatment facilities (over 622,000 attempts were reported among adults who accessed those service settings) and even at schools or criminal justice settings. (Appendix D contains additional data on various community system settings and, where possible, the demographic make-up of the boundaried populations they contain.) The RPTF modeled example interventions to illustrate how individuals could be reached and have their suicide attempt and mortality risk reduced (see Appendix G for example models).

Because individuals who attempt suicide are at high risk for later suicide mortality, RPTF models assume that efforts that are successful in reducing attempts will also translate into reduced suicide deaths (see Section 3 below). Multiple "boundaried settings" are provided here to indicate that there are ample opportunities to identify individuals who are at greater risk for or have attempted suicide, to provide

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[5] A chart describing the RPTF Prioritized Research Agenda development process can be found in Appendix I.

appropriate interventions, and to decrease U.S. suicide attempts and deaths by 20% in 5 years and 40% in 10 years. Youth in high schools are included in Figure 6 to illustrate the opportunity to build resilience in youth that could later translate into lower risk for suicide attempts and deaths in adulthood.

Figure 6. Suicide Attempts in Boundaried Settings:
Opportunities to Reduce 648,000 Adult Attempts by 20% (135,600 fewer attempts)

Emergency Departments
390,359
Treated for Attempts [†]

Outpatient Mental Health Services
515,900[¶]
Substance Use Treatment Facilities
106,000[¶]

Probation/Parole
161,000[¶]
Youth in High School
1,297,520[*]
Full time College
108,000[¶]
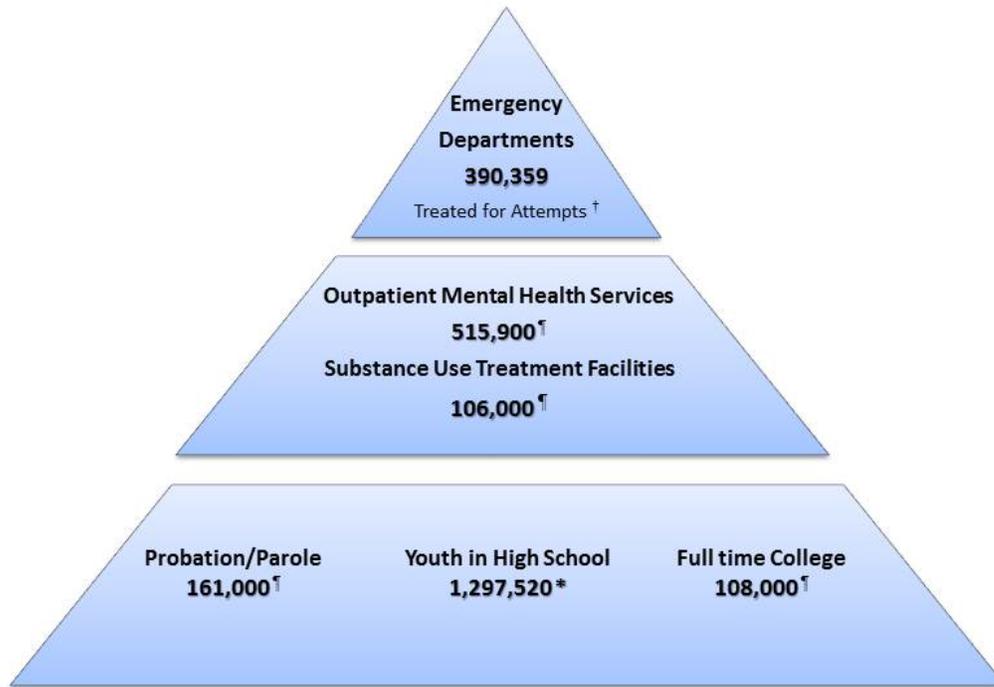
[†]Source: CDC's National Electronic Surveillance System, 2010
[¶]Source: SAMHSA's National Survey on Drug Use and Health, 2008–2009
[*]Source: CDCs Youth Risk Behavior Surveillance System, 2011 (Attempters treated by Doctor or Nurse)

2. Identifying the means by which people attempt suicide

Given evidence from other countries suggesting that suicide deaths can be prevented through reducing access to lethal means (e.g., see Hawton, 2007), the RPTF also sought U.S. data on methods used in suicide attempts and deaths where interventions might be deployed. Again, where possible, these data were examined by age, race, and ethnicity (see Appendix D).

While some data on means of suicide attempts are available (e.g., firearms), other means are more difficult to identify as noted below:

- 51% of U.S. suicide deaths (56% male suicides) involve the use of a firearm.
- After suffocation (hanging), the next most frequently used suicide means is poisoning (6,599 deaths). The Drug Abuse Warning Network (DAWN) estimates there were 198,403 ED visits resulting from drug-related suicide attempts in 2009 (SAMHSA, 2011).
- An example of the limitations of finding suicide burden surveillance information is the challenge of obtaining national figures for COMV. The estimate of 735 COMV deaths in 2010 had to be projected from data collected in 2005.

- Similarly, for the 781 suicide deaths due to falls, the RPTF was unable to easily access data indicating if there were multiple suicide deaths at particular building, bridge or railroad/subway sites.

3. Applying intervention models to existing data

Similar to other public health successes with goals for health burden reduction, the RPTF sought potential interventions that, if fully implemented, would reduce suicide attempts and deaths. If an intervention appeared feasible and favorable in burden reduction, the research pathways for that intervention could be considered a priority.

Using the Australian government's approach to review the relative impact of prevention efforts—Assessing Cost-Effectiveness in Prevention (ACE; Vos et al., 2010)—Dr. Frances Lynch, Dr. Matthew Miller, and Ms. Cathy Barber developed models of potential burden reduction for various interventions and groups.

Based on the decision-analytic modeling methods—that is, data used to inform decisions—of the ACE approach, one year and five year estimates of intervention effects were considered. Various parameters were estimated, including the proportion of the population the intervention is likely to reach, the strength and duration of the effects, and potential competing mortalities (deaths due to other causes). The outcomes of these models served as guides to the RPTF process for considering *optimal effects* of existing interventions. Limitations in the effects, reach, and/or duration would suggest the need to refine the intervention or develop novel, alternative approaches.

In developing these models, gaps in the U.S. scientific literature became apparent with regard to understanding the trajectory of suicidal behavior (e.g., when and if an individual acts on ideation; repeats attempts). Lacking in nearly all intervention studies are long-term outcomes. Many studies focused on suicide attempts as outcomes. Few studies were large enough to examine differences in suicide death. Also lacking were data on people who attempted suicide over time (i.e., frequency of reattempts, case fatality of attempts). Estimates of suicide mortality for those who attempted suicide relied on meta-analyses (looking across multiple studies) from a mixture of European, Australian and North American studies of people who attempt suicide and are seen for acute medical care (Bergen et al., 2012). These data were applied to extrapolate the effects of interventions on reducing the numbers of suicide attempts and deaths. However, such models could be extremely inaccurate when projecting to the U.S. population, since they assume that the effect of an intervention on suicide death would be entirely mediated through reducing nonlethal suicide attempts.

Five models were completed for consideration by the experts (see Appendix G):

- Two were approaches to reducing suicidal persons' access to lethal means.
- One addressed providing psychotherapy to adults who had attempted suicide and were seen in emergency care.
- One estimated the benefits of a school-based preventive intervention delivered in first grade on attempt rates in high school and young adulthood.
- One model examined the association between the actual implementation of state mental health parity laws and suicide rates among working age adults.

B.) Expert consultation on the Prioritized Research Agenda

In the process of developing its research agenda, discussed in the sections that follow, the RPTF engaged more than 60 national and international research experts. These experts did the following:

- Reviewed the RPTF's prepared materials (e.g., surveillance, logic models, literature review).
- Considered what we know, what we need, and what is the morbidity and mortality associated with the 12 Aspirational Goals identified by the RPTF.
- Consulted on and then considered the proposed research pathways.
- Recommended short- and long-term research objectives most likely to lead to substantial reductions in suicide deaths and attempts.

Roles
The RPTF engaged these experts in the context of three roles in the process of development of its research agenda:

1. Overview Experts
These are individuals capable of considering a broad array of proposed research pathways, and identifying research areas that have the potential to reduce the burden of suicide. The Overview Experts were selected to represent diverse disciplines and viewpoints.

Figure 7. OVERVIEW EXPERTS

David Brent, MD

C. Hendricks Brown, PhD

Martha Bruce, PhD, MPH

William 'Biff' Bunney, MD

Eric Caine, MD

Kathleen Carroll, PhD

Keith Hawton, DSc DM FRCPsych

Robert Johnson, MD, FAAP*

Ira Katz, MD, PhD

Maria Oquendo, MD

Mary Jane Rotheram-Borus, PhD

*served as Overview Expert Chair

2. Topic Experts

The Topic Experts were selected based on their research experience, and/or knowledge of literature that addresses significant intervention components.

Topic Experts were provided logic models created to identify the research needed to achieve each Aspirational Goal, examining the following for each model:

- Assumptions and steps in an intervention process.
- The strength of associations between resources, activities and outcomes.
- Potential "active ingredients" in the intervention models.
- Where potential research roadblocks exist, and breakthroughs are needed.

Topic Experts were provided with much of the same RPTF inputs that the Overview Experts were provided and were asked to summarize the state of the research and recommend needed research pathways.

Figure 8. TOPIC EXPERTS

Aspirational Goal 1	Aspirational Goal 2	Aspirational Goal 3
-Hilary Blumberg, MD	-Lisa Horowitz, PhD, MPH	-Jan Fawcett, MD
-Yogesh Dwivedi, PhD	-Edwin Boudreaux, PhD	-Matthew Nock, PhD
-John Keilp, PhD		
-Gustavo Turecki, MD, PhD		

Aspirational Goal 4	Aspirational Goal 5	Aspirational Goal 6
-Courtney Bagge, PhD	-Andrew Nierenberg, MD	-Courntey Bagge, PhD
-Gregory Brown, PhD		-Gregory Brown, PhD
-Kenneth Conner, PsyD, MPH		-Kenneth Conner, PsyD, MPH
-David Goldston, PhD		-David Goldston, PhD
-Mark Ilgen, PhD		-Mark Ilgen, PhD

Aspirational Goal 7	Aspirational Goal 8	Aspirational Goal 9
-Jodi Jacobson Frey, MSW, PhD	-Jeffrey Bridge, PhD	-Jeffrey Bridge, PhD
-Philip Osteen, PhD	-Jürgen Unützer, MD, MPH, MA	-Jürgen Unützer, MD, MPH, MA
	-Steven Vannoy, PhD, MPH	-Steven Vannoy, PhD, MPH

Aspirational Goal 10	Aspirational Goal 11	Aspirational Goal 12
-Anthony Jorm, PhD, DSc	-Yeates Conwell, MD	-Cathy Barber, MPA
-Tracy Stecker, PhD	-Jitender Sareen, MD FRCPC	-Matthew Miller, MD, MPH, Sc.D.
	-Peter Wyman, PhD	

3. Discussants
Discussants were selected for their expertise and to broaden the base of suggestions.

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Figure 9. DISCUSSANTS

Aspirational Goal 1
-John Mann, MD, PhD
-Carlos Zarate, MD

Aspirational Goal 2
-Amy Wenzel, PhD

Aspirational Goal 3
-Robert Simon, MD, DLFAPA

Aspirational Goal 4
-Craig Bryan, PsyD
-Marsha Linehan, PhD, ABPP

Aspirational Goal 5
-Nina Schooler, PhD

Aspirational Goal 6
-Craig Bryan, PsyD
-Marsha Linehan, PhD, ABPP

Aspirational Goal 7
-Wendi Cross, PhD

Aspirational Goal 8
-Howard Goldman, MD, PhD

Aspirational Goal 9
-Howard Goldman, MD, PhD

Aspirational Goal 10
-Wendi Cross, PhD
-Bernice Pescosolido, PhD
-Thomas Niederkrotenthaler,
   MD, PhD, MMS

Aspirational Goal 11
-Richard Catalano, PhD
-Howard Goldman, MD, PhD

Aspirational Goal 12
-Bernice Pescosolido, PhD

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In October 2012, the RPTF convened the Overview Expert Panel to discuss the agenda development process and listen to Topic Experts. All slide presentations were narrated and stored on a website that Overview Experts could access. Discussions of the presentations (Overview Experts, Topic Experts, and Discussants) took place by conference calls. These conference call discussions were conducted from October 2012 through February 2013, with a final in-person meeting in March 2013.

4. Readers
Readers were asked to review the Research Prioritization Agenda once it had been developed by the RPTF (with the input from the Overview Experts, Topic Experts, and Discussants).

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Figure 10. READERS

Joan Asarnow, PhD	Gretchen Haas, PhD	Jerry Reed, PhD, MSW
J. Michael Bostwick, MD	Nav Kapur, MBChB, MMedSC, FRPsych, MD	Gregory Simon, MD MPH
Madelyn Gould, PhD, MPH	Tom Laughren, MD	Leif Solberg, MD
Todd Gould, MD	Richard McKeon, PhD, MPH	Marcia Valenstein, MD, MS

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C.) Process taken by the RPTF

1. Stakeholder Survey

In order to develop a research agenda based on the insights of the broad spectrum of people who have knowledge and experience related to the burden of suicide, the RPTF elicited the goals they have about addressing this problem (see Claassen et al., in press, for more details). Using an online survey conducted in the fall of 2011, the RPTF gathered responses from 716 individuals representing 49 U.S. states, territories, and the District of Columbia, and 18 countries. The RPTF asked these researchers, clinicians, patient- and family-survivor members, and organization/policy makers for their Aspirational Goals (see Glossary).

Survey respondents were individuals whose association with specific organizations and/or institutions suggested that their professional and/or personal lives had been affected by the quantity and quality of available suicide prevention research.

Survey participants were asked to help select Aspirational Goals for research, which would be used for the final Research Agenda. An Aspirational Goal was defined as an important goal for scientists and researchers to achieve in order to reduce the number of people who attempt or die by suicide. It was understood that an Aspirational Goal would be a 'big idea,' rather than a specific research study.

The survey first asked for Aspirational Goals that would reduce suicide deaths and attempts by 20% in five years. Each participant recommended at least two Aspirational Goals that would reduce the burden of suicide.

The RPTF survey used *ExpertLens*, an online, modified-Delphi process developed by RAND (Dalal et al., 2011; Khodyakov et al., 2011). A Delphi process is an approach to reach consensus and includes steps to become informed by others' opinions. The four-round survey generated and then evaluated candidate research goals for the agenda via ranking, rating, and discussion tasks.

- **Round One—An Idea Generating Round** asked participants to suggest goals for research and identify ways to evaluate the merits of the suggested goals.
- **Round Two—An Initial Ranking and Rating Round** asked participants to evaluate a 'Short List' of goals taken from the Idea Generating Round.
- **Round Three—A Feedback and Discussion Round** showed participants how their rankings and ratings compared to other participants, and gave them a chance to discuss their opinion with others.
- **Round Four—A Final Ranking and Rating Round** gave participants a chance to change their goal ratings after the Feedback and Discussion Round.

Round One—Idea Generating
In the Idea Generating Round, more than 1,500 Aspirational Goals were suggested. Using a process that included multiple rounds of categorization of all suggestions, the 12 most frequently mentioned goals were identified—called the *Short List Aspirational Goals* (see Figure 11). These 12 Aspirational Goals were ranked, rated, and discussed in the last three rounds of the Survey.

**Figure 11. 12 Aspirational Goals
(as a result of the Stakeholder Survey)**

Aspirational Goal 1—Know what leads to, or protects against, suicidal behavior, and learn how to change those things to prevent suicide.

Aspirational Goal 2—Determine the degree of suicide risk (e.g., imminent, near-term, long-term) among individuals in diverse populations and in diverse settings through feasible and effective screening and assessment approaches.

Aspirational Goal 3—Find ways to assess*who is at risk for attempting suicide in the immediate future.

Aspirational Goal 4—Ensure that people who are thinking about suicide but have not yet attempted receive interventions to prevent suicidal behavior.

Aspirational Goal 5—Find new biological treatments and better ways to use existing treatments to prevent suicidal behavior.

Aspirational Goal 6—Ensure that people who have attempted suicide can get effective interventions to prevent further attempts.

Aspirational Goal 7—Ensure that health care providers and others in the community are well trained in how to find and treat those at risk.

Aspirational Goal 8—Ensure that people at risk for suicidal behavior can access affordable care that works, no matter where they are.

Aspirational Goal 9—Ensure that people getting care for suicidal thoughts and behaviors are followed throughout their treatment so they don't fall through the cracks.

Aspirational Goal 10—Increase help-seeking and referrals for at-risk individuals by decreasing stigma.

Aspirational Goal 11—Prevent the emergence of suicidal behavior by developing and delivering the most effective prevention programs to build resilience and reduce risk in broad-based populations.

Aspirational Goal 12—Reduce access to lethal means that people use to attempt suicide.

*While stakeholders indicated that predicting who is at imminent risk was an aspirational research goal, expert consultants recommended that assessments focused on finding treatable conditions or symptoms was more actionable than prediction per se. Therefore, this goal has been reworded.

Rounds Two and Four—Ranking and Rating Rounds

In the Initial and Final Ranking and Rating Rounds, survey participants completed two tasks with the Short List of Aspirational Goals. First, they ranked the goals from most to least important overall (goal ranking exercise). Next, they were asked to consider the importance of each of the 12 Aspirational Goals using four criteria (goal rating exercise). The four criteria were:

1. What is the potential of this goal to prevent fatal and nonfatal suicide attempts?
2. How easily and rapidly can research produced by this goal be widely implemented in real-world settings?
3. How many of the population groups most vulnerable to suicidal behavior would be impacted if this goal were achieved?
4. How acceptable would this goal's suicide prevention approach be to suicidal persons and their families?

Round Three—Feedback and Discussion Round

As explained above, between the two Ranking and Rating Rounds, participants were shown how their rankings and rating compared to those of other survey participants. They were then given a chance to join an online discussion about the importance of each of the 12 Short List Aspirational Goals.

The RPTF staff carefully reviewed and coded the over 1,500 suggestions, sorting them initially into research domains (screening, risk assessment, types of prevention approaches, services and policy research, and postvention research). Overlapping domains were collapsed into 12 Aspiration Goals.

Stakeholder Survey Results

The final results of the Stakeholder Survey (shown in Figure 12) are based on ratings data and combine the Aspirational Goals into a tiered goal structure. Overall, survey respondents favored research efforts that were practical and results-oriented when rating the Aspirational Goals.

1. The highest-rated Aspirational Goals were grouped and labeled Tier One. They are:
   - **Aspirational Goal 6**—Ensure that people who have attempted suicide can get effective interventions to prevent further attempts.
   - **Aspirational Goal 9**—Ensure that people getting care for suicidal thoughts and behaviors are followed throughout their treatment so they don't fall through the cracks.
   - **Aspirational Goal 7**—Ensure that health care providers and others in the community are well trained in how to find and treat those at risk.
   - **Aspirational Goal 8**—Ensure that people at risk for suicidal behavior can access affordable care that works, no matter where they are.

2. The Tier Two goals include:
   - **Aspirational Goal 4**—Ensure that people who are thinking about suicide but have not yet attempted receive interventions to prevent suicidal behavior.
   - **Aspirational Goal 1**—Know what leads to, or protects against, suicidal behavior, and learn how to change those things to prevent suicide.
   - **Aspirational Goal 10**—Increase help-seeking and referrals for at-risk individuals by decreasing stigma.
   - **Aspirational Goal 11**—Prevent the emergence of suicidal behavior by developing and delivering the most effective prevention programs to build resilience and reduce risk in broad-based populations.
   - **Aspirational Goal 3**—Find ways to assess who is at risk for attempting suicide in the immediate future.

3. The following three Aspirational Goals were all ranked somewhat lower than Tier One and Tier Two, but not all in a way that clustered into one group:
   - **Aspirational Goal 5**—Find new biological treatments and better ways to use existing treatments to prevent suicidal behavior.
   - **Aspirational Goal 12**—Reduce access to lethal means that people use to attempt suicide.
   - **Aspirational Goal 2**—Determine the degree of suicide risk (e.g., imminent, near-term, long-term) among individuals in diverse populations and in diverse settings through feasible and effective screening and assessment approaches.

Figure 12. Final Aspirational Goals Ordered in Tiers.

TIER	ASPIRATIONAL GOAL
1	**Goal 6** – Prevention of reattempts
1	**Goal 9** – Enhanced continuity of care
1	**Goal 7** – Provider training
1	**Goal 8** – Access to affordable and effective care
2	**Goal 4** – Psychosocial interventions for those at risk
2	**Goal 1** – Risk and protective factor interactions
2	**Goal 10** – Stigma reduction
2	**Goal 11** – Population-based risk-reduction/resilience-building
2	**Goal 3** – Prediction of imminent risk
	Goal 5 – Improved biological interventions
	Goal 12 – Reduction of access to lethal means
	Goal 2 – Population- and setting-based screening

2. Request for Information on Roadblocks and New Paradigms

In the spring of 2012, the NIMH, National Institute on Drug Abuse (NIDA), and National Institute on Alcohol Abuse and Alcoholism (NIAAA) released a Request for Information (RFI): A Call to Identify Key Methodological Roadblocks and Propose New Paradigms in Suicide Prevention Research (Notice number NOT-MH-12-017).

The RFI was distributed among researchers working in diverse disciplines, as well as the general public. It asked for input in the following areas:

- Key methodological roadblocks in suicide prevention research. A methodological roadblock, for purposes of the RFI, was defined as a "critical, unresolved challenge that is clearly limiting progress along an important suicide prevention research pathway."
- New paradigms and theoretical models with the potential to spark innovative research. These were defined in the RFI as "novel ways of thinking about suicidal behavior and avenues for its prevention."

In response to the RFI, the RPTF received submissions of over 262 distinct candidate paradigms and 83 methodology roadblocks. These responses were analyzed by a subset of the RPTF support staff from NIMH. They categorized the responses into nine categories: 1) alternative research method/paradigms; 2) assessment; 3) infrastructure issues; 4) limitations in current theory; 5) low base rate; 6) operationalization of events; 7) psychometrics; 8) research/training; and 9) analytic approaches to inform decision makers.

The RFI's findings and their analysis are discussed below. These findings were presented to the RPTF's expert consultants, who applied them to their work on the logic models and the literature review.

RFI Analysis

The responses were reviewed by the RPTF's qualitative analyst, Dr. Chelsea Booth, to identify discrete ideas that might represent roadblocks or paradigms. Some submissions included multiple responses; these were disaggregated into the separate categories. In other cases, a response could be both categorized as a candidate paradigm and a methodology roadblock and was, therefore, included in both

categories. Those submissions which were not directly responsive to the RFI were analyzed for core themes and underlying assumptions that could be included in one of the two RFI response categories.

The resultant 375 unique ideas were then transferred to a spreadsheet and first categorized by Primary and Secondary Relevant Aspirational Goals (based on the RPTF Stakeholder Survey responses from 2011) by Dr. Cindy Claassen and Dr. Chelsea Booth.

Once responses were categorized according to aspirational goal, Dr. Joel Sherrill performed an initial analysis to identify and sort those responses that indeed reflected roadblocks or paradigms. Many responses to the RFI were similar to those from the Stakeholder Survey responses (i.e., rather than suggesting a methodological roadblock or new paradigm, these responses identified a goal or suggested the need for a specific study). The team elected, for this document, to include only those responses that attempted to respond directly to the RFI topic requests in the areas of key methodological roadblocks and new paradigms and theoretical models—this totaled 25 candidate paradigms and 16 methodology roadblocks.

There was considerable overlap between the methodology roadblocks and new paradigms. For example, alternative paradigms were often posed in response to a corresponding methodological roadblock. Thus, after further analysis, the results were combined and sorted into nine categories: 1) alternative research method/paradigms; 2) assessment; 3) infrastructure issues; 4) limitations in current theory; 5) low base rate; 6) operationalization of events; 7) psychometrics; 8) research/training; and 9) analytic approaches to inform decision makers. Short descriptions of the responses within each of the nine categories are provided in each section below.

The RFI yielded broad feedback from a diversity of respondents. While a substantial number of responses involved restatements of the RPTF Aspirational Goals or suggestions for specific studies, a portion of the feedback was more directly responsive to the RFI's solicitation of methodological roadblocks and alternative paradigms. Suggestions regarding roadblocks and paradigms spanned a number of topics (e.g., psychometrics, training), and included both widely acknowledged challenges (e.g., low base rates of events) as well as more novel observations.

Summary of Responses
Alternative method/paradigm.
- Exclusion of substance abusers in existing studies limits generalizability of results, suggesting the need for alternative sampling strategies/paradigms.
- Randomization is not always possible, suggesting the need for alternative trial designs.
- Reliance on more standard quantitative approaches has yielded limited progress, suggesting qualitative approaches might be exploited to examine relationships between important factors not immediately amenable to quantitative approaches in order to generate hypotheses and bridge gaps between theory and practice.
- Standard approaches for examining putative causal factors are insufficient, suggesting the need for alternative analytic approaches, such as models used in accident research or models based on chaos and catastrophe theories and self-organized criticality.
- Lack of good proxy variables poses challenges for lab analogue studies of suicide, suggesting the need for alternative surrogate endpoints and experimental paradigms that allow experimental control over potentially causal variables.

- Lack of reviewer expertise and appreciation for qualitative research: Editors of journals contribute to the low publication of qualitative studies.
- Use of research models used in accident research: Suicide researchers should test models used in accident research for applicability and validity in suicide research.
- Alternative theories/paradigms that have been successfully used to develop preventive intervention approaches in other health areas (e.g., behavioral economic theory and research paradigms used in obesity and addiction) could be explored as alternative models for developing suicide prevention approaches.
- Alternative assessment (e.g., ecological momentary sampling) and analytic paradigms could be used to microanalyze the time preceding attempts in order to develop a clearer understanding of the relationship between suicidal ideations and manifest behaviors (e.g., in the weeks, days, hours, and minutes prior to engaging in suicide).
- Alternative paradigms might focus on identification of 'safety signs' as distinct from 'reasons for living' and resilience factors.
- Centralized/standardized assessment resources might be used to address cost, inefficiencies, and unreliability of assessments associated with standard approaches.

Assessment.
- Biases in self-report and retrospective recall complicate the investigation of the role of earlier experience.
- Models for assessing and conceptualizing development influences, especially in studies with adolescents and youths, should be developed and elaborated.

Infrastructure issues.
- Continuous national patient registries that can collect data on birth cohorts and, as appropriate, utilization of medical and mental health services including emergency departments, outpatient, and inpatient facilities, would help facilitate research.
- Funding silos (e.g., mental health vs. drug abuse, military vs. general biomedical research) limit overall progress.
- Lack of training and understanding regarding research among IRBs delays or precludes research that includes suicidal individuals and beliefs about what increases suicide risk (e.g., beliefs that it is not safe to ask about suicide) and can hamper certain types of studies.
- Failure to encourage or mandate evaluation components for all suicide prevention programs (consistent with the Surgeon General's Call to Action to Prevent Suicide [1999 recommendations]) results in missed opportunities to gather data on potentially promising strategies.
- Delays in access to suicide and suicide attempt data pose roadblocks to studies on community-level interventions and other research.
- Encouragement and support for collaborating and sharing data from evaluation efforts across local/state/national surveillance data collection systems could facilitate research and policy decisions.
- Despite understanding that suicidal behavior is multi-determined, research continues to be primarily discipline myopic rather than incorporating attention to social, psychological, psychiatric, and physiological factors related to suicidal behavior.
- There is a lack of research approaches and coordinated strategies for suicide prevention that can deal effectively with myriad local, regional, state, and national agencies and organizations

pose barriers to answering certain questions (e.g., research on care transition models that span agencies/organizations).
- Insufficient attention/research infrastructure has been focused on policy and implementation.
- Lack of opportunities/outlets for affected family members to contribute to research (e.g., DNA repositories) results in missed opportunities.
- The National Violence Death Reporting System (NVDRS) is not available in all states. The NVDRS is another source of information and its availability in all states would ensure that the tracking of all suicides would be informative and permit more effective prospective and retrospective research to prevent suicide.

Limitations in current theory.
- We need more research about the transition from suicidal thoughts to a suicide attempt.

Low base rate.
- Low base rates and lack of methods to overcome power challenges complicate the identification of risk/etiological factors and intervention effects (e.g., detection of moderators).
- Better methods are needed to detect false negatives.
- Challenges in identifying individuals making a first-time attempt (e.g., those who do not come to the attention of medical services) and failure to differentiate them from chronically suicidal individuals leads to potential gaps and lack of clarity in the literature.

Operationalization of event.
- Lack of standard nomenclature limits comparisons in the literature and overall research progress (e.g., failure to differentiate between ideators and people who attempt).
- Lack of standardization in reporting in community-practice/surveillance systems (e.g., in emergency departments and across medical examiners) complicates comparisons and integration across data sets.

Psychometrics.
- Limited data on reliability and validity of assessment tools used in cross-setting or cross-culture research (especially when used well outside of the target setting/population context in which they were validated) limits confidence in the results of individual studies and complicates comparisons across studies. Furthermore, because culture is often treated as an explanatory variable in such studies, this makes it easy to overlook the real reasons for the differences found.

Research and training.
- Service platforms (e.g., HMO research networks) could be better exploited for training, infrastructure, and research.
- Interventions (e.g., training of providers, better treatments) that are being utilized in our military and post-military system ought to be subjected to rigorous investigation regarding efficacy, and if effective, disseminated.

Analytic approaches to inform decision makers.
- Lack of simulation strategies for combining information regarding attributable risk with information on intervention effectiveness (based on the existing literature) complicate assessment of the impact of intervening.

- Limited analytic methods to explore relative value (cost-effectiveness) of universal vs. targeted prevention efforts (e.g., in terms of impact on the rate of attempts and deaths) limit research that could inform policy decisions.

3. Logic Models

In order to achieve the Aspirational Goals, the RPTF recognized the need to identify the factors which influence the outcomes of each goal. To accomplish this task, the RPTF staff set out to create logic models that represent the steps which must be taken to achieve each Goal, revealing the relationships between the resources, activities, and outcomes.

The validity of using logic models to inform the steps needed to accomplish an objective is highlighted in the Community Guide to Preventive Services Task Force (2012). The Community Guide is a credible resource based on a scientific, systematic review process that addresses what interventions are helpful to communities (health, costs, harm, etc.) and whether more research is needed to learn if the interventions do indeed work. Steps presented in the Community Guide process are to:

- Develop logic models to illustrate assumptions about how various suicide prevention efforts work;
- Determine what literature should be examined that may support or refute a component of the intervention; and
- Identify gaps where more research is needed (see Wethington et al., 2008, for a Community Guide example).

Using similar nomenclature to describe intermediate outcomes, interventions, and final outcomes, the RPTF staff developed logic models for each Aspirational Goal (see Appendix F).

After the logic models were completed, they were provided to experts for their consideration of research support for aspects of the logic models. In addition, the expert consultants were asked to examine the following:

- Assumptions and steps in an intervention process.
- The strength of associations between resources, activities and outcomes.
- Potential "active ingredients" in the intervention models.
- Where potential research roadblocks exist, and breakthroughs are needed.

The logic models were used to develop suggested research pathways (i.e. the steps needed to accomplish the goals). Analysis of the logic models also revealed possible moderating (e.g., works only for certain age groups) and mediating factors (e.g., hopelessness decreases before suicide risk decreases), as well as how intervention models may or may not serve various subgroups.

4. Literature Review

The RPTF sought to determine whether previously conducted studies could inform the process of identifying research pathways that will help to achieve its objectives. The RPTF first identified systematic reviews of suicide prevention/interventions ("review of reviews"). It then looked at primary studies that had been published subsequent to the systematic reviews. The material covered in the RPTF's literature review had been published between January 2000 and September 2012.

The RPTF's literature review involved a comprehensive search of the most widely used databases for mental health and/or epidemiological research. These databases included: PubMed, PsychINFO, Cochrane Database of Systematic Reviews®, Embase, and Cumulative Index of Nursing & Allied Health Literature (CINAHL).

In conducting its comprehensive search, the RPTF used the following search terms:

- Self-injurious behavior
- Prevention
- Therapy
- Suicide (includes ideation, attempts, suicide deaths)
- Self-harm
- Randomized controlled trial
- Systematic review

The RPTF's search of primary studies was conducted in the seven peer reviewed journals (*Suicide & Life Threatening Behavior*; *Crisis—The Journal of Crisis Intervention and Suicide Prevention*; *British Journal of Psychiatry; Journal of Affective Disorders*; *Acta Psychiatrica Scandinavica; Archives of Suicide Research*; and the *American Journal of Public Health)* that most frequently publish suicide-related research and which were suggested by content experts. The search was limited to articles involving human subjects published in the English language.

Drawing from existing literature review quality assessment criteria (see Appendix H), the RPTF used the following criteria for evaluation of both the systematic reviews and primary studies:

- **Authors:** cite names of authors
- **Title:** full title of article
- **Year**: year article was published (between January 2000 and September 2012)
- **Primary or Review**: is the article a primary source or a systematic review?
- **Study Type:** Code if the study is a
  - ○ Systematic Review
  - ○ Meta-analysis
  - ○ Randomized Controlled Trial
  - ○ Cohort Study
  - ○ Case Control Study
  - ○ Qualitative
  - ○ Mixed Methods

Once the literature review was completed, the initial strategy was to concentrate on studies covering demographic groups with known elevated risk for suicide deaths and/or suicide attempts (i.e., middle-aged white men, American Indian/Alaskan Natives, veterans, the elderly, persons with mental and/or substance use disorders, youth, sexual minorities, and Latinas). The objective was to focus on prevention/interventions with the most potential for groups with the greatest burden.

This strategy also would identify the settings where the at-risk groups typically receive treatment (e.g., boundaried populations), determine if these groups were currently underserved in commonly used systems of care, and help identify the gaps in treatment so that prevention planners could consider

more innovative strategies to provide preventions/interventions in either traditional or non-traditional settings.

After determining that most reviews and primary sources do not describe the demographic characteristics of their samples beyond age and gender, this approach proved not to be feasible.

The RPTF then focused the Literature Quality Review on retrieving materials which matched the types of interventions that were identified in the 12 Aspirational Goals.

The articles published in peer-reviewed journals were evaluated by doctoral level researchers. Inter-rater reliability was assessed across all articles. Disagreements among reviewers were discussed and resolved by group consensus.

In addition to evaluating the quality of the reviews/studies, the reviewers also assessed if the prevention/interventions could be implemented in boundaried settings (e.g., primary care, public schools) and whether the interventions could be implemented and/or adapted to other settings.

Conclusions from the Literature Quality Review are:

- Many reviews, as well as specific studies, suffer from a lack of methodological rigor and inadequate statistical power. That is, either studies themselves were not large enough to provide a reliable interpretation of the outcomes, and/or the studies could not be combined to reach an adequately sized sample to make a determination of outcomes. As a result, many promising intervention approaches may not appear to be effective;
- A lack of standard measures and methods results in few opportunities to look across studies and identify reliable and common findings;
- This is particularly true of outcome measures that are often poorly defined and/or outcomes that do not align with recommended nomenclature; and
- Little consistency in reporting participant characteristics exists, which results in few opportunities to consider possible moderating variables (e.g., age, gender, ethnicity, rurality).

These findings led experts and the RPTF to conclude that the use of standard nomenclature, common data elements, and higher standards in methodological rigor (including better identification of sample characteristics) should be considered in funding efforts going forward.

5. 2008-2012 Suicide Research Portfolio Analysis

The RPTF is seeking to determine whether currently funded U.S. research studies from calendar year 2008 to 2012 can benefit and/or be leveraged by the RPTF prioritized research agenda. This includes suicide studies currently funded by federal and private (e.g., industry, foundations) entities.

The Portfolio Analysis is part of the RPTF efforts to assess the state of the science for suicide prevention. The objective of this analysis includes the identification of strengths and gaps in research portfolios. The value of this effort also is intended to support future needs to:

- Determine where investments have already been made;
- Consider how future grants can leverage current efforts;

- Identify investigators of funded studies to promote knowledge sharing early in the research process;
- Promote research collaborations (e.g., facilitate multi-disciplinary efforts);
- Promote the use of standardized methods and assessment strategies, identify opportunities for data integration and sharing;
- Contribute to efforts devoted to assessing the value of information for decision makers and policy leaders; and
- Identify input to research pathways which will increase likelihood of favorable outcomes.

Private and public funding entities that support suicide prevention research were invited to participate in the Portfolio Analysis. The threshold for including an agency or foundation were investments of $100,000 or more of a total suicide-related portfolio in any one calendar year, between the years 2008 and 2012.The contributors to these analyses include:

- U.S. Federal Government (Public)
  - o Centers for Disease Control and Prevention (CDC)
  - o Department of Defense (DoD)
  - o Department of Veterans Affairs (VA)
  - o National Institutes of Health (NIH)
  - o Substance Abuse and Mental Health Services Administration (SAMHSA)
- U.S. Private
  - o Foundations
    - ▪ American Foundation for Suicide Prevention
    - ▪ Brain & Behavior Research Foundation

In addition to which studies are relevant to the Six Key Questions and their corresponding Research Objectives in the Agenda, NIMH is in the process of developing an online Portfolios Analysis software application to inventory suicide research grants currently funded by federal and private (e.g., industry, foundations) entities in the U.S. An example screenshot of this online survey is illustrated in Figure 13.

Figure 13. Screenshot of NIMH Suicide Research Portfolio Analysis Survey

6. Building the Prioritized Research Agenda

Six Key Questions

Research progress across multiple areas of science (e.g., risk factor, intervention research) is often needed to adequately reduce the mortality and morbidity of a public health problem. The RPTF identified six Key Questions that reflect the breadth of the science needed to reduce suicide burden. These questions reflect the range of public health and medicine approaches to public health problems (e.g., etiology, course, case identification, interventions-treatment and prevention, services research). They represent concerns that are common to patients, family members, policymakers, suicide prevention advocates, and researchers.

The RPTF matched each of the Aspirational Goals to one of the Key Questions:

1) Why do people become suicidal?
    - *Aspirational Goal 1: Know what leads to, or protects against, suicidal behavior, and learn how to change those things to prevent suicide.*

2) How can we better or optimally detect/predict risk?
    - *Aspirational Goal 2: Determine the degree of suicide risk (e.g., imminent, near-term, long-term) among individuals in diverse populations and in diverse settings through feasible and effective screening and assessment approaches.*
    - *Aspirational Goal 3: Find ways to assess who is at risk for attempting suicide in the immediate future.*

3) What interventions are effective? What prevents individuals from engaging in suicidal behavior?
    - *Aspirational Goal 4: Ensure that people who are thinking about suicide but have not yet attempted receive interventions to prevent suicidal behavior.*
    - *Aspirational Goal 5: Find new biological treatments and better ways to use existing treatments to prevent suicidal behavior.*
    - *Aspirational Goal 6: Ensure that people who have attempted suicide can get effective interventions to prevent further attempts.*

4) What services are most effective for treating the suicidal person and preventing suicidal behavior?
    - *Aspirational Goal 7: Ensure that health care providers and others in the community are well trained in how to find and treat those at risk.*
    - *Aspirational Goal 8: Ensure that people at risk for suicidal behavior can access affordable care that works, no matter where they are.*
    - *Aspirational Goal 9: Ensure that people getting care for suicidal thoughts and behaviors are followed throughout their treatment so they don't fall through the cracks.*
    - *Aspirational Goal 10: Increase help-seeking and referrals for at-risk individuals by decreasing stigma.*

5) What other preventive interventions (outside health care settings) reduce risk?
    - *Aspirational Goal 11: Prevent the emergence of suicidal behavior by developing and delivering the most effective prevention programs to build resilience and reduce risk in broad-based populations.*

- *Aspirational Goal 12: Reduce access to lethal means that people use to attempt suicide.*

6) What new and existing research infrastructure is needed to reduce suicidal behavior in the United States?
   - *All 12 Aspirational Goals*

Research Pathways

The RPTF distributed the six Key Questions to Topic Experts and Discussants, and asked "what do we know" and "what do we need" to move research ahead and reduce the burden of suicide. These Experts also were asked to propose what they thought should be the research pathways and identify the infrastructure needed to help reduce suicide attempts and deaths, and, thus, achieve the RPTF's five and ten year goals.

In October 2012, the RPTF convened the Overview Expert Panel to discuss the agenda development process and listen to Topic Experts. The presentations were summaries of the state of the science for particular Aspirational Goals.

Discussions of the presentations took place by conference call among Topic Experts, Discussants, Overview Experts, and RPTF members. These conference call discussions took place from October 2012 through February 2013, with a final in-person meeting with Overview Experts in March 2013.

Short- and Long-Term Objectives

Finally, the RPTF asked the Overview Experts to consider the proposed research pathways, and to develop Short- and Long-Term research objectives that they considered most likely to lead to substantial reductions in suicide deaths and attempts. Short-term objectives were seen as research that could be completed first, and long-term goals often depended on progress of the initial, short-term steps.

PART 3: Appendices, Acknowledgements, Glossary, and References

VI.) Appendices

Appendix A. Core Values and Operating Principles of the RPTF

CORE VALUES: Through this research agenda development process, the Research Prioritization Task Force (RPTF) seeks to produce a final agenda in which the very best science is represented as the highest priority. The RPTF seeks to do this by using procedures that promote inclusiveness, innovation and accountability.

THE GENERAL PRINCIPLES guiding the process are:

- **Timeliness:** We will take relatively prompt steps to meet established timelines.
- **Accuracy:** We will proceed in a way that minimizes the possibility of bias, inconsistencies or errors once the process has been completed.
- **Balanced Input:** We will design an input system with optimal variation in the choice of stakeholder groups surveyed.
- **Adequate Sampling:** We will provide for an adequate sampling approach for stakeholder groups.
- **Critical Review:** We will give due consideration to what suicide research already has been completed and identify the important gaps that currently exist.
- **Structured Decision-Making:** We will develop plans for prioritization of research topics.
- **Transparency and Public Access:** We will build transparency into the process by ensuring public access to agendas and minutes and a way for unsolicited input to be received and considered.
- **Adequate Dissemination**: We will implement a plan for dissemination of information on the agenda development process and on the final agenda.
- **Behavior Change:** We will encourage both United States funding agencies and suicide prevention scientists to consider and respond to key ideas in the final agenda and to adjust their priorities accordingly.
- **Long-term Maintenance:** We will create protocols to ensure that the agenda becomes a "living document."

Appendix B. Structure of the Task Force Process

Process to Develop a Prioritized Research Agenda
Encouraged by other successful public health efforts that have used mathematical modeling and other science tools to prioritize research approaches to reducing sources of mortality (e.g., alcohol-related motor vehicle accidents), the RPTF developed a comprehensive process to produce the scientific knowledge that will be needed to reduce the burden of suicide in the United States. This process also intends to build on knowledge from previous studies, leverage current research efforts, and engage leading experts on suicide and its burden in the creation of an effective research approach.

The process included the following steps:[6]

1. **Stakeholder Survey of Goals for Reducing Suicide** (described in detail on page 62-65)**:** To get the best ideas on how to reduce suicide deaths and attempts, the RPTF surveyed people who have knowledge and experience related to the burden of suicide (e.g., researchers, clinicians, survivors of suicide attempts, survivors of suicide loss, organization/policy makers). The RPTF elicited the survey respondents' Aspirational Goals—that is, what they think needs to be done in order to reduce suicide deaths and attempts by 20% in five years and 40% in ten years. The RPTF analyzed the suggestions and clustered them into 12 Aspirational Goals (see Figure 11, page 63). These Goals underlie the research questions that need to be addressed in order to achieve the objective of reducing suicide burden.

2. **Logic Models for Aspirational Goals:** The RPTF then identified the research steps needed to achieve each Aspirational Goal. It did this by creating logic models, which visualize the achievement of each Goal and reveal the relationships between the resources, activities, and anticipated short-term and long-term outcomes. The logic models were provided to expert consultants to consider in developing the researcher pathways that could ultimately lead to achieving each Aspirational Goal.

3. **Literature Review of What is Currently Known:** To determine whether previously conducted studies could inform the process of identifying research pathways that will help to achieve its objectives, the RPTF evaluated the quality of existing research and sought ways to improve research designs.

4. **Mathematical Models of the Outcomes of Targeted Interventions:** The RPTF sought to determine the potential effects of intervention on suicide deaths and attempts. It focused on reachable populations in boundaried settings (see Glossary) and also examined means of suicide attempts used most frequently. The RPTF applied models of interventions to examine potential benefits, illustrating that if multiple approaches were applied optimally, interventions could meet the reduction goals of 20% in five years and 40% in ten years.

5. **Identification of Methodological Roadblocks and New Paradigms:** The National Institutes of Health (NIH) issued a Request for Information (RFI) to identify and describe key methodological roadblocks and propose new paradigms in suicide. Consultants analyzed the results and incorporated them into background materials for experts to review.

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[6] Note: For a complete description of the process, see Section IV.

6. **Analysis of Currently Funded Studies in Progress:** To determine which suicide studies currently funded by U.S. federal and private (e.g., industry, foundations) entities are aligned with the research agenda, the RPTF is conducting a Portfolio Analysis of these studies (NIMH, forthcoming). This analysis will reveal research gaps and opportunities for knowledge-sharing, research collaboration, data integration, and input to research pathways that will increase the likelihood of reduced suicide burden.

7. **Expert Review of RPTF Work:** The RPTF convened Overview Experts, Topic Experts, and Discussants and asked them to consider the state of the science and what we need to know in order to accomplish each of the 12 Aspirational Goals. The RPTF asked these experts to consider proposed research pathways, and recommend short- and long-term research objectives (see the *Suicide Prioritization Plan of Action* for a table linking pathways to short- and long-term research objectives).

8. **Identification of Six Key Questions:** The RPTF identified six Key Questions that reflect the breadth of the science optimally needed to reduce suicide burden. These questions mirror the range of public health and medical approaches to public health problems (e.g., etiology [why do people become suicidal?], course, case identification [how to better detect risk?], interventions [both within and outside health care] services research, research infrastructure needs).

9. **Finalization of the Prioritized Research Agenda:** The RPTF organized the Aspirational Goals, research pathways and short- and long-term research objectives in the context of the six Key Questions and presented these as the complete agenda.

The Prioritized Research Agenda

The RPTF research agenda is organized around six Key Questions. Each question is tied to one or more of the 12 Aspirational Goals, which serve as an organizing frame for the suggested research pathways required to reduce the burden of suicide.

Figure B-1. Organization of the Prioritized Research Agenda.

National and international research experts reviewed and considered the RPTF's prepared materials (e.g., surveillance, logic models, and literature review). The RPTF asked the experts to consider what we know, what we need, and what is the morbidity and mortality associated with the 12 Aspirational Goals. For each Key Question, the RPTF asked experts to consider the proposed research pathways, and recommend short- and long-term research objectives most likely to lead to substantial reductions in suicide deaths and attempts. Short-term objectives were seen as research that could be completed first, and long-term objectives often depended on these initial steps. These objectives are organized according to the six Key Questions. Experts' summary of what we know, and recommended research pathways to attain the objectives, can be found within each of the Key Questions. The complete agenda can be found in Part 2, Section IV (beginning on page 17).

Appendix C. An Approach to Identifying Burden

Suicide Decedents

In order meet the goal of reducing the percent of all suicide deaths and attempts in the U.S., the RPTF sought to identify numbers of individuals affected, as well as rates of subgroups. In addition, as noted in many of the Key Question's "What Do We Need to Know" discussions in this agenda, U.S. suicide prevention efforts have been hampered by limited surveillance information. Progress in prevention could be improved if more information were available about suicide decedents, those who attempt suicide and survive, and other subgroups at risk. Specifically, more progress could be made if we knew what care may have been accessed prior to individuals' suicide attempts; what type of means were used; or what occupation the decedent had, or what was the custodial setting lived in at the time of death. Figure C-1 below illustrates some approaches described in the agenda with regard to subgroup identification through either suicide means, or boundaried settings (e.g., health care, work settings). While these subgroups are illustrated as separate groups, there could be overlap among these decedent subgroups. For example, a suicide decedent who was a military veteran may have died by firearm, and could have visited a health care setting 30 days prior to suicide death. Such information could indicate opportunities for multiple risk identification and opportunities to intervene. Overlapping subgroups could indicate additive or synergistic risk, suggesting another way to model and identify subgroups at risk.

Figure C-1. Identifying 38,000 Suicide Decedents in the United States
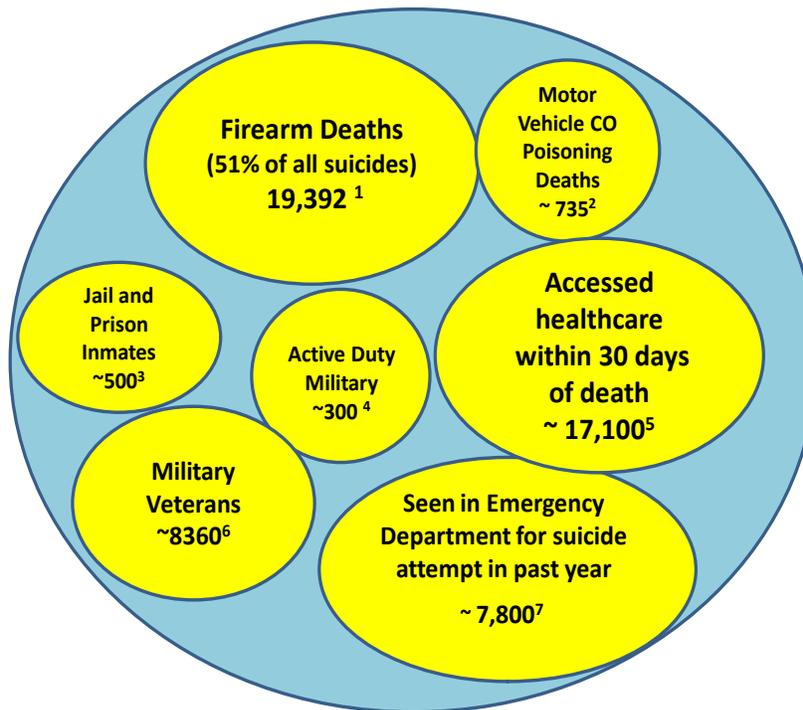
The table below provides the sources for the Figure C-1 estimates. In addition, the table provides information on the rates of suicide for these subgroups where possible. It is important to consider the rates for the smaller number of suicide subgroups, as they may comprise a small portion of the total suicide deaths, but reflect a very high risk for a particular setting or demographic group.

Some of these groups are described in more detail in Appendix D. If additional surveillance information becomes more accessible, other 'reachable' subgroups could be identified for future prevention efforts.

Table C-1. Sources for Burden Estimates

[1.]CDC WISQARS (2010 data) extracted from http://webappa.cdc.gov/sasweb/ncipc/mortrate10_us.html Model for Estimating Reduction in U.S. Suicide Deaths Following a Reduction in Suicidal Adult Persons' Access to Firearms. The projected suicide rate of individuals who are gun owners is estimated to be 28.8/100,000 (Appendix G: p. 140)
[2.] CDC Wonder (2010 data); Model for Estimating Reduction in U.S. Suicide Deaths from Carbon Monoxide Poisoning in Vehicles, Appendix G: pp 142-146. Rate estimated to be .3 per 100,000 (Appendix G: p. 147)
[3.] Bureau of Justice Statistics (Dec, 2011) extracted from: https://www.ncjrs.gov/app/publications/abstract.aspx?ID=258213. Rates per person years in these settings are not available.
[4.] DoDSER report CY 2011 https://t2health.org/sites/default/files/dodser/DoDSER_2011_Annual_Report.pdf. The suicide rate for Active Duty servicemembers in 2009 was 19.7 Medical Surveillance Monthly Report, June 2012, Vol. 19, No. 6. p. 7-10.
[5.] Trofimovich, L et.al, 2012. Health care experiences prior to suicide and self-inflicted injury, active component, U.S. Armed Forces, 2001-2010. The rate of suicide among active military who seek care within a 30 day window is not known.
[6.] Suicide Data Report 2012, Department of Veterans Affairs. Pp. 15. *Estimated 22 Veterans per day died by suicide in 2010.* http://www.va.gov/opa/docs/Suicide-Data-Report-2012-final.pdf. *(*365 x 22= 8030). The suicide rate for U.S. veterans (regardless of Veteran health care access) is unknown.
[7.] CDC WISQARS (2010 data) and Owens, Horrocks & House, 2002; *Estimates 2% of people who attempt will die of suicide in the following year* (2% of 390,359=7807) (Appendix G, Table G-5)

Appendix D. Suicide Burden

Burden Tables

In keeping with the need to identify subgroups at risk that could be reached, the burden tables below represent a mosaic of suicide attempt and suicide information from existing statistical data systems[7]. While certain important advances have been made in recent years (i.e. more surveys include measures of suicidality); it is notable that no single system or survey provides a clear picture of the pathways or trajectories from suicidal ideation, plan and attempt to suicidal death in the U.S. population. Data in these tables come from studies or surveillance systems that are not designed to ascertain events that clearly preceded suicide attempt or death (that is, potentially modifiable risk factors); they collect data that are meant to help understand prevalence or correlates of behavior or manner of death.

Given the charge of reducing the burden of suicide death and attempt, the RPTF staff approached the task by asking "from what potential service platforms might we launch intervention programs to intercede in the suicidal behavior trajectory to prevent attempts and death?" This step was a decidedly different approach than determining the demographic profile (i.e. age, gender, socioeconomic status) of suicidal individuals by focusing on various service delivery system platforms (e.g., EDs, schools, jails/prisons) that could be identified within a statistical system, that could have suicide attempt or death burden quantified and that fell under the responsibility of an agency capable of further investigation and action. The results of this initial, yet not exhaustive, query are contained in the following tables. Population estimates of the number of suicide attempts or deaths are arranged along the service/intervention platform categories of health care, education, adult and juvenile justice, and means safety. Omitted here, but being pursued, are platforms for the active military and the VA—agencies particularly impacted by suicide attempt and death among the members they serve.

Within the platform categories themselves, separate tables present population estimates of suicide attempts and/or suicide deaths. All data sources are referenced in the tables and listed (with links when possible) on the last page of this appendix. The first seven data tables are intended to estimate the number of people who attempt or die by suicide that could be identified and helped within a variety of service system settings in one year and five year increments. Within health care settings, Table D-1 shows emergency department (ED) data from two sources. The first source is the National Survey on Drug Use and Health (NSDUH), a household population survey conducted annually by the Substance Abuse and Mental Health Services Administration. Data from NSDUH indicate that 686,000 of the adults who reported being seen in the ED in the past year also report attempting suicide in the past year. The NSDUH data do not indicate which event came first, or if the two events were connected (i.e., the person went to the ED because of a suicide attempt). However, these data do indicate that a certain volume of ED users also are at risk for suicidal behavior. The second source of data in Table D-1 is the WISQARS database, which accesses ED administrative records that indicate reasons for ED visits. This data resource covers youth and adults and shows that close to 465,000 people are seen in the ED for suicide attempt.

There are no U.S. national data of the fatality rates of people seen in EDs for suicide attempts; nor are there national estimates of re-attempt rates. Therefore, the columns estimating deaths among individuals who have reported attempts are often empty in these tables. This is a significant gap in U.S. surveillance information. One exception is the Table D-3, which indicates preliminary analyses on the *rates* of attempts and deaths in a mental health research network.

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[7] The data sources used are listed beginning on page 93.

In order to complete the modeling of potential attempts and deaths averted that are presented in Appendix G, the baseline burden of attempts and deaths are drawn from these tables, but re-attempt and fatality estimates were determined from available literature. The Model for Estimating Potential Population Health Outcomes from Psychotherapeutic Interventions for Persons Seen in an ED for Suicide Attempt and Table G-7 draw from the WISQARS data presented in Table D-1. If evidence-based interventions were available to other settings included in Appendix D, it is conceivable that additional attempts and deaths could be averted.

Similarly, national surveillance data is lacking with regard to specific suicide methods used by those who attempt suicide and survive. While Tables D-8 and D-9 provide detailed information about the population distributions of suicide deaths by firearm, falling, poisoning and motor vehicle carbon monoxide (MVCO), we have no national data on how many individuals attempted suicide with these methods but survived. Nor do we know how many individuals reattempt with similar or different methods over time. Therefore, the attempt columns (for 1 and 5 years) are empty in Table D-8 as well as part of Table D-9. Again, in modeling the potential deaths averted through means safety approaches, experts had to make estimates of re-attempts given this absence of data (see Appendix G).

Where possible, estimates are presented in age group and by race/ethnicity categories. While in most circumstances the population 'universe' was either determined by the survey itself (i.e., the Youth Risk Behavior Surveillance Survey [YRBSS] covers youth in 9th–12th grade) or by the nature of the service platform targeted (all adults seen in the Emergency Department in the past year), others required decisions to be made. In the case of the College Student population data from the National Survey on Drug Use and Health (NSDUH), it was determined that college campuses may more realistically target interventions toward students enrolled in classes full time (who theoretically spend more time in close proximity to college services) than the exponentially larger (and less proximal) part-time student population. If it is desirable to examine suicide attempt among part-time students, NSDUH data resources exist to do so.

Table D-1. Health Care Setting

Setting	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempt)	Est. Deaths 5 Years (5 x 1 year death)
Emergency Departments (population survey)						
NSDUH (Avg. 2008-2009)[1]	Adults (18+)	Male	259,000		1,295,000	
		Female	427,000		2,135,000	
			Total: 686,000			
Reported past year attempts among those who were seen in ER in the past year	Non-Hispanic White		444,000		2,220,000	
	Non-Hispanic Black		123,000		615,000	
	Non-Hispanic Other		27,000		135,000	
	Hispanic		92,000		460,000	
	American Indian/Alaska Native					
Emergency Departments (ED Administrative Records)						
WISQARS (2010) Non-Fatal Injury Report[2] (# used for Psycho-therapeutic interventions model)	Youth (17 and younger)	Male	17,493		87,465	
		Female	47,479		237,395	
	Adult (18-64) (Total: 390,359)	Male	177,603		888,015	
		Female	212,691		1,063,455	
	Older Adult (65+)	Male	4,108		20,540	
		Female	5,557		27,785	
			Total: 464,931			
ED visits linked to suicide attempt	Non-Hispanic White		294,761		1,473,805	
	Non-Hispanic Black		39,629		198,145	
	Non-Hispanic Other		8,833		44,165	
	Hispanic		42,418		212,090	
	American Indian/Alaska Native					

NSDUH: National Survey on Drug Use and Health
WISQARS: Web-based Injury Statistics Query and Reporting System

Table D-2. Health Care Setting

Setting	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempt)	Est. Deaths 5 Years (5 x 1 year death)
Substance Treatment (population survey)						
NSDUH[1] (Avg. 2008-2009)	Adult (18+)	Male	56,000		280,000	
		Female	50,000		250,000	
		Total: 106,000				
Reported past year attempts among those who were treated at a specialty facility for substance use in the past year	Non-Hispanic White		73,000		365,000	
	Non-Hispanic Black		21,000		105,000	
	Non-Hispanic Other					
	Hispanic		7,000		35,000	
	American Indian/Alaska Native					
Mental Health Outpatient (population survey)						
NSDUH[1] (Avg. 2008-2009) *People who attempted suicide in total pop. X 46.9% of them who received outpatient care in past year*	Adult (18+)		515,900		2,579,000	
Mental Health Inpatient (populations survey)						
NSDUH[1] (Avg. 2008-2009) *Suicide attempters in total pop. X 31.7% of them who received inpatient care in the past year*	Adult (18+)		348,700		1,743,500	

NSDUH: National Survey on Drug Use and Health

Table D-3. Health Care Setting

Setting	Population Groups	Attempts 1 Year per 100,000	Deaths 1 Year per 100,000	Est. Attempts 5 Years (5 x 1 year attempt) per 100,000	Est. Deaths 5 Years (5 x 1 year death) per 100,000
Primary Care (health care network database)					
Mental Health Research Network[3] (9,245,000 lives covered)	Youth	38	0.4	190	2
	Adult	92	16.3	460	81.5
	Older Adult	26	19.8	130	99
	Male	43	16.1	215	80.5
	Female	78	8.2	390	41
Mental Health Research Network[3] 2000-2010	White	88			
	African American	77			
	Asian	56			
	Hispanic (any race)	79			
	American Indian/Alaska Native	168			

Table D-4. Education System Setting

Setting	Population Groups		Attempts Treated by Doctor/Nurse 1 Year	Deaths 1 Year	Est. Attempts (treated) 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
High School (School based population survey)						
YRBSS 2011[4] Grades 9-12 (2010 total population of youth age 14-17 = 16,550,000 per NCES[5])	Male	(1.9% of 8,109,500)	154,080		770,400	
	Female	(2.9% 8,440,500)	244,774		1,223,870	
Students reporting past year suicide attempt that was treated by a doctor or nurse			Total: 398,854			
High School (School based population survey)						
YRBSS 2011[4] Grades 9-12 (2010 total population of youth age 14-17 = 16,550,000 per NCES[5])	Male	(5.8% of 8,109,500)	470,351		2,351,755	
	Female	(9.8% of 8,440,500)	827,169		4,135,845	
Students reporting past year suicide attempt			Total: 1,297,520			

YRBSS: Youth Risk Behavior Surveillance System
NCES: National Center for Education Statistics

Table D-5. Education System Setting

Setting*	Population Groups		Attempts 1 Year	Deaths 1 year	Est. Attempts 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
College: Full-time students (population survey)						
NSDUH[1] (Avg. 2008-2009)	Age 18+	Male	34,000		170,000	
		Female	74,000		370,000	
		Total: 108,000				
Reported attempt among full-time college students in past year	Non-Hispanic White		41,000		205,000	
	Non-Hispanic Black		24,000		120,000	
	Non-Hispanic Other		10,000		50,000	
	Hispanic		34,000		170,000	
	American Indian/Alaska Native					

Setting	Population Groups	Est. Deaths (2004-2009)
College: Students (2004-2009) (Professional association survey)		
National Survey of Counseling Center Directors (NSCCD)[6]	Male	424
	Female	156
Reported death among college students 2004-2009*	Total (includes 42 of unknown gender): 622	

*Data from 645 Institutions/29% of total U.S. Institutions (not all Institutions contributed data for all five surveys)

Table D-6. Justice System Setting

Setting	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
Probation/Parole (population survey)						
NSDUH [1] (Avg. 2008-2009)	Adults (18+)	Male	84,000		420,000	
		Female	77,000		385,000	
			Total: 161,000			
Reported past year suicide attempts among persons on probation/parole in the past year	Non-Hispanic White		102,000		510,000	
	Non-Hispanic Black		30,000		150,000	
	Non-Hispanic Other		3,000		15,000	
	Hispanic		26,000		130,000	
	American Indian/Alaska Native					
Local Jails (jail census data)						
2009 data extracted from Bureau of Justice statistics table[7]	Adult	Male		278		1,390
		Female		25		125
				Total: 303*		
*Race/ethnicity and gender breakouts are not available for 2009. Ratios below (and gender above) apply percent of suicides within race/ethnicity categories for 2000-2009 local jail inmate suicide deaths (Table 11) to the2009 numbers**						
Ratio = 69.9%	White			212		1,060
14.5%	Black			44		220
1.4%	Other***			4		20
11.6%	Hispanic/Latino			35		175
2%	American Indian/Alaska Native			6		30

NSDUH: National Survey on Drug Use and Health

* 303 total local jail inmate suicides 2009 (Table 1)

   91.9% of suicides are male (Table 11)

** Numbers do not add up to 303 due to rounding

***Other: Asian, Hawaiian/Pacific Islander, other, added together

Table D-7. Justice System Setting

Setting	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
Prison (prison census data)						
2009 Data extracted from Bureau of Justice statistics table[7]	Adult	Male		191		955
		Female		10		50
				Total: 201*		
*Race/ethnicity and gender breakouts are not available for 2009. Ratios below (and gender above) apply percent of suicides within race/ethnicity categories for 2000-2009 prison suicides (Table 23) to the2009 numbers ***						
Ratio = 58.4%	White			117		585
21%	Black			42		210
2.5%	Other***			5		20
16.5%	Hispanic/Latino			33		165
1.1%	American Indian/Alaska Native			2		10

*201 total state prisoner suicides in 2009 (Table 13)

   95.2% of suicides are male (Table 23)

**Numbers do not add up to 201 due to rounding*

***Other = Asian, Hawaiian/Pacific Islander, other added together

Table D-8. Means Safety

Means	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
Suicide Deaths by Firearms						
WISQARS (2010)[8] Fatal Injury Report	Youth (10-17 years)	Male		319		1,595
		Female		55		275
	Adult (18-64 years)	Male		12,708		63,540
		Female		2,031		10,155
	Older Adult (65+ years)	Male		3,932		19,660
		Female		344		1,720
				Total: 19,392		
	White			17,909		89,545
	Black			1,079		5,395
	Hispanic					
	Asian/Pacific Islander			226		1,130
	American Indian/Alaska Native			178		890
Suicide Deaths by Falling						
WISQARS (2010)[8] Fatal Injury Report	Youth (10-17 years)	Male		12*		
		Female		1*		
	Adult(18-64 years)	Male		502		2,510
		Female		162		810
	Older Adult (65+ years)	Male		65		325
		Female		38		190
				Total: 781		
	White			653		3,265
	Black			67		335
	Hispanic					
	Asian/Pacific Islander			57		285
	American Indian/Alaska Native			4*		

WISQARS = Web-based Injury Statistics Query and Reporting System

*=indicates unstable estimate

Table D-9. Means Safety

Means	Population Groups		Attempts 1 Year	Deaths 1 Year	Est. Attempts 5 Years (5 x 1 year attempts)	Est. Deaths 5 Years (5 x 1 year deaths)
Suicide Attempts by Prescription Medication						
DAWN (2009)[9]	Adult	Male	70,761		353,355	
		Female				
Suicide Deaths by Poison						
WISQARS (2010)[8] Fatal Injury Report	Youth (10-17 years)	Male		24		120
		Female		27		135
	Adult (18-84 years)	Male		3,184		15,920
		Female		2,655		13,275
	Older Adult (65+ years)	Male		365		1,825
		Female		344		1,720
	Total: 6,599					
	White			6,153		30,765
	Black			244		1,220
	Hispanic					
	Asian/Pacific Islander			138		690
	American Indian/Alaska Native			64		320
Suicide Deaths by Motor Vehicle Carbon Monoxide (MVCO)						
WONDER (2010)[10] (# used for MVCO model)	Adult*			735		3,675

DAWN: Drug Abuse Warning Network

WISQARS: Web-based Injury Statistics Query and Reporting System

WONDER: Wide-ranging Online Data for Epidemiologic Research

* Percent of total gas suicides that were Motor Vehicle Carbon Monoxide (MVCO) suicides (1,022) x 0.7

Data Sources:

1. Substance Abuse and Mental Health Services Administration (SAMHSA), Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2008 and 2009.

2. Centers for Disease Control and Prevention (CDC), Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System, Non-Fatal Injury Report, 2010.

3. Mental Health Research Network: http://www.healthpartners.com/hprf/research/research-areas/mental-health/mhrn/index.html (personal communication).

4. Centers for Disease Control and Prevention (CDC), Youth Risk Behavior Surveillance –United States, 2011, MMWR 2012; 61 (No. 4), page 72.

5. National Center for Education Statistics; Digest of Education Statistics, Enrollment in grades 9 through 12 in public and private schools compared with populations 14-17 years of age, 2010. http://nces.ed.gov/programs/digest/d10/tables/dt10_050.asp

6. Schwartz, . A. J. (2011), Rate, Relative Risk, and Method of Suicide by Students at 4-Year Colleges and Universities in the United States, 2004–2005 through 2008–2009. Suicide and Life-Threatening Behavior, 41: 353–371. doi: 10.1111/j.1943-278X.2011.00034.x

7. U.S. Department of Justice, Bureau of Justice Statistics, Prison and Jail Deaths in Custody,2000-2009 - Statistical Tables, 2011, (NCJ 236219), pages 5-24. https://www.ncjrs.gov/app/publications/abstract.aspx?ID=258213

8. Centers for Disease Control and Prevention (CDC), Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System, Fatal Injury Report, 2010. http://webappa.cdc.gov/sasweb/ncipc/mortrate10_us.html

9. Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. (June 16, 2011). *Trends in Emergency Department Visits for Drug-Related Suicide Attempts among Males: 2005 and 2009*. Rockville, MD. http://www.samhsa.gov/data/2k11/WEB_DAWN_018/WEB_DAWN_018.htm

10. Centers for Disease Control and Prevention (CDC), CDC WONDER Online Database, Compressed Mortality File 2005-2010.

11. Centers for Disease Control and Prevention, Injury, Prevention and Control, National Violent Death Reporting System (NVDRS), 2005-2010.

Appendix E. What Is Suicide Prevention Research?

The *2012 NSSP* proposes many actions for reducing suicide deaths and attempts. However, the evidence base that underlies these proposed actions is uneven and fragmented. Accordingly, the RPTF's effort specifically excluded descriptions of programs, practices, or policies that do not contain scientific approaches to measuring and assessing outcomes or identify what component or 'change agent' was making a difference.

It is important to note, however, that most suicide prevention programs, practices, and policies are amenable to research that can assess their impact. Some scientific methods of evaluating a program are discussed below.

Randomized Control Trials

The *NSSP* does include a limited number of evidence-based suicide prevention practices that have been put through a rigorous randomized control trial (RCT). In a RCT, individuals or groups are randomly enrolled in intervention or control conditions, and the outcomes in both groups are compared. Randomized experiments, for prevention and treatment, can provide strong evidence of an intervention's effectiveness or ineffectiveness.

RCT trials are considered the gold standard to determine what works. By themselves, however, randomized trials of effectiveness in suicide prevention are not sufficient. First, because suicide death is rare compared to cases of depression, drug use, and many other mental health issues, RCTs focusing on suicide must be many times larger than other mental health trials, thus vastly increasing the expense or length of a trial. Second, randomized trials can only answer a limited number of questions. Therefore, a comprehensive research agenda needs to include other types of research as well.

Natural Experiments and Other Research Methods

Reviews of scientific literature suggest that studies that evaluate prevention strategies should use a variety of methods as alternatives to RCTs. These include cohort studies or quasi-experimental designs where investigators look at changes over time and use statistical methods to account for natural variation.

In many areas of science, including suicide research, investigators also look at "natural experiments" where interventions are delivered but not 'controlled' in an experimental way. Statistical methods are used to account for potential biases that commonly occur in such studies (e.g., those with more frequent symptoms are more likely to receive more interventions than those with less frequent symptoms).

Also, like other areas of science, suicide prevention research relies on many other methods and approaches from the biomedical, psychosocial, and economic fields that include, but are not limited to: epidemiology, genome wide association studies, psychological autopsy studies, brain imaging, neuropsychological assessment, qualitative analyses, toxicology, pharmacology, services research, program evaluation, and surveillance.

Indeed, a number of the recommended research pathways described in this document suggest that research be paired with the roll out of policies and practices believed to be helpful, so that more can be learned and tested, if possible, in a controlled manner.

Appendix F. Logic Models

The logic models aim to capture a number of inter-related ideas and assumptions that were submitted in the Stakeholder Survey. Dr. Jane Pearson developed these models to help Topic Experts prepare materials that would encompass the Aspirational Goals. Many Topic Experts developed their own logic models to reflect their views of current and needed research ideas pertaining to the Aspirational Goals.

Logic Model Key
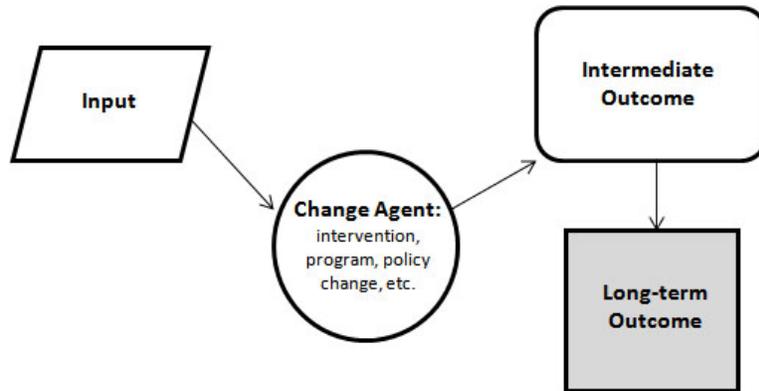
Aspirational Goal 1—Know what leads to, or protects against, suicidal behavior, and learn how to change those things to prevent suicide.

Aspirational Goal 2—Determine the degree of suicide risk (e.g., imminent, near-term, long-term) among individuals in diverse populations and in diverse settings through feasible and effective screening and assessment approaches.
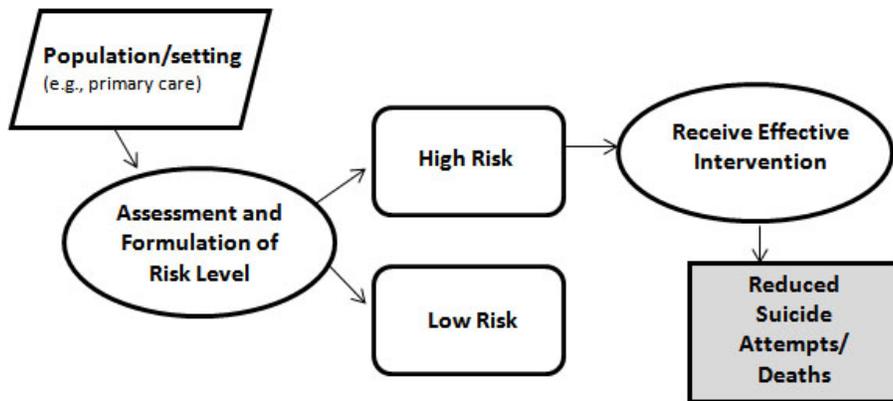
Aspirational Goal 3—Find ways to assess who is at risk for attempting suicide in the immediate future.

Aspirational Goal 4—Ensure that people who are thinking about suicide but have not yet attempted can get effective interventions to prevent suicidal behavior.
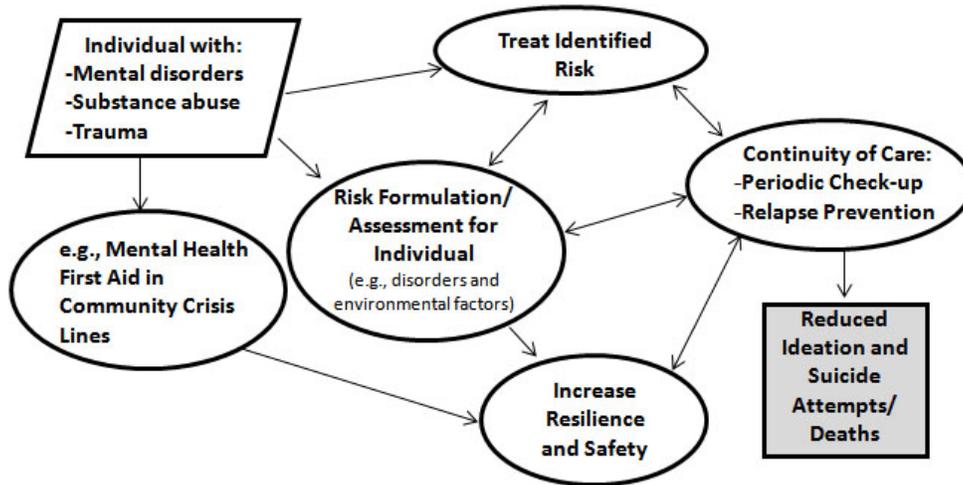
Aspirational Goal 5—Find new biological treatments and better ways to use existing treatments to prevent suicidal behavior.
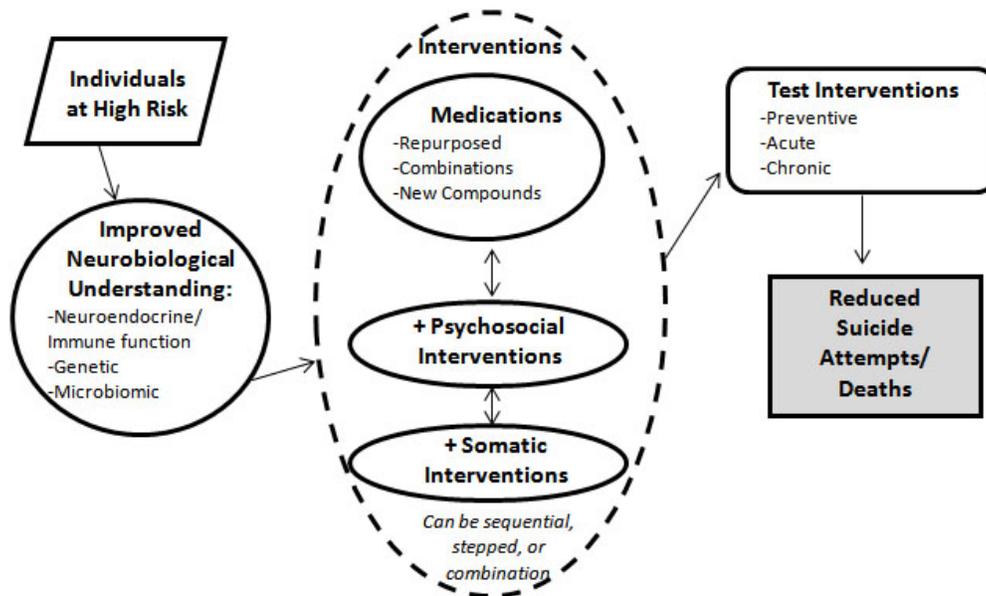
Aspirational Goal 6—Ensure that people who have attempted suicide can get effective interventions to prevent further attempts.
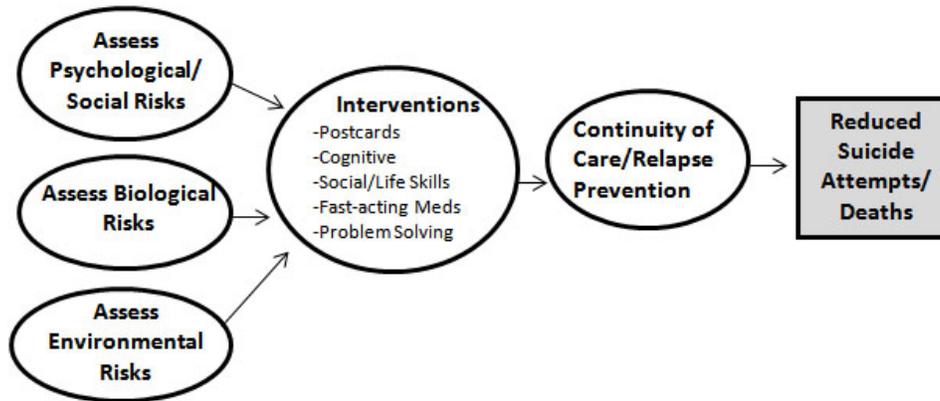
Aspirational Goal 7—Ensure that health care providers and others in the community are well trained in how to find and treat those at risk. (FORMAL)
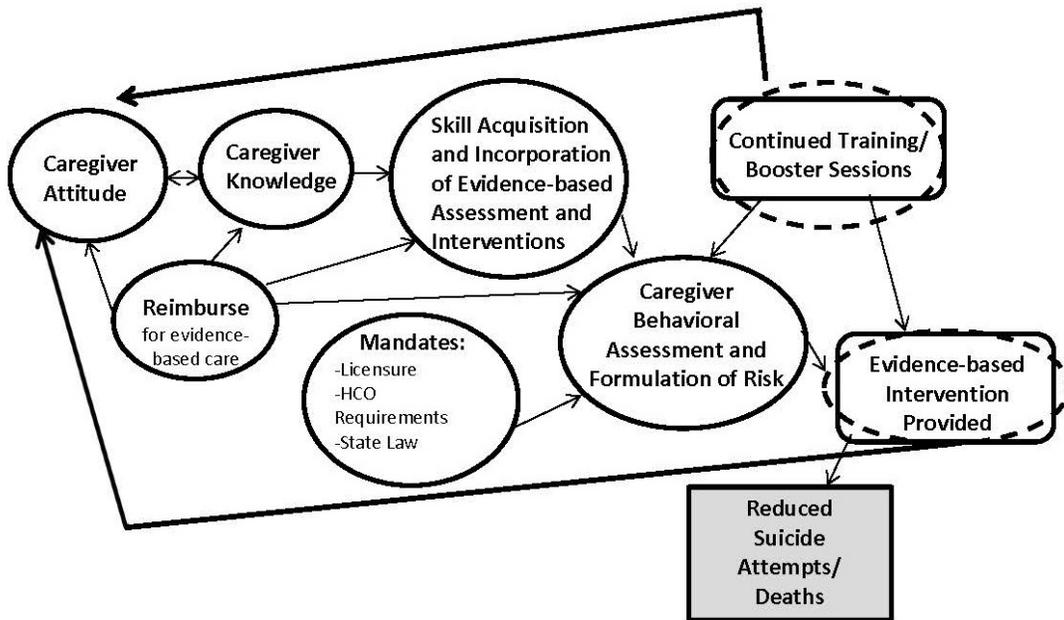
Aspirational Goal 7—Ensure that health care providers and others in the community are well trained in how to find and treat those at risk. (INFORMAL)
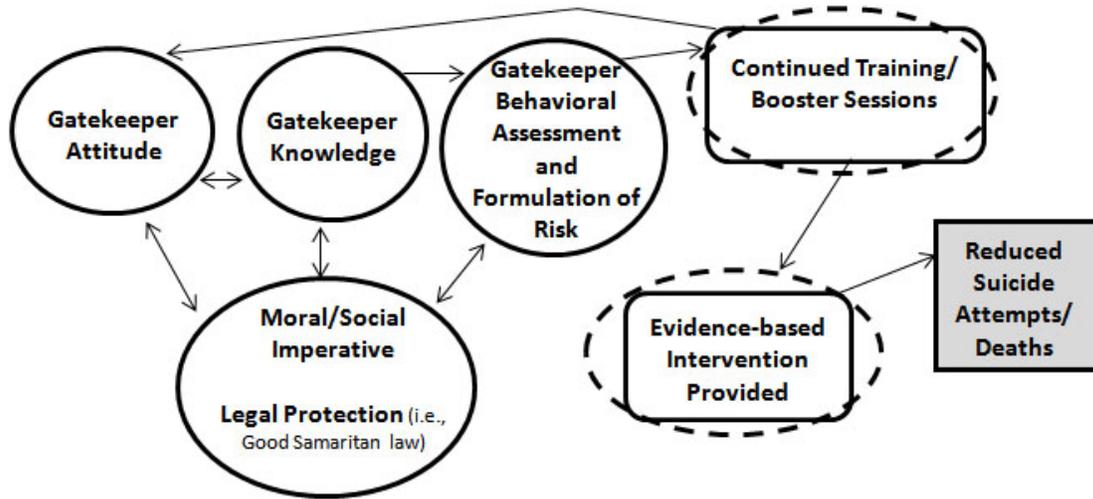
Aspirational Goal 8—Ensure that people at risk for suicide behavior can access affordable care that works, no matter where they are.
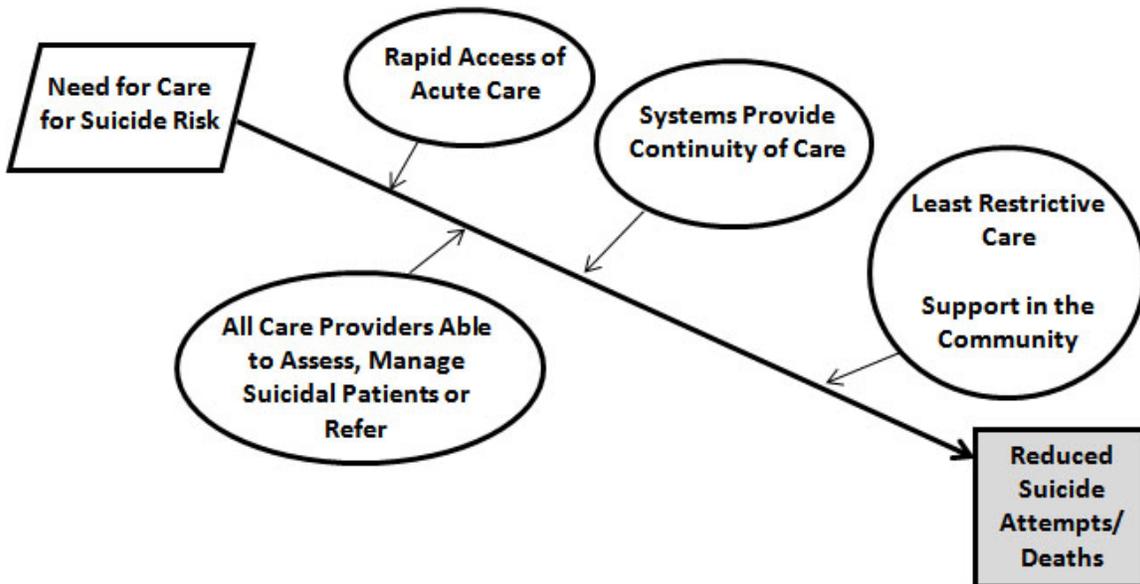
Aspirational Goal 9—Ensure that people getting care for their suicidal thoughts and behaviors are followed throughout their treatment so they don't fall through the cracks.

Aspirational Goal 10—Increase help-seeking and referrals for at-risk individuals by decreasing stigma.
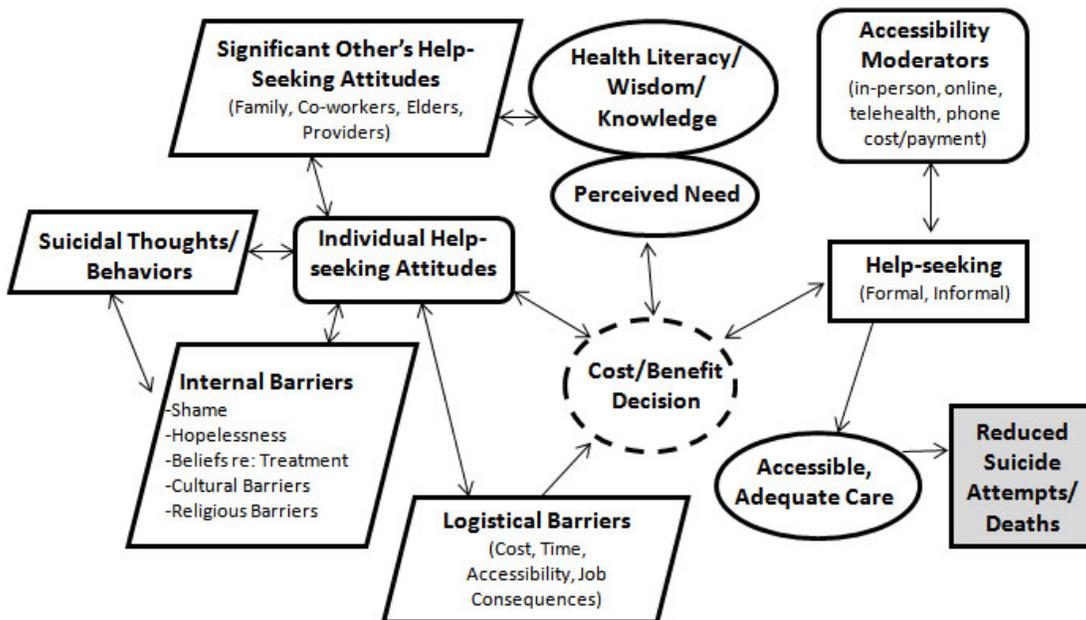
Aspirational Goal 11—Prevent the emergence of suicidal behavior by developing and delivering the most effective prevention programs to build resilience and reduce risk in broad-based populations.
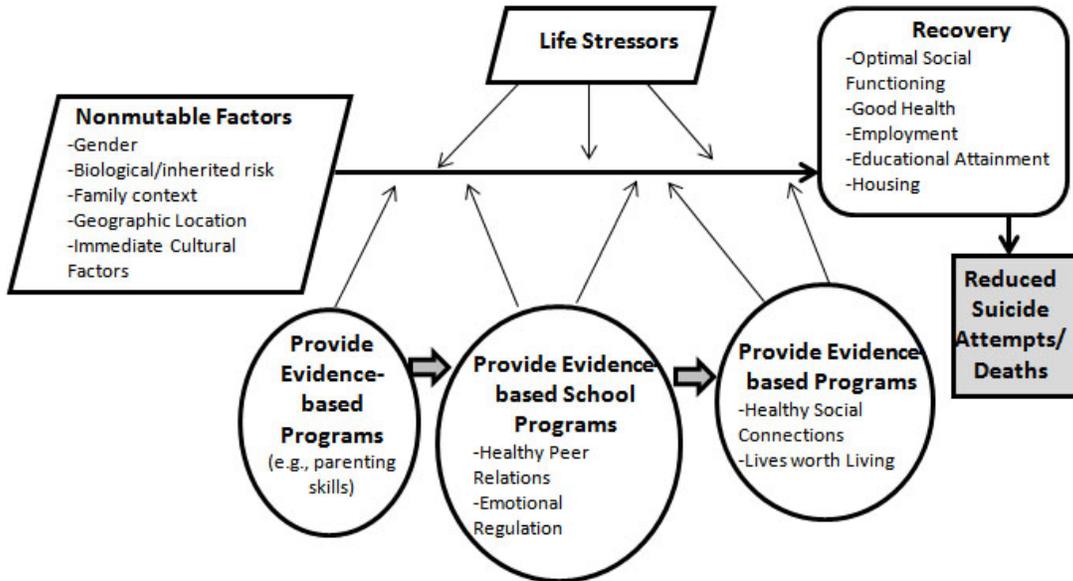
Aspirational Goal 12—Reduce access to lethal means that people use to attempt suicide (firearms, poisons, and alcohol).
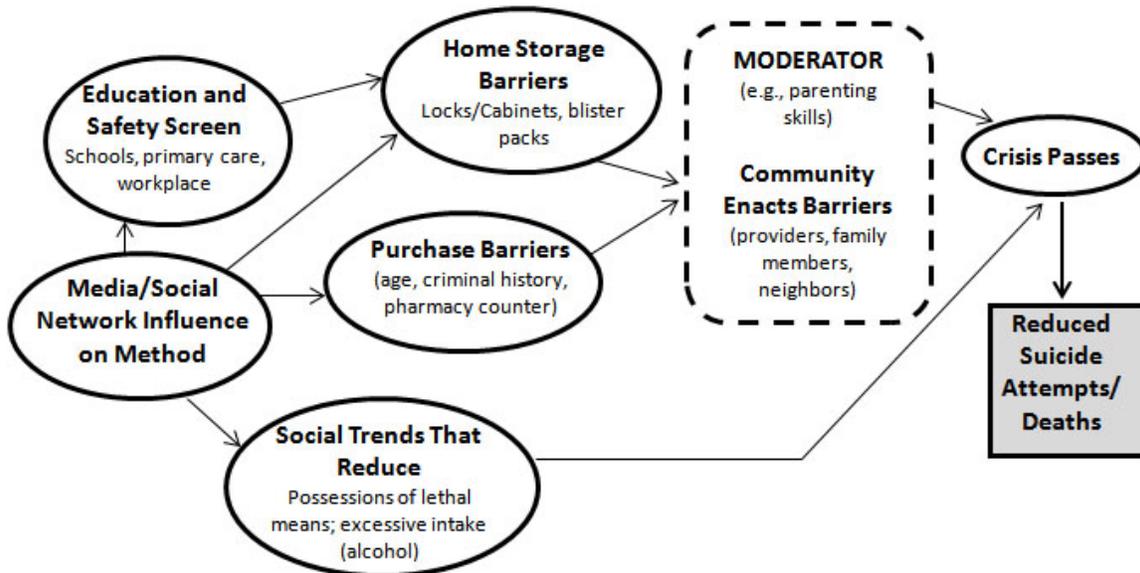
Aspirational Goal 12—Reduce access to lethal means that people use to attempt suicide (jumping hotspots—buildings, bridges, train tracks, etc.).
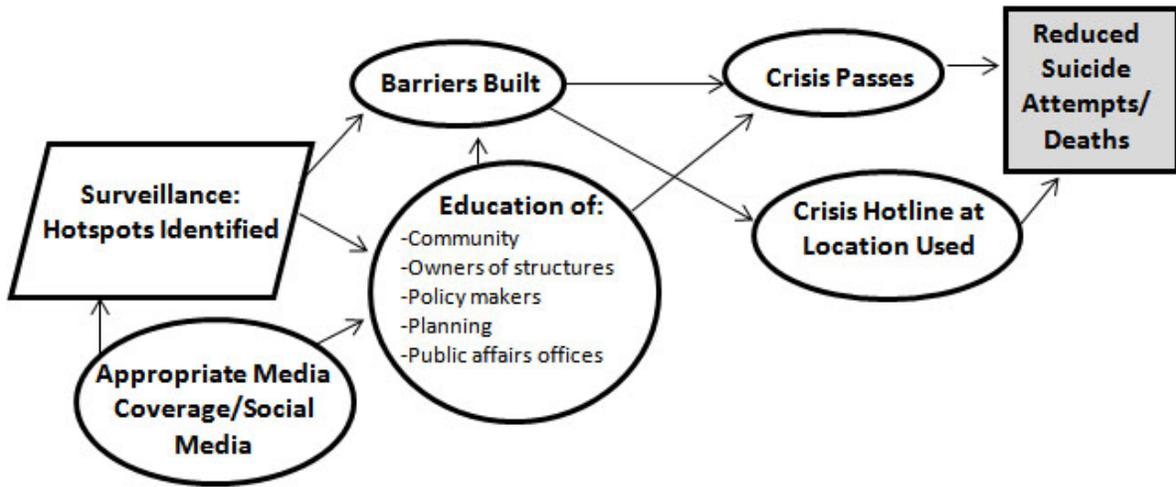
Appendix G. Intervention Model Examples

As noted in Appendix B, as part of the RPTF prioritization process, the Task Force asked experts to assist in determining the potential effects of interventions on suicide deaths and attempts through mathematical models of those interventions projected onto the U.S. population. The models required multiple parameters that ideally would be informed by research. In the process of developing these models, significant knowledge gaps were identified, allowing the RPTF to identify these areas for research priorities.

Model for Estimating Reduction in U.S. Suicide Deaths Following a Reduction in Suicidal Adult Persons' Access to Firearms[8]

Background

In 2010, 51% of U.S. suicide deaths were by firearm. As of November 2011, the suicide prevention community largely had not considered reducing a suicidal person's access to firearms among the more feasible suicide prevention tactics (Claassen et al., in press). Despite the absence of any explicit focus on reducing firearm suicides, there was a decline in U.S. suicide rates between 1986 (12.9 per 100,000) and 2000 (10.4 per 100,000), driven largely by a decline in the rate of firearm suicides and occurring at a time when household firearm ownership was decreasing and suicide attempts were staying flat (Miller, Azrael, and Barber, 2012). Since 2000, the U.S. suicide rate has increased to 12.4 in 2010, with increases across all methods, particularly hanging (Centers for Disease Control and Prevention, 2012).

The expert overview documents on reducing suicidal persons' access to lethal means outlined the evidence (from case control studies, cross-sectional ecologic studies, longitudinal studies, and surveys) that access to a firearm increases the risk of suicide. The increased risk is driven by a higher rate of firearm suicide. Access to firearms is not associated with increased risk of mental illness, suicidal thoughts, suicide attempts, or non-firearm suicide completions. Therefore, the assumed causal mechanism explaining the increased suicide risk is that suicidal people with access to guns are more likely to use guns in their suicide attempts and therefore to die in their attempts than suicidal people without access to guns.

One reason the suicide prevention field has not focused on firearm access has been the assumption that doing so would necessarily involve legislative strategies. However, a number of non-legislative strategies have been developed in recent years. These include clinical strategies ("lethal means counseling") to counsel patients at risk for suicide—and their families—to temporarily store any household guns away from home or securely locked against the vulnerable person's access; community strategies to deliver that same message using a gatekeeper training model; partnerships with gun-owning groups to incorporate messages pertaining to suicide prevention and reducing suicidal persons' access to firearms in all standard firearm safety classes and literature; broad-scale (non-targeted) promotion of safe firearm storage; and changes in social norms around keeping guns at home.

To estimate the number of lives that might be saved from suicide if the proportion of suicidal people who had access to a firearm at home were reduced, we used a modified decision-analytic model with the following steps: 1) Define the specific question of interest, 2) Identify sources of data for the

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[8] Modeling effort led by Catherine Barber and Matthew Miller, Harvard University.

population and event parameter estimates (e.g., effectiveness of interventions), 3) Identify gaps in data and methods for handling research gaps, and 4) Run and test models under varying assumptions.

Question to be Modeled

How many suicides would be averted if 25% of suicidal people who would otherwise have access to firearms at home, no longer had access (due to offsite storage, effective locking, or other strategies)?

Data Sources

Table G-1. Input Values and Data Sources.

Parameter	Values Used in Model	Data Source
POPULATION		
US adult population (18+) US adult suicides (18+)	234,564,071 37,355	2010 CDC-WISQARS 2010 CDC-WISQARS
Household firearm ownership rate 2010	.33	National Opinion Research Center (NORC) General Social Survey and CDC's 2004 Behavioral Risk Factor Surveillance System (BRFSS) survey.
INTERVENTION PARAMETERS		
Efficacy of intervention (Model One)	.21/100,000 (CI* 0.14,0.28) change in suicide rate per each percentage point drop in household firearm access	.21/100,000 change in suicide rate for every 1 percentage point change in rate of household firearm ownership (used here as a proxy for reduction in household firearm access by suicidal persons). Based on linear regression analysis of ecologic data at the state level. Source: Miller et al. (in press, 2013)
Efficacy of intervention (Model Two)	.33 RR**	People without guns at home have a relative risk of suicide three-fold lower than people with guns based on case control studies (RRs generally range from 2-5 depending on the study) (e.g., Kellermann et al. 1992; Brent, 2001)
Uptake of intervention	25%	Model is theoretical; it assumes intervention results in 25% of at-risk people with guns at home no longer having access to household guns.
Fatal re-attempt rate	NA	Fatal method substitution is already taken into account in the model because intervention parameters are based on observed overall suicide rates, not firearm suicide rates.

* CI denotes confidence interval.
**RR denotes relative risk.

Table G-1 describes all data sources for the population and model parameters applied.

Population

The 2010 population of adults ages 18 and over and suicides in this age group are from CDC WISQARS based on U.S. Census data and national mortality data from the National Vital Statistics System.

Estimates of the national household gun ownership rate in 2010 are from the National Opinion Research Center's General Social Survey and the 2004 Behavioral Risk Factor Survey.

Intervention Parameter Values

The intervention that we seek to model is change in a suicidal person's status from having to not having access to a gun at home. We do not specify how the access is reduced (e.g., guns stored elsewhere temporarily, permanently disposed of, locked against the at-risk person's access, firing pins temporarily removed) nor do we specify how the intervention is delivered (e.g., lethal means counseling by providers, community strategies, secular change in household gun ownership rates).

Data limitation—There have been few studies of non-legislative interventions aimed at reducing firearm access in at-risk groups in the U.S. (e.g., Brent et al., 2000; Kruesi et al., 1999) and none large enough to evaluate impact on suicide outcomes. The Brent study and Kruesi study found that among parents of adolescents treated for psychiatric disorders who had guns at home, 27% (Brent et al., 2000) and 63% (Kruesi et al., 1999) of the parents counseled to reduce access at home reported doing so (compared with none in the control group in the Kruesi study). Both studies, however, were very small.

Method to overcome data limitation—In the absence of outcome data from intervention trials, we can estimate the impact of not having access to guns at home by observing the difference in overall suicide rates between people who live in homes with guns vs. people who live in homes without guns. These studies have been conducted at the ecologic level using cross sectional or longitudinal data and at the individual level using a case control approach. We model a hypothetical scenario in which 100% of suicidal people with guns at home (or their friends/family) are exposed to an intervention urging them to effectively block the at-risk person's access to firearms at home; we assume a 25% uptake rate (that is, 25% effectively reduce the at-risk person's access). We estimate the number of suicides that will be averted within the 25% by applying the "intervention effectiveness" rates that can be inferred from the ecologic studies (Model 1) and the case control studies (Model 2). These models would be more complex if, on average, people who live in homes with guns were found to have higher rates of mental illness, substance abuse, suicidal ideation, or suicide attempts than people who do not. This appears not to be the case, according to four studies using national survey data (Betz et al., 2011; Miller et al., 2009; Ilgen et al., 2008; Sorenson & Vittes, 2008).

Parameter Estimates: Model 1 (Ecologic Data)—In linear regression analysis modeling state suicide rates Miller and colleagues (Miller et al., in press 2013) estimated that suicide rates among adults 18 and over increase 0.21 per 100,000 population for each one percentage point increase of firearm ownership, independent of underlying suicide attempt rates and controlling for other factors that, at the individual level, correlate with suicide risk. This increase in suicide rate is due to the change in the firearm suicide rates (0.23 firearm suicides per 100,000 population), with no effect on non-firearm suicide rates across states that differ in gun prevalence. The data source for state level gun ownership rate was the 2004 Behavioral Risk Factor Surveillance System and for state suicide attempt rates among adults, the Substance Abuse and Mental Health Services Administration's 2008-2009 NSDUH was used.

To model the impact of approximately 25% of suicidal people with guns at home no longer having access to those guns, we estimate the impact of an eight unit drop in firearm ownership in the U.S. (i.e., dropping from the current 33% to 25% (a 24% drop), or 0.21*8= 1.7 suicides per 100,000 population.

Parameter Estimates: Model 2 (Case Control Data)—A second way to model a 25% drop in firearm access among suicidal people uses relative risk estimates from case control data that suggest the risk of

suicide in homes with firearms is two-to-five fold higher than among homes without firearms, all else equal. Assuming a relative risk of three and given a 2010 household gun ownership rate of 33% and an adult suicide rate of 15.92, we are able to estimate the suicide rate among adults in non-gun owning households by solving for x: 15.92=0.67x + (0.33*3x) = 9.6 and multiply that rate by three to estimate the average rate among gun owners (28.8). Based on these rates, we can estimate reduction in suicides if firearm ownership rates dropped from 0.33 to 0.25 (again, a proxy for drop in firearm access among suicidal people), as shown below.

Results

Results of the two models are summarized in Table G-2 below. In Model 1, going from ⅓ homes with firearms to ¼ homes with firearms would result in a decrease of approximately 3,900 suicides among adults. That is, a drop in the suicide rate of 1.7/100,000 applied to the 2010 U.S. adult population equals 1.7/100,000 x 234,564,071=3,941 lives. Estimates that include the range of beta coefficients from regression analyses are 2,627–5,254.

Under Model 2, applying the estimated suicide rate of 9.6 among non-gun owners to a larger proportion of the U.S. adult population (75% rather than 67%) and the suicide rate of 28.8 among gun owners to a smaller proportion (25% rather than 33%) results in an estimated 3,612 suicide deaths averted (or a range of 2,259–5,163 if RRs of two-to-five are used in calculating gun and non-gun owner rates).

In summary, if household firearm access dropped 25%, **there would have been approximately *3,600–3,900 fewer U.S. adult suicide deaths in 2010*. Such a drop would meet roughly half of the 20% reduction in suicide goal in one year.**

Table G-2. Potential Suicides Averted Resulting from 25% Reduction in Suicidal Persons' Access to Household Firearms

Intervention	Parameter	Parameter applied to	Suicide Deaths Averted 1 Year	Suicide Deaths Averted 5 Year*
Model 1 (Ecologic Data) Change in suicide rate associated with a 8-unit (24%) drop in household gun ownership (proxy for drop in access)	.21/100k (.95 CI 0.14,0.28) times 8	234,564,071 Adult population	3,941 (2,627–5,254)	3,941 (2,627–5,254)
Model 2: (Case Control Data) Change in suicide rate associated with a 8-unit (24%) drop in household gun ownership (proxy for drop in access)	Suicide rate =9.6 in non-gun households and 28.8 in gun households calculated based on 0.33 Relative Risk of Non-Gun to Gun Households	Adult population under new assumption that 75% of adults live in non-gun and 25% in gun households	3,612 (2,259–5,163)	3,612 (2,259–5,163)

* Unlike the Carbon Monoxide model, we assume no change in suicides averted after five years because the model is based on observations of actual rates or risk in a population with vs. without household firearm access where some degree of lethal substitution has already occurred in the non-gun households. Because we had no estimates of lethal substitution when motor vehicle exhaust is unavailable, we modeled rates of lethal substitution over time.

Children

For children under 18, the relative risk of suicide associated with living in a home with firearms is at least as great as it is for adults (Kellerman et al., 1992; Brent 2001; Miller & Hemenway, 1999). The expected drop in adult suicides of 3,600-3,900 represents roughly 19–20% of total 2010 adult firearm suicides. Applying a 19% drop to the 375 firearm suicides occurring among children in 2010 would net approximately 70 suicides averted. Because children's overall suicide rate and ratio of firearm to non-firearm suicides is lower than for adults, adding children to the main model would inflate the estimates of suicides averted. While adding a separate model for children is justified, given the relatively small numbers of suicides averted, for simplicity we have presented the model only for people 18 and over.

Persistence of Decline in Suicides Associated with Reduced Firearm Access

The benefit in reducing suicide rates would be apparent immediately and in direct proportion to the decline in firearm access, all else equal. We assume, based on observations of means restriction in the United Kingdom, Israel, Sri Lanka and Samoa (summarized in Miller et al., 2012), that the saving of lives would be sustained for multiple years. No data allow an empirical estimate of precisely how long *measurable* benefits would persist, as secular changes in underlying socioeconomic conditions and in availability and popularity of other methods can contribute to changes in suicide rates that may either mask or amplify benefits of reducing suicidal people's access to firearms.

Discussion/Gaps in Research Database

Surveillance

Current and repeated national and state-level surveillance efforts (e.g., CDC's Behavioral Risk Factor Surveillance System) that collect information on the number, type, and storage practices of firearms in households would provide opportunities to better examine risk and protective practices related to suicide attempts and deaths. Expanding the CDC's NVDRS to all states would allow for a more complete picture of the circumstances of suicide deaths. These data collection resources are necessary to determine the effectiveness of prevention strategies , as well as any focused interventions to improve firearm safety to reduce suicide firearm deaths. In his *Now is the Time* plan to address gun violence prevention, President Obama proposed an expansion of the NVDRS to all 50 states (White House, 2013).

Targeted Interventions

Miller and Barber's Aspirational Goal 12 presentation included descriptions of small studies that examined the role of provider counseling to improve firearm safety. Regional and national campaigns, designed with adequate baseline and target audience input, could test approaches to shifting social norms to improve firearm safety practices. State efforts comprised of gun owner and suicide prevention advocate collaborations to improve gun safety have gotten underway in recent years and have accelerated in recent months. Whether these efforts can be evaluated with regard to suicide prevention outcomes remains to be seen.

Non-Targeted Interventions

Safe firearm storage campaigns aimed at the general population for accident and theft prevention, and not necessarily for suicide prevention, are likely to protect against suicide (e.g., Grossman, 2005), even if it is often the case that the at-risk teenager or adult householder will in fact have access to the key or combination. A model that estimates the impact of population-based safe storage campaigns on adult and child suicides will be useful.

Alternate Mortality

This model estimates suicides averted, a slightly different concept than lives saved. Over the course of one and five years, a proportion of people who would be saved from suicide by the intervention could be expected to die by other means. A model that estimates lives saved would need to take into account the considerably higher non-suicide mortality observed among people who attempted suicide compared with their demographically-matched non-suicidal peers (Bergen et al., 2012a).

Model for Estimating Reduction in U.S. Suicide Deaths from Carbon Monoxide Poisoning in Vehicles[9]

Background

In considering opportunities to reduce suicidal persons' access to lethal means for the RPTF Overview Experts to consider, the RPTF staff found a small amount of literature on the effects of the introduction of catalytic converters to vehicles and a decrease in suicides due to carbon monoxide (CO) poisoning (e.g., Amos et al., 2001; Studdert et al., 2010; Thomsen et al., 2006; Mott et al., 2002). Over 90% of people who kill themselves with motor vehicle exhaust are found inside the passenger cabin of a car or truck (Ostrom et al., 1996). Strife and Paulozzi (2004) noted that catalytic converters do not completely remove CO, particularly when a vehicle is started cold or running within a closed space, leaving suicide attempts by CO in vehicle cabins still a high fatality risk. They proposed a device that detects cabin levels of CO, warns the driver, and automatically shuts down the engine in a stationary car if levels rise above a dangerous threshold. The gadget has been investigated in the U.S. (Grace et al., 1991; Galatsis & Wlodarski, 2006) and has been proposed to the United Nation's World Forum for Harmonization of Vehicle Regulations (the "WP") by Canada (Canadian Department of Transport, 2001) and Australia (2001) as a potential suicide prevention device.

To estimate the number of lives that might be saved from suicide through use of the device, we used a modified decision-analytic model with the following steps: 1) Define the specific question of interest, 2) Identify sources of data for the population and event parameter estimates (e.g., effectiveness of interventions), 3) Identify gaps in data and methods for handling research gaps, and 4) Run and test models under varying assumptions.

Question to be Modeled

How many lives would be saved if all motor vehicles in the U.S. fleet were outfitted in the factory with a carbon monoxide-sensing engine-shutoff device?

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[9] Modeling effort led by Catherine Barber and Matthew Miller, Harvard University.

Data Sources

Table G-3. Input Values and Data Sources for Reducing Suicide from Carbon Monoxide Poisoning in Vehicles.

Parameter	Values Used in Model	Data Source
POPULATION		
MVCO suicides	735	2010 CDC-WONDER Gas Suicides (1,022) multiplied by 0.72 (proportion of gas suicides that were motor vehicle carbon monoxide [MVCO] according to a review of a random sample of 100 gas suicides in the National Violent Death Reporting System [2005-2010])
INTERVENTION PARAMETERS		
Efficacy of intervention	85%	Reports indicate the device has good sensitivity but a 6-8 year life. We set the efficacy at 85% in the absence of more specific data.
Uptake of intervention	100%	Model is theoretical, based on best case scenario of all vehicles having the device.
Fatal re-attempt rate (Assumption One)	Year 1: 4.1% Year 5: 6.8%	Bergen et al., 2012. 6.8%=actual suicide rate observed among people who attempted gas suicide. Year 1 is based on Owens' review, which found that 60% of eventual suicides occur within first year of index attempt.
Fatal re-attempt rate (Assumption Two)	Year 1: 17% Year 5: 20%	Assumes half of people who attempted persist in attempt despite engine shut-off and substitute other methods that day or shortly thereafter. Multiple assumptions are made and explained in text.

Table G-3 describes all data sources for the population and model parameters applied.

Population Estimates
Population estimates for people using motor vehicle exhaust in a suicidal act were based on three sources. For fatalities, prior to 1999, the International Classification of Disease, Ninth Revision (ICD-9) codes used in the U.S. to characterize cause of death identified motor vehicle exhaust CO (MVCO) suicides. The chart below lists MVCO deaths from 1979 to 1998. In 1987, 2687 individuals died by MVCO suicide (rate of 1.11 per 100,000). In 1998, the MVCO poisoning deaths dropped to 1,329 (.48 per 100,000). Since 1999, the U.S. has used the ICD-10 system for coding cause of death, which does not differentiate motor vehicle CO suicides from other gas suicides. We examined a random sample of 100 gas suicides from NVDRS records for the period 2005-2010 and read through the narratives to identify those attributable to motor vehicle exhaust. We identified that 72% of those suicides were due to motor vehicle exhaust. We applied 0.72 to the 1,022 gas suicides in 2010 to estimate 735 MVCO suicides in 2010. We estimate that there are another 1,015 nonfatal MVCO attempts (applying the 0.42 case fatality ratio for gas suicidal acts reported by Spicer and Miller [2000] to the estimated 735 MVCO deaths); however, we are not attempting to model the impact of the intervention on potentially decreasing the medical severity of nonfatal attempts.

Parameter Estimates

We have located engineering reports on the technical ability of air quality monitoring devices to detect dangerous CO levels in motor vehicles but have seen no reports on the actual effectiveness of an engine shut-off device in averting suicides and accidental poisonings. In the absence of data, we are applying an 85% efficacy rate based on reports of "very good sensitivity" and a life of over six years for the device (Galatsis & Wlodarski, 2006).

A 2004 commentary by CDC staff, Strife & Paulozzi, described the device:

> A better approach might be a CO detector in motor vehicles that sounds an alarm and then slows the engine to a stop, allowing the accumulated CO to dissipate. Such an alarm should preferentially measure the cabin air rather than the air outside the motor vehicle. It should be difficult to tamper with and inexpensive to install. Such devices were actually recommended by the U.S. Centers for Disease Control in 1990 to prevent adolescent MVCO suicides.
>
> Technical details for such detectors for automobile passenger compartments were sketched out in a 1991 report from the Carnegie-Mellon Research Institute to the U.S. National Highway Traffic Safety Administration (NHTSA) and results of field tests with such devices have been published more recently. The Carnegie-Mellon report recommended the development of such devices and calculated that they could be mass produced for less than $12 apiece. (p.74)

Our model specifications are based on a theoretical scenario in which all motor vehicles in the U.S. have been outfitted with the device. Research is needed to learn whether car manufacturers and NHTSA have considered this device and its technical feasibility (e.g., are false alarms so common as to make them commercially unpopular?), and whether the price estimate (which remains low in a 2006 report) is accurate.

Fatal Re-attempt Estimates

Averting an MVCO does not necessarily save a life from suicide if the thwarted attempter fatally substitutes another method during the incident or at a later time. Unlike the case for firearms, we have neither ecologic nor case control data from which to estimate the overall suicide rate among people who have vehicles with vs. without the devices. Therefore we must estimate the fatal reattempt rate. We did this under two sets of assumptions:

1. **The fatal reattempt rate among those who attempt suicide will be *the same as* among people with a nonfatal MVCO attempt**. As part of a larger study that followed over 30,000 self-harm patients over an average of five years, Bergen et al., (2012b) observed people who attempted gas suicide (n=118) and found that eight (6.8%) completed suicide. This completion rate was five times higher than that for people who attempted suicide via an overdose. Bergen did not report a one year suicide rate. We inferred one based on applying the observation from Owens' review that 60% of suicides that occur within five years of an index attempt (by all methods combined) took place in the first year after the attempt.

2. **The fatal reattempt rate among those who attempt suicide will be *higher than* among people with a nonfatal MVCO attempt.** In the absence of CO-monitoring devices, the difference between those who die by MVCO and those who survive is likely a function not simply of external factors outside the attempter's control (engine stalling, unexpected rescue) but by differences in level and duration of suicidal intent. Therefore, basing fatal reattempt rates on

those observed for people surviving an MVCO attempt may under-estimate eventual suicides. We have little empirical evidence on which to base an alternate estimate, however. We use a thought experiment instead. There are two steps to the estimate: the reattempt rate and the case fatality ratio (CFR) for those re-attempts. We assume that after being thwarted from the MVCO attempt, the would-be completers will either immediately or relatively quickly re-attempt at a rate double the highest one-year reattempt rate observed in the Owens review (so 2 x 25%, or 50%). The case fatality for those attempts will depend in part on the CFR of the substituted method. Miller et al., (2013; submitted) observed that among self-harm patients who used "other" methods (that is, methods other than overdose or cutting), 45% of those who re-attempted continued to use "other" methods and 55% switched to cutting or overdose. Therefore, we assumed that among the 50% who re-attempt, 45% will use a higher-lethality method (average CFR of 70%) and 55% will use a low-lethality method (1–2% based on observational studies, but we inflated that to 5% assuming higher lethal intent). The overall one year suicide rate would therefore be (0.5 *0.45 * 0.7) + (0.5 * 0.55 * 0.05) = 17.1%. We assume that the higher lethal intent of would-be completers will be expressed either immediately (on the same day as the thwarted MVCO attempt or shortly thereafter) and that the rate in years two through five will be the same as observed in the Bergen study among people with a nonfatal MVCO attempt (or 17.1% plus the difference between the five year and one year rate in Assumption #1, or 17.1% + 2.7% = 19.8%).

Which assumption is the more logical?

It's impossible to know. The five-year completion rate of 6.8% seems low when one considers that people dying in a CO attempt used a high lethality method that involved some degree of technical maneuvering and allows an ambivalent attempter opportunity to back out mid-attempt. However, the upper range of eventual suicides according to Owen et al.'s review of some 70 studies that examined fatal outcomes was 11% (including one study that was limited to people who survived jumping in front of a London Underground train, a presumably high-intent attempt with a highly-lethality method). Further, a study of 30 people who survived a MVCO attempt (Skopek & Perkins, 1998) found that most survived not because of internal factors (like a mid-attempt change of heart), but due to external factors like engine failure or unexpected rescue. Exposure to the gas averaged 2.5 hours, and only four of the 30 called for help. In spite of this, and in spite of the fact that most knew their method had high lethality, suicide intent scores were relatively low, most people who attempted either did not plan the act or planned it the same day, plans (if any) were minimal, 60% had had an argument with an intimate partner, and 80% of people who attempted reported no longer feeling suicidal. These findings would suggest that while eventual attempt rates are likely to be higher than among people who attempt more generally, they are unlikely to be extremely high.

Results

Table G-4 presents results of the model. We estimate that if all motor vehicles had been equipped with the CO shut-off devices in 2010, among the 735 people who would otherwise have died by MVCO suicide, 519–600 lives will have been spared from suicide by the end of Year 1 and 500–583 would have been spared from suicide by the end of Year 2.

Table G-4. Results of Motor Vehicle Modeling.

Intervention	Population Group	Suicide Deaths Averted 1 Year	Suicide Deaths Averted 5 Year
All vehicles have CO-sensing engine shut-off devices (.85 efficacy)	MVCO suicide decedents in 2010	Lives saved minus fatal re-attempts	Lives saved minus fatal re-attempts
Model 1: Would-be MVCO completers have same fatal re-attempt rate as people with a nonfatal MVCO attempt (4.1% 1 year, 6.8% 5 year)	735	600	583
Model 2: Would-be MVCO completers have higher fatal re-attempt rate than people with a nonfatal MVCO attempt (17% 1 year, 20% 5 year)	735	519	500

Discussion/Gaps in Research Database

The purpose of this model is to estimate the number of lives in one year that could be saved from suicide in both the near and long term if all vehicles in the U.S. motor fleet were equipped with CO-sensing engine shut-off devices. It does not include the estimated 150 or so unintentional MVCO poisoning deaths that occur, for example in wintertime when people sit in an idling car unaware that the exhaust pipe is blocked by snow. As Strife & Paulozzi (2004) noted:

> … [T]he cost of the technology is lower than that of some other required automobile safety features that are designed to prevent smaller numbers of deaths. Tire pressure monitoring systems, for example, cost approximately $48 per vehicle. NHTSA has recently required such systems for American automobiles. NHTSA estimated that such systems could prevent approximately 124 deaths annually, many fewer than the 1,500 MVCO deaths that might be prevented by MVCO detectors.

There are a number of suicide research gaps identified through the process of developing this model. They include (but are not limited to): greater precision in defining the annual number of intentional MVCO poisoning deaths, characteristics of those decedents (recent access to care; history of prior attempts and by what methods), the degree of effectiveness of the CO detection mechanism, and whether individuals who survive a MVCO suicide attempt remain at risk for suicide, and if so, over what time period.

Table G-5. MV Exhaust deaths (E952.0, from CDC WONDER)

Year	Deaths	Population	Rate
1979	1,929	224,635,398	0.86
1980	1,998	226,624,371	0.88
1981	1,986	229,487,512	0.87
1982	2,032	231,701,425	0.88
1983	2,103	233,781,743	0.90
1984	2,210	235,922,142	0.94
1985	2,308	238,005,715	0.97
1986	2,450	240,189,882	1.02
1987	2,684	242,395,034	1.11
1988	2,247	244,651,961	0.92
1989	1,814	247,001,762	0.73
1990	1,877	248,922,111	0.75
1991	1,833	253,088,068	0.72
1992	1,706	256,606,463	0.66
1993	1,670	260,024,637	0.64
1994	1,618	263,241,475	0.61
1995	1,659	266,386,596	0.62
1996	1,508	269,540,779	0.56
1997	1,367	272,776,678	0.50
1998	1,329	276,032,848	0.48

Table G-6. Gas suicides (X67 Intentional self-poisoning by and exposure to other gases and vapors; from CDC WONDER)

Year	Deaths	Population	Rate
1999	1,535	279,040,168	0.6
2000	1,438	281,421,906	0.5
2001	1,442	284,968,955	0.5
2002	1,419	287,625,193	0.5
2003	1,356	290,107,933	0.5
2004	1,328	292,805,298	0.5
2005	1,265	295,516,599	0.4
2006	1,288	298,379,912	0.4
2007	1,299	301,231,207	0.4
2008	1,141	304,093,966	0.4
2009	1,092	306,771,529	0.4
2010	1,022	308,745,538	0.3

Model for Estimating Potential Population Health Outcomes from Psychotherapeutic Interventions for Persons Seen in an Emergency Department (ED) for Suicide Attempt[10]

Background

In 2010, suicide ranked as the 10th leading cause of death in the United States. Over 38,000 deaths occurred as a result of suicide in 2010, with an estimated 1.4 million years of potential life lost in recent years (O'Connor et al., 2013). The cost of suicide includes the significant pain and suffering of the individuals who die from suicide as well as the impact on their families and communities. In addition, there are significant medical costs and lost economic productivity associated with suicide (Yang & Lester, 2007). As the number of suicide deaths continues to climb and suicide rates remain stable despite myriad efforts to curb them, there is need for a fresh, population-based approach to suicide prevention in the U.S.

Rationale for Development of Population Health Outcome Estimates

The purpose of this report is to describe efforts to evaluate the potential population level health outcomes that could occur as the result of implementation of effective suicide prevention interventions. Suicide death and suicide attempt are relatively rare events and persons at risk for attempting or dying by suicide are particularly vulnerable populations. For these and other reasons, suicide is difficult to study and most individual studies evaluating suicide screening and treatment for persons at high risk of suicide have been relatively small. Yet, the toll of suicide is quite high, with devastating consequences to the individual and dramatic consequences for family members and friends of those who attempt and die from suicide. Thus, from a public health perspective there is significant need to understand the best strategies to reduce the risk of these events on a population basis.

In order to provide guidance to help to address this need, we developed a model to estimate the potential population health outcomes that could accrue from full implementation of effective suicide prevention interventions. While direct evidence from randomized controlled trials or other strong study designs is generally thought to provide the strongest evidence of effectiveness of an intervention, statistical modeling can aid understanding of the impact of an intervention in a broad population (Glass & McAtee, 2006; Leischow & Milstein, 2006; Mabry et al., 2008). In addition, modeling can help to systematically synthesize data from multiple sources and studies. Models clearly define alternatives, outcomes under consideration and make assumptions explicit so that they can be discussed and modified or tailored to specific needs or policy decisions. Since most studies of suicide screening and prevention are small and relatively short term, modeling provides a way to begin to understand what the population impact of implementing effective interventions might look like over the long term.

This work is based on modeling methods of the Australian National Health project Assessing Cost-Effectiveness (ACE; Vos et al., 2012; http://www.sph.uq.edu.au/docs/BODCE/ACE-P/ACE-Prevention_final_report.pdf). The ACE project used decision-analytic modeling to evaluate the relative costs and health outcomes associated with effective prevention interventions. Specifically the ACE project used evidence synthesis to evaluate health outcomes and developed estimates of cost using secondary data. The ACE approach then combined these estimates using modeling techniques to estimate the cost and value of alternative prevention strategies across the health system; including

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[10] Modeling effort led by Frances Lynch, Kaiser Permanente (with input from Catherine Barber, Matthew Miller, and the RPTF support staff).

evaluation of suicide prevention strategies (Mihalopoulos, 2009 unpublished manuscript). The focus of the ACE effort was to help inform public policy decision-making regarding prevention services in the Australian public health context. The ACE models included long-term effects modeled as quality-adjusted life years and included costs from the Australian health care perspective. The ACE analyses resulted in incremental cost-effectiveness ratios of cost per quality-adjusted life year for alternatives evaluated. In addition, the ACE project also laid out important contextual information not represented within the technical aspects of the modeling strategy. These were termed second stage filters and included qualitative evaluation of the strength of the evidence base; effects on equity; "feasibility" and "sustainability" in terms of work force considerations, financing mechanisms and health system structure; "acceptability" of the intervention to key stakeholders including clinicians, patients, and policy makers; and other important beneficial or harmful effects associated with the intervention not identified in the analyses.

The work presented in this report is an abbreviated version of the ACE approach. The ACE project spanned five years and was intended to be a comprehensive assessment of prevention services to improve population health. In contrast, the current effort is a relatively brief effort to illustrate the utility of this analytic approach vis-á-vis suicide prevention in the U.S. States, to help inform experts on the potential value of different strategies to reduce suicide, and to help identify gaps in current research that, if filled, could help to guide future suicide prevention efforts. For these reasons, we limited the current models to examine suicide deaths and suicide attempts averted in one- and five-year time frames.

Methods
The current work developed a decision-analytic model using the following six steps: 1) Define the specific question of interest, 2) Identify sources of data for the population and event parameter estimates (e.g., effectiveness of interventions), 3) Identify gaps in data, 4) Identify methods for handling research gaps, 5) Run and test models, and 6) Perform sensitivity analyses.

Question to Be Modeled
If we delivered evidence-based psychotherapeutic interventions designed to prevent suicide reattempt in ED settings, how many suicide attempts and deaths could we avert in one year? In five years?

Data Sources
Table G-7 describes all data sources for the population and model parameters applied. Population estimates were based on two sources. First, we estimated the total population of individuals who could potentially benefit from intervention using the U.S. Consumer Product Safety Commission (CPSC) injury surveillance and follow-back system known as the National Electronic Injury Surveillance System (U.S. Consumer Product Safety Commission National Electronic Injury Surveillance System). NEISS gathers data on injury from the ED of approximately 100 hospitals selected as a probability sample representing all 5,000+ U.S. hospitals with emergency departments. Since 2000, NEISS includes data on fatal and nonfatal injuries related to suicide. Information on other causes of death comes from the Center for Disease Control (Kochanek et al., 2012). Other research indicates that persons who attempt suicide also have much higher rates of death from other causes, particularly accidents.

To estimate the effectiveness of psychotherapeutic interventions for the prevention of suicide attempts and deaths, we used estimates from a recent systematic evidence review of suicide screening and prevention interventions generated by the Agency for Health Research and Quality (AHRQ)

Evidence Based Practice System to inform the U.S. Preventive Services Task Force (USPSTF; O'Connor et al., 2013).

The USPSTF review estimated the effectiveness of psychotherapeutic approaches to suicide prevention based on 19 psychotherapy trials with adults. The approaches included cognitive behavioral treatment (CBT), interventions that incorporate elements of CBT (e.g. dialectical behavior therapy DBT), and other non-CBT treatments such as psychodynamic or interpersonal therapy. Most of the trials included persons with a recent suicide attempt. The USPSTF review estimated that the effect for all adult psychotherapy trials reporting suicide attempts demonstrated a 32% reduction in the suicide attempts (relative risk [RR] = 0.68, 95% CI, 0.56 to 0.83). Because the studies observed few deaths, the report could not assess whether or not psychotherapeutic interventions reduced the risk of suicide deaths. The report noted some additional benefits of psychotherapy beyond reducing suicide attempts. Specifically, there was some evidence that psychotherapeutic interventions led to a reduction in depression symptoms and in the use of emergency services and inpatient care.

Gaps in Research Base
Our current estimates are limited by a number of gaps in the literature regarding suicide attempt and death in general, and due to limited information about the impact of the psychotherapeutic interventions. Key gaps are listed below.

Gaps related to population rates of suicide outcomes:

1. Of persons treated in U.S. ED settings for a suicide attempt, what proportion are people with first time attempt and what proportion are people with repeat attempts? In the U.K., Hawton and colleagues (2006) have proposed approaches for monitoring self-harm presentations to hospitals.
2. When a person has attempted suicide what is the risk of suicide attempt and/or death in the following year, five years, and 10 years? Analyses of self-harm patients followed over time in the United Kingdom are available (e.g., Owens et al., 2002), but U.S. data should be compared to those findings in order to examine possible differences in suicide attempt means and patterns of re-attempts. For instance, if a person has attempted multiple times but by different methods, how much does that increase risk of suicide attempt or suicide death? How do risks of multiple attempts vary by age group (youth, adult, older adult) in the U.S., as noted by Zahl & Hawton (2004) in the U.K.? Are there other important demographic subgroups in the U.S. (e.g., race, ethnicity, geographic region)?
3. What is the relationship between suicide ideation, suicide attempts not requiring medical care, suicide attempts requiring medical care, and suicide death over time?
4. Methods for estimating suicidal behavior and outcomes vary by data source which makes modeling more challenging. Large surveys, such as the Youth Risk Behavior Survey (YRBS), are very valuable sources of information, but may not accurately represent youths outside the sampling frame (e.g., those not attending school).

 Gaps related to knowledge about suicide prevention interventions:

1. Do effective psychotherapeutic interventions have long term effects? Do persons receiving interventions have reduced risk for multiple years or only for the first year after intervention?
2. Do effective psychotherapeutic interventions reduce the risk of suicide death as well as a suicide attempt? Most studies do not include long-term outcomes such as subsequent suicide death

because suicide death is relatively rare and most studies do not follow participants for more than one year.

3. If a person has received an intervention and has a new attempt, will repeating the intervention have any effect on later attempts?
4. Persons who attempt suicide also die of other causes at a much higher rate (Bergen et al., 2012). Do effective psychotherapeutic interventions for suicide prevention also reduce the risk of non-suicide death?
5. Are psychotherapeutic interventions effective for subgroups not represented in current literature, e.g., non-white populations? Most studies have not been large enough to provide subgroup analyses for many important subgroups, such as racial and ethnic subgroups.

Gaps related to implementation of suicide prevention interventions in health care settings:

1. Can effective psychotherapeutic interventions be reasonably implemented in typical health care settings (e.g., general medical of a health system)? What resources are needed to put the interventions into practice? How much training does staff need to implement interventions?
2. Would persons who have attempted suicide and present at the ED be willing to participate in the interventions that have been shown to be effective? What proportion of persons who present with a suicide attempt would be willing to participate? What resources does it take for persons to participate in the interventions (time, transportation, insurance)?
3. What settings are most likely to identify and/or care for persons at risk for suicide? Where do people who have attempted suicide go for care (e.g., primary care, mental health specialty care)? Are resources available at these care settings?

Addressing Gaps in Model

We used several approaches to address gaps in the model by reviewing the literature. In cases where high quality analyses were available, we used estimates from the literature. Specifically, in the case of risk of reattempt following a suicide attempt, we used findings from a review of international epidemiologic studies (Owens, Horrocks & House, 2002). For rates of acceptance or uptake of the intervention by people who attempt and come to the ED, we estimated that most (80%–100%) would take up the intervention since the level of care is high and patients would likely be willing to accept an intervention. However, this is not based on actual data regarding acceptance or uptake, as we know of no studies that have examined this in practice. For this reason we present two estimates to see how outcomes vary for the levels of this variable. Because there are so few data on the likely effectiveness of the interventions in subgroups, it was not possible to extrapolate to specific subgroups at this time.

Modeling Approach

The intervention was modeled to address the adult U.S. population in 2010 (the most recent year death data are available) who were seen in an ED for a suicide attempt and were 18 to 64 years of age. Definition of being seen for suicide attempt (as opposed to being seen for another concern) was determined by the NEISS surveillance system.

We chose age 18 as the lower age limit for our models because it is the commonly accepted threshold for legal adulthood and to date, there are no known effective, evidence-based suicide prevention interventions for children and adolescents. We chose 64 as the upper age limit because the lethality of suicide attempts rises substantially among individuals over age 64 years.

The number of people aged 18 to 64 who attempted suicide in 2010, as identified by the NEISS, were modeled through a Markov chain with one-year cycles for a period of five years or until they were predicted to have died. The comparator program is usual care. All persons enter the cycle with an attempt. However, some individuals may have had multiple attempts. We adjusted risk following epidemiologic work on risk of suicide death over time in the United Kingdom (Owens, Horrocks et al., 2002). This adjustment was required as the overall published annual rates of suicide attempt include multiple episodes of suicide attempt from the same person.

The model also adjusted for other causes of death using CDC data. The psychotherapeutic intervention arm of the model shows fewer people continuing to attempt post the index 2010 episode (the probability of deliberate self-harm for years two to five was adjusted by the RR of intervention effectiveness, including a decay rate where the intervention no longer has any effect after five years post the intervention).

We also estimated the total number of suicide attempts and deaths that could be averted over the one and five year time frames if the intervention was provided every year for five years to all persons coming to ED settings with a suicide attempt in each year.

Results

Table G-8 presents results of the model. Assuming that all adults age 18–64 years who attempt suicide and are subsequently treated in ED would accept the intervention, we estimate that over a one year time-frame, implementing evidence-based psychotherapeutic interventions would decrease the number of suicide attempts by about 18,737. If the intervention was offered over a five year time-frame, the intervention would reduce the number of attempts in this population about 109,306. Over a one year-time frame we estimate this would result in about 2,498 fewer deaths from suicide, and over a five year time-frame about 13,928 fewer suicide deaths.

Discussion

The purpose of this modeling effort is to provide a first step in understanding the potential population health outcomes that could be achieved through strategic public health efforts to reduce suicide attempts and deaths through full implementation of evidence-based interventions to persons who attempt suicide and are treated in ED. The results are likely optimistic for several reasons. First, some adults who attempt suicide and come to an ED may be unable or unwilling to participate in a psychotherapeutic intervention. It is unknown what the likely uptake or acceptance rate for such an intervention would be in typical ED settings. Second, these events are a relatively low occurrence compared to other emergent issues for any particular ED provider. Thus, it is uncertain as to what is the best method for managing the process within ED. Additional research about the best ways for ED providers to link persons with suicide attempt to evidence based psychotherapy are needed. It seems unlikely that a typical ED would be able to provide such services directly, so some type of referral system is likely needed. However, other measures may also be necessary to make sure that persons follow through with such care. In addition, the cost of providing evidence-based psychotherapy to this patient population has not been studied in previous research and information on the relative costs and effectiveness of these interventions could aid health systems in deciding what types of programs are possible to implement.

The current model is a first step in trying to understand potential population health outcomes for people who attempt suicide and are in ED settings. However, the model is limited by lack of data on some important aspects of care for persons with a suicide attempt. For example, few studies have had

sufficient sample sizes to provide evidence regarding the effectiveness of these interventions for many important subgroups. In addition there are very limited data on important outcomes such as the impact of psychotherapeutic interventions on long-term outcomes such as subsequent suicide death, or the risk associated with multiple suicide attempts.

In addition to the devastating consequences of suicide attempt to the person who demonstrates such behavior, suicide attempt and suicide death have dramatic consequences for family and friends of those who attempt and die from suicide and these consequences may have many important and lasting health implications for these people. These effects have not been captured in the current analysis and therefore the current results only include a partial representation of the health benefits of prevented suicides.

Table G-7.

Model Input Parameter Values for Psychotherapeutic Intervention in the Emergency Department (ED) Setting

Parameter	Values Used in Model	Source
POPULATIONS	Defines populations that might benefit from the intervention being evaluated	
Adults (ages 18-64) with past year suicide, and an **ED visit linked** to suicide attempt	390,359	NEISS 2010
RATES OF KEY EVENTS		
Proportion who attempt suicide and survive in year following attempt	15% in first year following attempt, cumulative risk at end of five years is 25%	Owens, Horrocks & House, 2002.
Proportion who die of suicide attempt in year following attempt	2% in first year following attempt, cumulative risk at end of five years is 3%	Owens, Horrocks & House, 2002.
Other causes death rate	Rate varies by age, average rate is 0.0073	CDC Website Kochanek et al., 2011. *NOTE: persons who attempt suicide may be much more likely to die of other causes, such as accidents (Bergen et al., 2012a)*
INTERVENTION RELATED PARAMETERS		
Efficacy of Intervention (Relative Risk)	RR = 0.68 (95% CI—0.56-0.83)	O'Connor et al., (2013)
Decay rate of Intervention Effectiveness	100% in Year 1, decays to zero by five years	ACE Suicide Review; Mihalopoulos personal communication
Hospital and ER based Clinicians are able to refer directly to PST	No delay in linking patients to services	ACE Suicide Review; Mihalopoulos personal communication
No Dose Effect of Intervention	Anyone receiving any intervention benefits at indicated efficacy	ACE Suicide Review; Mihalopoulos personal communication
Uptake of Intervention	Main Analysis 100%, Sub-analysis 80% Uptake refers to the number of people who are likely to accept the intervention Intentionally optimistic since task is to provide estimates of number of suicide attempts and suicide deaths that could be averted with optimal dissemination of evidence-based treatment	Input from RPTF staff

Table G-8.

Potential Population Health Outcomes for *Psychotherapeutic Interventions in Emergency Department (ED) Setting*

Adults 18-64 with Suicide Attempt Linked with an ED Visit

Problem Solving Therapy for Prevention of Repeat Suicide Attempts 100% Uptake RR=0.68 (95% CI— 0.56-0.83)					
	Estimated Suicide Attempts and Suicide Deaths Averted	*Actual Suicide Attempts Seen in ED*	*Estimated Percent of Total Attempts Averted*	*Actual Suicide Deaths Ages 18-64*	*Estimated Percent of Total Suicide Deaths Averted*
	Estimated Number	**NEISS 2010**		**WISQARS 2010**	
Non-fatal Suicide Attempts Averted in 1 Year	**18,737**	390,359	**5%**		
Non-fatal Suicide Attempts Averted in 5 Years	**109,306**	1,951,795	**6%**		
Suicide Deaths Averted in 1 Year	**2,498**			31,354	**8%**
Suicide Deaths Averted in 5 Years	**13,928**			156,770	**9%**
Problem Solving Therapy for Prevention of Repeat Suicide Attempts 80% Uptake RR=0.68 (95% CI — 0.56-0.83)					
	Estimated Suicide Attempts and Suicide Deaths Averted	**Suicide Attempts Seen in ED**	**Estimated Percent of Total Attempts Averted**	**All Suicide Deaths Ages 18-64**	**Estimated Percent of Total Suicide Deaths Averted**
	Estimated Number	**NEISS 2010**		**WISQARS 2010**	
Non-fatal Suicide Attempts Averted in 1 Year	14,990	390,359	4%		
Non-fatal Suicide Attempts Averted in 5 Years	84,447	1,951,795	4%		
Suicide Deaths Averted in 1 Year	1,999			31,354	6%
Suicide Deaths Averted in 5 Years	11,146			156,770	7%

Model for Potential Suicide Related Population Health Outcomes from Early School-based Prevention in Young Children[11]

Background

In 2010, suicide ranked as the third leading cause of death for youth aged 15–24 in the U.S. (WISQARS 2013). Close to 3,600 deaths occurred as a result of suicide in youth ages 13–22 in 2010 (WISQARS 2013). The cost of youth suicide includes the significant pain and suffering of the individuals who die from suicide as well as the impact on their families, peers, and communities. The resulting human and economic costs related to youth suicide are large. In addition to the loss of life due to suicide death, many additional youth experience a non-fatal attempt, with 2.4% of high school aged youth making an attempt requiring medical treatment, and 7.8% having any type of attempt. Intervention programs for youth at high risk, such as those who have already indicated suicide ideation are an important strategy to reduce the burden related to suicide (HHS, 2012). However, it may also be important to try to mitigate known risk factors for suicidal behavior in youth before suicide behavior is manifested. Effective broad-based early prevention programs, such as the Good Behavior Game (GBG) (e.g., Kellam et al., 2008) or The Incredible Years program (Webster-Stratton et al., 2011) have been demonstrated to reduce risks known to be associated with teen suicide such as mental health conditions (e.g., depression, impulsive or aggressive behavior), drug and/or alcohol abuse, and school failure. Elementary schools provide a setting to reach most youth.

Recent evidence suggests that the GBG intervention delivered to elementary school aged children significantly reduces suicidal ideation and suicide behaviors during adolescence and young adulthood (Wilcox et al., 2008). The GBG is an approach that teachers use in the management of classroom behaviors that rewards children for displaying appropriate on-task behaviors during instructional times. It is a classroom-wide game format with teams and rewards. It has been found to reduce aggressive, disruptive classroom behavior, which is a risk factor for adolescent and adult illicit drug abuse, alcohol abuse, cigarette smoking, antisocial personality disorder, and violent and criminal behavior.

Rationale for Development of Population Health Outcome Estimates

The purpose of this report is to describe efforts to evaluate the potential population level health outcomes that could occur as the result of implementation of effective suicide prevention interventions. Suicide death and suicide attempt are relatively rare events and persons at risk for attempting or dying by suicide are particularly vulnerable populations. For these and other reasons, suicide is difficult to study and most individual studies evaluating suicide screening and treatment for persons at high risk of suicide have been relatively small. Yet, the national toll of suicide is quite high, with devastating consequences to the individual and dramatic consequences for family members and friends of those who attempt and die from suicide. Thus, from a public health perspective there is significant need to understand the best strategies to reduce the risk of these events on a population basis.

In order to provide guidance to help to address this need, we developed a model to estimate the potential population health outcomes that could accrue from full implementation of effective suicide prevention interventions. While direct evidence from randomized controlled trials or other strong study designs is generally thought to provide the strongest evidence of effectiveness of an intervention, statistical modeling can aid understanding of the impact of an intervention in a broad population (Glass

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[11] Modeling effort led by Frances Lynch, Kaiser Permanente.

& McAtee, 2006; Leischow & Milstein, 2006; Mabry et al., 2008). In addition, modeling can help to systematically synthesize data from multiple sources and studies. Models clearly define alternatives, outcomes under consideration and make assumptions explicit so that they can be discussed and modified or tailored to specific needs or policy decisions. Since most studies of suicide screening and prevention are small and relatively short term, modeling provides a way to begin to understand what the population impact of implementing effective interventions might look like over the long term.

This work is based on modeling methods from the Australian National Health project Assessing Cost-Effectiveness (ACE; Vos et al., 2012; http://www.sph.uq.edu.au/docs/BODCE/ACE-P/ACE-Prevention_final_report.pdf). The ACE project used decision-analytic modeling to evaluate the relative costs and health outcomes associated with effective prevention interventions. Specifically the ACE project used evidence synthesis to evaluate health outcomes and developed estimates of cost using secondary data. ACE researchers then combined these estimates using modeling techniques to estimate the cost and value of alternative prevention strategies across the health system; including evaluation of suicide prevention strategies (Mihalopoulos, 2009 unpublished manuscript). The focus of the ACE effort was to help inform public policy decision-making regarding prevention services in the Australian public health context. The ACE models included long-term effects modeled as quality-adjusted life years and included costs from the Australian health care perspective. The ACE analyses resulted in incremental cost-effectiveness ratios of cost per quality-adjusted life year for alternatives evaluated. In addition, the ACE project also laid out important contextual information not represented within the technical aspects of the modeling strategy. These were termed second stage filters and included qualitative evaluation of the strength of the evidence base; effects on equity; "feasibility" and "sustainability" in terms of work force considerations, financing mechanisms and health system structure; "acceptability" of the intervention to key stakeholders including clinicians, patients, and policy makers; and other important beneficial or harmful effects associated with the intervention not identified in the analyses.

The work presented in this report is an abbreviated version of the ACE approach. The ACE project spanned five years and was intended to be a comprehensive assessment of prevention services to improve population health. In contrast, the current effort is a relatively brief effort to illustrate the utility of this analytic approach vis-a-vis suicide prevention in the U.S. States, to help inform experts on the potential value of different strategies to reduce suicide, and to help identify gaps in current research that, if filled, could help to guide future suicide prevention efforts. For these reasons, we limited the current models to examine suicide deaths and suicide attempts averted. In the case of early intervention with young children we recognized that we would not expect changes in suicide attempts and deaths in a short timeframe. For this reason we estimated outcomes over a 15 year time frame rather than in one- and five-year time frames used in models of adult preventive interventions.

Methods
The current work developed a decision-analytic model using the following six steps: 1) Define the specific question of interest, 2) Identify sources of data for the population and event parameter estimates (e.g., effectiveness of interventions), 3) Identify gaps in data, 4) Identify methods for handling research gaps, 5) Run and test models, and 6) Perform sensitivity analyses.

Question to Be Modeled
If we delivered evidence-based early intervention programs designed to mitigate important risk factors for mental health problems, including suicide related outcomes, how many suicide attempts and deaths could we avert over a 15 year period? Specifically, we illustrate possible outcomes using one

evidence-based early intervention, the GBG (developed by Barrish et al., 1969; suicide attempt outcomes as described by Wilcox et al., 2008).

Data Sources

Table G-9 describes all data sources for the population and model parameters applied. Population estimates were based on the following sources. First, we estimated the total population of children eligible for the intervention using data from the U.S. Department of Education (Keaton, 2012, Table 1). Specifically, we used data on the total number of children enrolled in the first grade in 2008. To estimate the number of suicide attempts requiring medical care for youths aged 13–22, we used two sources of data. For youths 13–18 we used data from the YRBS to estimate the number of suicide attempts requiring medical care. The YRBS sample consists of youth in public and private schools in at least one grade 9–12. Thus, the YRBS does not provide estimates of suicide attempt for young adults 19–22. To estimate suicide attempts requiring medical care in ages 19–22 we used data from the NSDUH. To estimate suicide deaths we used data from the CPSC injury surveillance and follow-back system known as the National Electronic Injury Surveillance System (NEISS). NEISS gathers data on injury from the ED of approximately 100 hospitals selected as a probability sample representing all 5,000+ U.S. hospitals with emergency departments. Since 2000, NEISS includes data on fatal and non-fatal injuries related to suicide. Information on other causes of death comes from the CDC (Kochanek et al., 2011).

To estimate the effectiveness of early intervention in young children for the prevention of suicide attempt and death we chose to focus on one prevention program that has been demonstrated to reduce the risk of suicide attempt (Wilcox et al., 2008).

Wilcox and colleagues (2008) reported the estimated effectiveness of the GBG intervention received in first grade on the risk of suicidal behavior through age 21. They estimated that the effect for children receiving the more intensive version of the GBG as a 50% reduction in the suicide attempts (relative risk [RR] =0.50, 95% CI, 0.30 to 0.90). Because the study observed few deaths, the study could not assess whether or not the intervention reduced the risk of suicide death. To illustrate the possible impact of receiving the GBG on suicide death, we examined how the suicide deaths might be impacted if the intervention had a small effect on suicide death. Specifically we modeled the impact on suicide death if the intervention led to a 10% decrease in the rate of suicide death rate for those receiving the intervention.

Gaps in Research Base

Our current estimates are limited by a number of gaps in the literature regarding suicide attempt and death in general, and due to limited information about the impact of the early interventions on suicide outcomes, particularly suicide death. Key gaps are listed below.

Gaps related to population rates of suicide outcomes:

1. Of U.S. youth who make a suicide attempt requiring medical care, what proportion are people with a first time attempt and what proportion are people with repeat attempts?
2. When a youth has attempted suicide what is the risk of suicide attempt and/or death in the following year, five years, and 10 years? Hawton et al. (2012) have described repeat rates of 27% over two to five years among self-harm among children and adolescents in the U.K. Mortality was 0.9% after a median follow-up period of six years, with half of the deaths involving suicide. In the U.S., few data sources are accessible that estimate the frequency of

re-attempts. How much does a prior attempt increase the risk of a later suicide death? Are risks higher for youth who first attempt at an earlier age? Do risks of multiple attempts vary by age group (youth, adult, older adult) or other important subgroups?

3. What is the relationship between suicide ideation, suicide attempts not requiring medical care, suicide attempts requiring medical care, and suicide death for children and youth? How do these outcomes interact over time?
4. Methods for estimating suicidal behavior and outcomes vary by data source which makes modeling more challenging. Large surveys such as the YRBS are very valuable sources of information, but may not accurately represent youths outside the sampling frame.

Gaps related to knowledge about suicide prevention interventions:

1. What is the relationship of early intervention to onset of suicide related outcomes?
2. When do effects first appear? Are effects constant over time? How long does the effect last?
3. Do effective early interventions reduce the risk of suicide death as well as suicide attempt? Most studies do not include long-term outcomes such as subsequent suicide death because suicide death is relatively rare.
4. Would multiple years of intervention reduce suicide risks more?
5. Persons who attempt suicide also die of other causes at a much higher rate (Bergen et al., 2012a). Do early intervention programs such as the Good Behavior Game reduce the risk of non-suicide death?
6. Are early intervention programs effective for subgroups not represented in current literature? Are they effective for high risk children only?

Gaps related to implementation of suicide prevention interventions in typical settings:

1. Can effective early interventions, such as the GBG, be implemented in the intensive way that has been shown to be effective in research studies in typical education settings (e.g., typical public school classroom)? What resources are needed to put the interventions into practice? What are the costs to the schools to implement this type of program in a rigorous way?
2. What proportion of children should receive these early intervention programs? Which children?

Addressing Gaps in Model

We used several approaches to address gaps in the literature. In cases where high quality analyses were available, we used estimates from the literature. Specifically, in the case of risk of reattempt following a suicide attempt, we used findings from an epidemiologic study in the U.K. (Owens, Horrocks & House, 2002; Hawton et al., 2012). For rates of acceptance or uptake of the intervention we assumed that not all U.S. children would receive the intervention, specifically we estimated that only 25% would receive the intervention since the program requires buy in by schools, families, and classroom teachers. In particular, since the program that was shown to be effective was a more intensive version, we expected that many schools might not participate or might not provide an intense enough version of the program to achieve the effects demonstrated in the research study. However, this is not based on actual data regarding acceptance or uptake by schools, since there are no known studies that have examined this in practice. Because there is minimal data on the likely effectiveness of the interventions in subgroups, it was not possible to extrapolate to specific subgroups at this time.

Modeling Approach

The intervention was modeled to address the youth population in the United States in 2010 (the most recent year NEISS data with associated death data are available). The definition of receiving medical care for a suicide attempt (as opposed to being seen for another concern) was determined by the YRBS. We chose 13 as the lower age limit for our models because WISQARS/CDC data indicate that estimates of suicide death are unstable for youth under the age of 13. State reports indicate that there are clearly suicide deaths earlier than age 13, but rates are low and unstable. We chose 22 as the upper age limit because the research to date has examined the impact of the example early intervention (the Good Behavior Game, Wilcox et al., 2008), through age 21.

The number of first grade children who could be eligible for early intervention in 2008 (Keaton, 2012) was modeled through a Markov chain with one-year cycles for a period of 15 years or until they were predicted to have died. We summed the outcomes for 15 cohorts of children over the 15 years, with an additional cohort of children receiving the intervention in each consecutive year. Each cohort receiving the intervention represents 25% of all first graders in that year. The comparator program is no early intervention. We adjusted risk following epidemiologic work on risk of suicide death over time in the United Kingdom (Owens, Horrocks, et al., 2002). This adjustment was required as the overall published annual rates of suicide attempt include multiple episodes of suicide attempt from the same person. The model also adjusted for other causes of death using CDC data.

Results

Table G-10 presents results of the model. Assuming that over 15 years, 25% of first grade children in each of 15 cohorts of first graders would receive the GBG intervention, we estimate that overall we could avert about 542,096 suicide attempts requiring medical care and 687 suicide deaths.

Discussion

The purpose of this modeling effort is to provide a first attempt to understand the potential population health outcomes related to suicide behavior that could be achieved through expanded implementation of evidence-based early childhood prevention interventions such as the GBG. However, the model is limited for several reasons. First, current research data have not examined the impact of the GBG, or other early intervention programs on suicide death. Nor do we have robust data on the relationship between suicide attempt and suicide death in youth, so it is difficult to estimate the likely impact of early intervention on subsequent suicide death. Second, we do not have good estimates of suicidal behavior in children younger than 13 years old, and early intervention is likely to improve outcomes for these younger children. In addition, the cost of providing evidence based early intervention to children has not been studied in previous research and information on the relative costs and effectiveness of these interventions could aid education systems in deciding what types of programs are possible to implement. Further, it is critical to recognize that early intervention programs provide many health and social benefits beyond reductions in suicide behavior, so these interventions may provide particularly efficient ways to enhance prevention of suicide in youth. However, effectiveness estimates used in the current model are based on a relatively intensive version of the GBG intervention (Wilcox et al., 2009), and it is unclear whether schools would be willing to adopt or have the resources necessary to implement the intervention in this more intensive manner. It is also unknown what proportion of children would be likely to receive the intervention in typical school settings.

In addition to the devastating consequences of suicide attempt to the person who demonstrates such behavior, suicide attempt and suicide death has dramatic consequences for family, friends, and peers of youth who attempt and die from suicide and these consequences may have many important and lasting

health implications for these people. These effects have not been captured in the current analysis and therefore the current results only include a partial representation of the health and social benefits of prevented suicides.

Table G-9.

Model Input Parameter Values for Early Intervention Model: Good Behavior Game in First Grade Children

Parameter	Values Used in Model	Source
POPULATIONS	Defines populations that might benefit from the intervention being evaluated.	
School Age Children in first grade (ages 6)	3,750,000 first grade children (25% of kids receive GBG intervention)	U.S. Department of Education—Number of First Graders
INTERVENTION RELATED PARAMETERS		
Relative Risk for SUICIDE ATTEMPT	RR=0.50 (95% CI—0.3-0.9)	Wilcox et al., 2008 (page 11); Kellam et al., 2011.
Relative Risk for SUICIDE DEATH	Assume 10% decrease in suicide death rate	Literature does not provide estimate of impact on suicide deaths **ACTUAL RATE IS UNKNOWN**
RATES OF KEY EVENTS		
Rate of reported suicide attempt with medical care	Varies by age group; Average rate is 2.1%	YRBSS 2010 for ages 14-18; NSDUH 2010 for ages 19-22
Rate of suicide death from ages 13-22 (up to 15 years post-intervention)	Varies by age group; Average rate across 13-22 age range is 7.9/100,000	WISQARS actual number of suicide deaths ages 13-22 in 2010
NO suicide attempts or deaths prior to age 13		WISQARS notes that prior to age 13, estimates are unstable. No deaths or attempts prior to this age.
Proportion who attempt suicide and survive in year following attempt	15% in first year following attempt; cumulative risk at the end of five years is 25%	Owens, Horrocks & House, 2002.
Proportion who die of suicide attempt in year following attempt	2% in first year following attempt; cumulative risk at end of five years is 3%	Owens, Horrocks & House, 2002.
Other Causes Death Rate	0.0006	CDC Website; Kochanek et al., 2011. Adults with suicide attempts may have increased risk of other causes of death (Bergen, et al., 2012); uncertain if pertains to children.
No Dose Effect of Intervention	Anyone receiving any intervention benefits at indicated efficacy	ACE Suicide Review; Mihalopoulos personal communication
Uptake Intervention	25% receive full intervention as delivered in Wilcox et al., 2008.	

Table G-10.

Potential Population Health Outcomes for *Early Childhood Intervention*

Good Behavior Game for Children in First Grade

	Good Behavior Game Provided to 15 Cohorts of First Graders *25% of First Grade Children Receive the Intervention* RR=0.50 (95% CI – 0.3-0.9) for Suicide Attempt				
	Estimated Suicide Attempts and Suicide Deaths Averted	*Expected Suicide Attempted Requiring Medical Care Ages 13-22*	*Estimated Percent of Total Attempts Averted*	*Expected Suicide Deaths Ages 13-22*	*Estimated Percent of Total Suicide Deaths Averted*
	Estimated Number	**YRBS 2010/ NSDUH 2010**		**WISQARS 2010**	
Non-fatal suicide attempts averted in 15 years following Intervention	**542,096**	4,345,125	**12%**		
Suicide deaths averted in 15 years following Intervention	**687**			14,425	**4.8%**

YRBS = National Youth Risk Behavior Survey
NSDUH = National Survey on Drug Use and Health
WISQARS = Web-based Injury Statistics Query and Reporting System

Model for Revisiting the Impact of Mental Health Parity Laws on Suicide[12]

Background

The recent trends in suicide are well documented. There were over 38,000 suicides in 2010, up from 29,350 in 2000. Suicide rates increased from 10.43 to 12.43 between 2000 and 2010. Suicide is the 3rd leading cause of death among those aged 15 to 24 years old (CDC, 2012).

In order to better understand the relationship between access to mental health care and mental health outcomes such as suicide morbidity and mortality, researchers have examined Mental Health Parity laws. In the mid-1990s, the first parity laws were enacted and required insurance coverage to include mental health benefits at the same rates and terms as physical health benefits. Because the state laws were enacted at varying levels of strength and at different times, they provide researchers with an opportunity to explore whether increasing access to mental health care has a significant impact on suicide rates.

This paper explores how enacting parity laws impacts suicide rates between the years of 1990 to 2010. Previous research on the effect of the parity laws over different time periods is mixed. Klick and Markowtiz (2006) used data between 1980 and 2000 and found that when states enacted parity laws, the suicide rates in the state did not change significantly. Lang (2013) extended the analysis to 2004 and captured the effect of 20 states enacting mental health laws between 2000 and 2002. He finds that enacting parity laws is associated with a significant decrease in suicide rates.

By extending the analysis to 2010, this paper is able to explore the long-term impact of parity laws more accurately. Furthermore, a number of states have enacted parity laws since 2004 and their effect is captured in the analysis below. The results show that mental health parity laws significantly decrease suicide rates when analyzed between 1990 and 2010. Suicide rates decrease significantly the year after the parity law is enacted, but return to their pre-enactment levels in the following years. The findings suggest that access to mental health care can play an important role in mental health outcomes, such as suicide.

Mental Health Parity Laws

In 1996, the Federal Mental Health Parity Act was passed. The law stated that health insurance plans could not set different annual and lifetime limits for mental and physical health care. Although the law did not require mental health insurance coverage to be included in health insurance packages, it appeared to have provided support for mental health advocates at the state level (Otten, 1998). In 1996, 11 states had enacted mental health insurance laws. By 2002, 45 states had enacted mental health parity laws and currently Wyoming is the only state that does not have a mental health insurance law.

Mental health parity is about making benefits for mental health problems comparable to physical health problems. While mental health laws are often referred to as parity laws, the strength of the laws vary considerably from state to state. The strongest parity laws, called 'Parity Laws' in this analysis, require insurance companies to provide mental health coverage at the same rates and terms as physical health coverage. This paper also places the four states with mandated offering laws into the parity law category. Mandated offering laws require insurance packages to offer mental health coverage at parity with physical health. Although the mandated offering law leaves the decision about carrying mental

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[12] Modeling effort developed by Matthew Lang, PhD, Xavier University.

health coverage up to the consumer, it provides access to mental health care at parity. Thirty-four states fall into the parity law category.

Another common type of mental health law is called a 'Minimum Mandated Benefit Law.' Minimum mandated benefit laws require insurance companies to provide mental health coverage, but the coverage does not need to be at parity with physical health. An example of this is Nevada, where insurance must cover at least 40 days of inpatient and outpatient mental health treatment and the copayments cannot be more than 150% of the out-of-pocket expenses of physical health treatment. Because the patient's financial burden of mental health care is greater under this type of law, it is considered a weaker law than a parity law.

A final mental health law category is 'Mandated if Offered Laws.' Mandated if offered laws require a certain amount of mental health coverage, that is conditional on mental health coverage being part of a health insurance plan. It is possible for insurance packages to not include any mental health coverage under a mandated if offered law. Because mental health coverage is not required under mandated if offered laws, it is also considered a weaker law than a parity law.

Although the language of mental health laws varies, states can be grouped into three general categories: Parity Law States, Weak Law States and No Law States. The parity law states include states that have enacted parity laws or mandated offering laws. The weak law states have enacted minimum mandated benefit laws or mandated if offered laws. The distinction between parity law and weak law states is useful in identifying how access to mental health care is related to changes in the suicide rate. If access to mental health care is an important determinant of suicide, enacting a parity law is expected to lead to a significant decrease in suicide rates.

Figure G-1 shows the growth in mental health parity laws between 1990 and 2010. The black line represents the suicide rate in the U.S. in a particular year. The gray line shows the fraction of the U.S. population that lives in a state with a parity law. Between 1996 and 2002, there is a significant increase in the fraction of the population with access to mental health care. The suicide rate is falling from 1993 to 2000 before beginning to increase again. There is a noticeable rise in the national suicide rate beginning in 2007, which corresponds with worsening economic conditions.

Figure G-1: Suicide Rates and Access to Mental Health Care
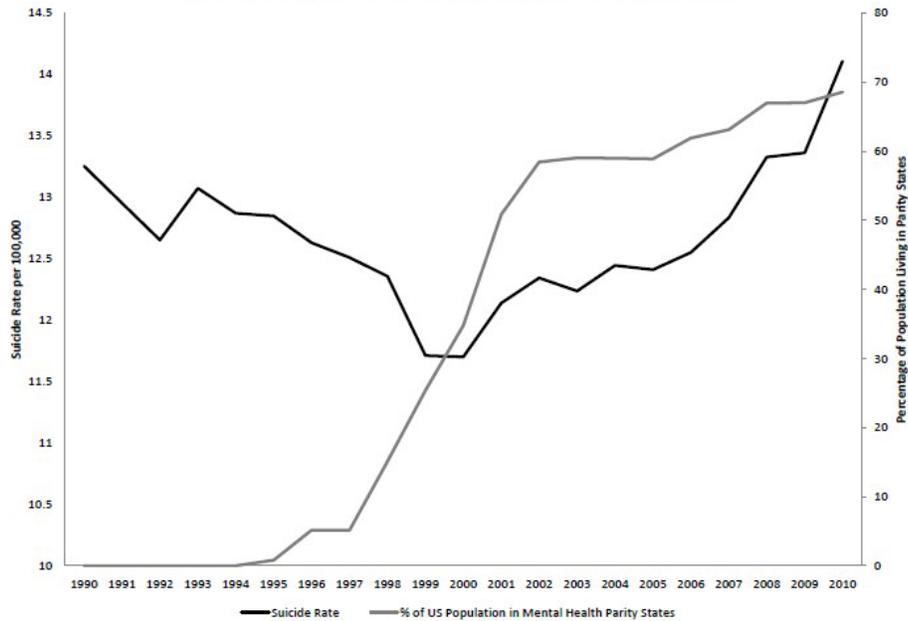
Data and Results

The data in the analysis come from a number of sources. Annual suicide data are from the Multiple Cause-of-Death Public-Use Files, published by the National Center for Health Statistics (CDC, 2012). Suicide data from 1990 to 2010 are used for every state and the District of Columbia for a total of 1,071 state-year observations.

States are classified based on whether they have a parity law, mandated offering law, minimum mandated benefit law or mandated if offered law. State statutes and bills containing information on the mental health law are used to classify the states. The National Conference of State Legislatures (NCSL; 2012) and National Alliance on Mental Illness (NAMI; 2009) both have documents with information on state mental health laws, but state statutes and bills occasionally differ with the NCSL and NAMI rankings. (Specific information on the source of the laws is available from Dr. Lang on request by emailing him at langm1@xavier.edu).

A number of time-varying characteristics that may influence the suicide rate are controlled for in the analysis below. The unemployment rate is retrieved from the Bureau of Labor Statistics (2013), the income per capita is from the Bureau of Economic Analysis (2013) and bankruptcy information is from the U.S. Courts (U.S. Courts, 2013). The regression results below are able to control for any time-invariant state characteristics that may impact suicide rates, such as attitude towards mental health care, using a fixed-effects specification.

Table G-11 shows summary statistics for the data. The suicide rate per 100,000 in the data is 11.44 between 1990 and 2004. Columns 2 and 3 show how the suicide rate in parity states changes before and after the enactment of a law. Prior to enacting a parity law, the average suicide rate in parity states was 11.08 per 100,000. After the enacting of a parity law, the average suicide rate fell to 10.36 per 100,000 in a parity state. Non-parity states had an average of 13.03 suicides per 100,000 over the entire dataset.

Information on the unemployment rate, income per capita and bankruptcy rate are also reported in Table G-11. The average unemployment rate in the data is 5.79 and the average income per capita is 36,660 dollars. The average bankruptcy rate is 434.19 per 100,000 and is relatively stable in parity states before and after the enacting of a law.

Table G-11. Summary Statistics

Variables	All States All Years	Parity States Before Enactment	Parity States After Enactment	Non-Parity States All Years
Suicide Rate per 100,00	11.44	11.08	10.36	13.03
	(2.74)	(2.43)	(2.75)	(2.28)
Unemployment Rate	5.79	5.78	5.85	5.74
	(1.88)	(1.56)	(2.06)	(2.01)
Real Income per Capita (10,000s)	36.66	32.11	43.66	33.71
	(9.07)	(6.47)	(5.81)	(9.73)
Bankruptcy Rate per 100,000	434.19	422.20	429.47	452.46
	(199.34)	(164.85)	(218.51)	(209.89)
States	51	34	34	17
	1,071	352	362	357

Note: Standard deviations are reported in parentheses and means are weighted by population.

The fact that average suicide rate decreased in parity states after the enacting of parity law is evidence that parity laws are associated with reductions in suicide (Lang, 2013). At the same time, Table G-11 is unable to rule out whether the decrease in suicide is driven by other factors such as an increase in income per capita.

In order to more accurately understand how enacting parity laws are related to state suicide rates, the change in state suicide rates should be examined before and after the enacting of a parity law. This can be done by running a fixed effects regression. The following regression

$$\ln S_{i;t} = \beta_0 + \beta_1 Parity_{i;t} + \beta_2 Weak_{i;t} + \_X_{i;t} + {}_i + \textstyle\prod_t + {}^{“}_{i;t}$$

runs the natural log of the suicide rate in state in year on whether they have a parity law or a weak law and a matrix of control variables $X_{i,t}$, including the unemployment rate, income per capita and the bankruptcy rate. State fixed effects, Y_i, are a set of binary variables for each state. The state fixed effects capture characteristics that are constant within a state over time, but vary from state to state, such as historical mental health initiatives. Time fixed effects, $\prod_t$, control for shocks that are common to all states but vary over time, such as the average price level or expectations about the national economy.

The variable of interest in the regression equation is β_1, which is interpreted as the average percentage change in the suicide rate that occurs when a state without a law, enacts a parity law. If a parity law is effective in reducing suicides, β_1 will be negative and significant.

Table G-12. Mental Health Parity Laws and Suicide Rates

Variables	(1)	(2)	(3)	(4)
Parity Law	-0.066***	-0.044***	-0.057***	-0.044***
	(0.0084)	(0.0084)	(0.010)	(0.0084)
Weak Law	-0.0014	-0.0038		
	(0.0085)	(0.0081)		
Minimum Mandated Benefit Law				0.0012
				(0.0090)
Minimum Offering Law				-0.017
				(0.013)
Unemployment Rate		0.0038		0.0039
		(0.0024)		(0.0024)
Income Per Capita (1000s)		-0.0048***		-0.0049***
		(0.0012)		(0.0012)
Bankruptcy Rate		0.00013***		0.00013***
		(0.000019)		(0.000019)
State and Year Fixed Effects	Yes	Yes	Yes	Yes
	1,071	1,071	714	1,071
	0.939	0.944	0.931	0.944

*** p<0.01, ** p<0.05, * p<0.1: Standard errors, in parentheses, are clustered at the state level. The dependent variable in all regressions is the natural log of the suicide rate. All regressions include state and year fixed effects. Columns 1, 2, and 4 contain all states. Column 3 only contains stated that enacted parity laws.*

Table G-12 presents the results of the fixed effects regressions. In column 1, only state and time fixed effects are included and the control variables are omitted. The coefficient of -0.066 on the parity law variable suggests that the suicide rate is 6.6% lower in a state when there is a parity law, relative to having no law enacted. Standard errors, clustered at the state level, are reported in parentheses and corrects for autocorrelation within states over time (Bertrand et al., 2004). When a state enacts a weak law, there is no impact on the suicide rate, as the coefficient on the weak law variable is relatively small at -0.0014 and insignificant.

Column 2 includes controls for unemployment, income and bankruptcy. The parity law coefficient remains negative and significant, while the weak law is still small and insignificant. The unemployment rate is not significantly related to the suicide rate, but increases in income per capita are associated with a decrease in the suicide rate. The bankruptcy rate is positively related to the suicide rate.

The first two regressions contain all states. It can be argued that there is an inherent difference between parity states and weak states, as parity states have enacted a stronger mental health law. Column 3 shows that if only parity states are used in the regression, enacting a parity law is associated with a significant decrease in the suicide rate.

The final regression in column 4 splits the weak law into two categories: Minimum Mandated Benefit Laws and Minimum Offering Laws. The results show that enacting either of the weak laws does not significantly change the suicide rate, relative to having no law. The parity law coefficient remains negative and significant.

Overall, Table G-12 shows that enacting a parity law is associated with a significant decrease in the suicide rate and the results are comparable to previous studies (Lang, 2013). The fact that weak laws are

not significantly related to suicide does not suggest that weak laws do not have an impact on mental health illness. There may only be a limited number of instances where the weak laws prevented a suicide and when the analysis is aggregated to the state level, picking up these reductions becomes difficult. If data was available for less severe outcomes, the weak laws may become more relevant in the analysis.

Despite the significant findings in Table G-12, it is still possible that the enacting of parity laws is picking up a general trend in suicides. If states experience a downward trend prior to enacting a parity law, it is possible that suicide rates would have decreased even if the law was never enacted. If states were seeing a strong upward trend in suicide prior to enacting a parity law, a subsequent decrease could be the result of other social policies in conjunction with the parity law.

To better understand the suicide pattern prior to the enacting of a parity law, the first row of Table G-13 shows the percentage difference in the suicide rate between the year the law was enacted and prior years. For example, under the heading '4,' the coefficient of -0.0036 is interpreted as the average difference in the suicide rate between the enactment year and four years before the enactment year. The insignificant coefficients suggest that there was no discernible suicide pattern prior to a law enactment.

Table G-13. Trends in Suicide Before and After Enacting a Parity Law, Relative to No Law

Years before enactment					
	5+	4	3	2	1
Log difference in suicide rate	0.017	-0.0036	-0.00026	0.020	0.017
Relative to enactment year	(0.023)	(0.022)	(0.020)	(0.018)	(0.017)
Years after enactment					
	1	2	3	4	5+
Log difference in suicide rate	-0.037**	-0.015	0.017	-0.0030	0.0025
Relative to enactment year	(0.016)	(0.015)	(0.015)	(0.014)	(0.014)

*** $p<0.01$, ** $p<0.05$, *$p<0.1$: Standard errors, in parentheses, are clustered at the state level. Regression only contains parity states and includes states and year fixed effects and demographic controls.

The second row of results in Table G-13 shows the difference in suicide rates between the enactment year and the years following enactment. One year after the enactment, suicide rates fall by 3.7% relative to the year of enactment. The effect becomes small and insignificant two or more years after the enactment year. According to Table G-13, there does not appear to be a trend suicide prior to the enacting of a law. The significant decrease in suicides associated with parity laws found in Table G-12 is driven primarily in the first years following the law enactment.

The coefficient in Table G-13 can be used to better understand how many suicides are prevented as a result of the parity laws. The average suicide rate in the parity states in the year of enactment was 10.2 per 100,000 and the total population in the states was 188.9 million. From these numbers, roughly 19,276 suicides occurred in these states the year of enactment. A 3.7% reduction in suicides decreases the suicide rate to 9.82 per 100,000, which converts to approximately 713 suicides prevented as a result of the parity laws in the year after enactment.

Discussion

The results above show that increasing access to mental health care through parity laws can lead to a significant decrease in suicide rates. The effect is most prominent in the years immediately after enactment.

The results also have implications for the federal 2008 Mental Health Parity Act, which has made all minimum mandated benefit states become parity states. In the tables above (statistical analysis not shown), a parity law affects suicide significantly more than a weak law. This suggests that the Mental Health Parity Act will lead to a significant decrease in suicide in minimum mandated benefit states. Because the law became effective in January 2010, more years of data are needed to explore the impact of the law.

Although the results of the regressions above yield significant results, it also points to a number of limitations. First, as seen in Figure G-1, there is a noticeable increase in suicide following 2007 when the economy experienced its worst recession since the 1930s. It is possible that access to mental health care is less effective when individuals are faced with significant financial stress. For example, suicide attempts are higher in areas with higher foreclosure rates (Currie & Tekin, 2011). This would suggest that simply providing access to mental health care through parity laws is not enough to prevent suicide when there is a financial crisis. Future research should then focus on what type of access is needed to more effectively prevent suicides in the face of a significant economic downturn.

Another limitation with the analysis is that only the outcome of suicide is examined. Other mental illnesses and mental health outcomes suffer from a lack of reliable data. To accurately understand the effectiveness of parity laws, the effect of mental health access on less extreme mental health outcomes must be explored. Although a number of studies show a correlation between mental illness and suicide, some of the parity laws only apply to severe mental illness, which limits the impact on more common conditions such as depression.

Overall, the results presented support previous research that finds that access to mental health care is important for suicidal individuals. Although providing access to mental health care can potentially impact suicide, it may also improve a number of social and financial outcomes, such as education and wages. As more accurate micro data on mental illness becomes available, the total impact of mental health care can be better understood.

Appendix H. Quality Assessment of Literature Reviews

Table H-1. Criteria for Quality Assessment of Reviews
Assessment of Multiple Systematic Reviews (AMSTAR)*

Comprehensiveness of Review	Search Methods	Inclusion & Exclusion Criteria	Scientific Quality	Other
Databases used: list databases used (e.g., PubMed)	What key words were used	Did they explicitly describe inclusion criteria? Exclusion criteria?	Validity criteria reported	Relevance to Aspirational Goal
Time period review covers: list years review covered		Inclusion of International, English Language Peer Reviewed Journals	Methods used to aggregate studies reported	
		Selection Bias Avoided	Scientific quality of review assessed using AMSTAR method	
			Quality of the evidence for the efficacy or effectiveness of the Intervention.	

*Shea, B.J., Grimshaw, J.M., Wells, G.A., Boers, M., Andersson, N., Hamel, C., Porter, A.C., Tugwell, P., Moher, D., Bouter, L.M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Medical Research Methodology.* http://www.biomedcentral.com/1471-2288/7/10

Table H-2. USPSTF** Quality of Evidence Criteria for Systematic Reviews
and Primary Sources

Good	Fair	Poor
Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes.	Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies, generalizability to routine practice, or indirect nature of the evidence on health outcomes	Evidence is insufficient to assess the effects on health outcomes because of limited number or power of studies, important flaws in their design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

***U.S. Preventive Services Task Force (UPSTF) Grade Definitions*. May 2008.
http://www.uspreventiveservicestaskforce.org/uspstf/grades.htm

Appendix I. Research Prioritization Task Force Research Agenda Development Process

Figure I-1. Research Agenda Development Process

```
                          ┌─────────────────────┐
                          │   Process Designed   │
                          └─────────────────────┘
                                     │
                          ┌─────────────────────┐
                          │   Burden of Suicide  │
                          │  Deaths and Attempts │
                          │      Identified      │
                          └─────────────────────┘
```

┌────────────────────────┐   ┌─────────────────────┐   ┌──────────────────────┐
│ *Literature Review and* │   │ Stakeholder Survey │   │ *Models of Potential* │
│ *Portfolio Analysis*   │   │ and Delphi Process │   │ *Attempts Averted and* │
└────────────────────────┘   └─────────────────────┘   │   *Lives Saved*   │
                                                            └──────────────────────┘

```
      ┌──────────────────────┐    ┌─────────────────────┐
      │ *NIH Request for*     │    │    Selection of     │
      │  *Information*        │    │  Aspirational Goals │
      │ *(methodological      │    └─────────────────────┘
      │  roadblocks and       │
      │  proposed new         │    ┌─────────────────────┐
      │  paradigms)*          │    │  Research Agenda     │
      └──────────────────────┘    │   Development         │    ┌──────────────────────┐
                                   │ (short- and long-term │    │ *Expert Consultants*  │
                                   │  objectives; research │    └──────────────────────┘
                                   │  pathways)            │
                                   └─────────────────────┘

                                   ┌─────────────────────┐
                                   │  Dissemination of    │
                                   │      Agenda          │
                                   └─────────────────────┘

                                   ┌─────────────────────┐
                                   │   Maintenance,       │
                                   │   Updating           │
                                   └─────────────────────┘
```

VII.) Acknowledgements

Research Prioritization Task Force

Co-Leads

Phillip Satow *(Private Sector Co-Lead)*
Representative
National Council for Suicide Prevention
Chair of the Board
The Jed Foundation

Thomas Insel, MD *(Public Sector Co-Lead)*
Director
National Institute of Mental Health
National Institutes of Health
U.S. Department of Health and Human Services

Task Force Members

Alan Berman, PhD
Executive Director
American Association of Suicidology

Mary Durham, PhD*
Vice President
The Center for Health Research
Kaiser Permanente

Saul Feldman, PhD
Chairman Emeritus
United Behavioral Health

Robert Gebbia, MA
Chief Executive Officer
American Foundation for Suicide Prevention

David Grossman, MD, MPH*
Medical Director, Preventive Care
Group Health Research Institute

Michael Hogan, PhD
Independent Advisor and Consultant
Hogan Health Solutions LLC
(Formerly) Commissioner
New York State Office of Mental Health

Robin Ikeda, MD, MPH
Deputy Director, Office of Non-Communicable
 Diseases, Injury and Environmental Health
Centers for Disease Control and Prevention
U.S. Department of Health and Human Services

Ira Katz, MD, PhD
Senior Consultant, Mental Health Program
 Evaluation
U.S. Department of Veterans Affairs

Daniel Reidenberg, PsyD FAPA
Executive Director
Suicide Awareness Voices of Education

*Former Task Force Member

Overview Experts

David Brent, MD
Academic Chief, Division of Child & Adolescent
  Psychiatry; Endowed Chair in Suicide Studies;
  Professor of Psychiatry, Pediatrics and
  Epidemiology; and Professor, Clinical
  Translational Science Institute
University of Pittsburgh School of Medicine

C. Hendricks Brown, PhD
Director, Center for Prevention Implementation
  Methodology, Prevention Science and
  Methodology Group and Professor,
  Department of Psychiatry and Behavioral
  Sciences, Department of Preventive Medicine,
  Feinberg School of Medicine
Northwestern University

Martha L. Bruce, PhD, MPH
Professor of Sociology in Psychiatry and
  Associate Vice-Chair for Research,
  Department of Psychiatry
Weill Cornell Medical College

William E. Bunney, MD
Distinguished Professor, Psychiatry & Human
  Behavior, School of Medicine, University of
  California, Irvine

Eric D. Caine, MD
Director, Injury Control Research Center for
  Suicide Prevention and John Romano
  Professor and Chair, Department of
  Psychiatry
University of Rochester Medical Center

Kathleen M. Carroll, PhD
Albert E. Kent Professor of Psychiatry
Yale School of Medicine

Keith Hawton, DSc DM FRCPsych
Professor of Psychiatry and Director, Centre for
  Suicide Research
University of Oxford (England)
Department of Psychiatry,
Warneford Hospital

Robert L. Johnson, MD, FAAP*
The Sharon and Joseph L. Muscarelle Endowed
  Dean; Professor of Pediatrics; Director,
  Division of Adolescent and Young Adult
  Medicine
New Jersey Medical School of the University of
  Medicine and Dentistry of New Jersey

Ira Katz, MD, PhD
Senior Consultant, Mental Health Program
  Evaluation
U.S. Department of Veterans Affairs

Maria Oquendo, MD
Vice Chair for Education, Professor of
  Psychiatry, Department of Psychiatry
Columbia University
New York State Psychiatric Institute

Mary Jane Rotheram-Borus, PhD
Director, Center for Community Health and
  Dena Bat Yakov Professor of Child Psychiatry
  and Biobehavioral Sciences, David Geffen
  School of Medicine
University of California, Los Angeles

*Chaired the expert meetings

Topic Experts

Courtney Bagge, PhD
Assistant Professor, Department of Psychiatry
and Human Behavior and Director, Suicidal
Behaviors Research
University of Mississippi Medical Center

Cathy Barber, MPA
Director, Public Health Practice Activities,
Harvard Injury Control Research Center

Hilary Blumberg, MD
Professor of Psychiatry, Diagnostic Radiology
and in the Child Study Center
Director, Mood Disorders Research Program
Yale School of Medicine

Edwin D. Boudreaux, PhD
Professor, Department of Emergency Medicine
and Psychiatry
University of Massachusetts Medical School

Jeffrey Bridge, PhD
Associate Professor of Pediatrics
The Ohio State University
Investigator, Center for Innovation in Pediatric
Practice
The Research Institute of Nationwide Children's
Hospital

Greg Brown, PhD
Research Associate Professor, Clinical
Psychology in Psychiatry, Perelman School of
Medicine
University of Pennsylvania

Kenneth Conner, PsyD, MPH
Acting Director
Veterans Affairs VISN 2 Center of Excellence for
Suicide Prevention
Associate Professor in Psychiatry
Co-Director, Center for the Study and
Prevention of Suicide
University of Rochester Medical School

Yeates Conwell, MD
Professor and Vice-Chair, Department of
Psychiatry; Co-Director, Center for Study and
Prevention of Suicide
University of Rochester School of Medicine

Yogesh Dwivedi, PhD
Professor, Department of Psychiatry and
Pharmacology
University of Illinois at Chicago

Jan Fawcett, MD
Professor of Psychiatry, Department of
Psychiatry
University of New Mexico's School of Medicine

Jodi Jacobson Frey, PhD, MSW
Associate Professor, School of Social Work
University of Maryland

David Goldston, PhD
Clinical Psychologist
Associate Professor of Medical Psychology,
Department of Psychiatry
Duke University

Lisa Horowitz, PhD, MPH
Senior Clinician, Psychiatric Consultation-Liaison
Service, Office of the Clinical Director,
National Institute of Mental Health
U.S. Department of Health and Human Services

Mark Ilgen, PhD
Investigator
National Veterans Affairs Serious Mental Illness
Treatment Resource and Evaluation Center
Associate Professor, Department of Psychiatry
University of Michigan
Clinical Psychologist

Anthony Jorm, PhD, DSc
Professorial Fellow, NHMRC Australia Fellow
and Lead, Population Mental Health Group,
Melbourne School of Population Health
The University of Melbourne (Australia)

John Keilp, PhD
Assistant Professor of Clinical Psychology (in
  Psychiatry)
Columbia University
Research Scientist IV, Head, Neuropsychology
  Laboratory, Division of Molecular Imaging and
  Neuropathology
New York State Psychiatry Institute

Matthew Miller, MD, ScD, MPH
Associate Professor of Health Policy and
  Management, Department of Health Policy
  and Management, Harvard University School
  of Public Health
Deputy Director, Harvard Injury Control
  Research Center

Andrew Nierenberg, MD
Professor of Psychiatry, Harvard Medical School
Director, Bipolar Clinic and Research Program
  and Associate Director, Depression Clinical
  and Research Program
Massachusetts General Hospital

Matthew K. Nock, PhD
Professor of Psychology, Department of
  Psychology and Director, Laboratory for
  Clinical and Developmental Research,
  Department of Psychology
Harvard University

Philip Osteen, PhD, MSW
Assistant Professor, School of Social Work
University of Maryland

Jitender Sareen, MD FRCPC
Professor of Psychiatry, Department of
  Psychiatry, Psychology, and Community
  Health Science
University of Manitoba
Director of Research and Anxiety Services,
  Department of Psychiatry
Health Sciences Centre in Winnipeg (Canada)

Tracy Stecker, PhD
Assistant Professor, Department of Community
  and Family Medicine Research Center
Dartmouth Medical School

Gustavo Turecki, MD, PhD
Vice-Chair, Research and Academy Affairs,
  Department of Psychiatry and Professor,
  Department of Psychiatry, Human Genetics
  and Neurology & Neurosurgery
McGill University
Director, McGill Group for Suicide Studies
Co-Director, Douglas-Bell Canada Brain Bank
  Head of the Depressive Disorder Program
Douglas Mental Health University Institute
(Canada)

Jürgen Unützer, MD, MPH, MA
Professor and Vice-Chair, Department of
  Psychiatry and Behavioral Sciences; Adjunct
  Professor, Departments of Global Health and
  Health Services; Director, Division of Integrate
  Care and Public Health; and Director, AIMS
  Center
University of Washington

Steven Vannoy, PhD, MPH
Assistant Professor, Department of Psychiatry
  and Behavioral Sciences
University of Washington

Peter Wyman, PhD
Director, School and Community-Based
  Prevention Laboratory and Professor of
  Psychiatry
University of Rochester Medical Center

Discussants

Craig Bryan, PsyD
Associate Director
National Center for Veterans Studies
Assistant Professor of Clinical Psychology,
  Department of Psychology
The University of Utah

Richard Catalano, PhD
Professor and Director of the Social
  Development Research Group, and Adjunct
  Professor of Education and Sociology, School
  of Social Work
University of Washington

Wendi Cross, PhD
Associate Professor of Psychiatry, Department
  of Psychiatry, and Associate Professor of
  Psychology, Department of Pediatrics,
  Neurodevelopmental & Behavioral Pediatrics
University of Rochester Medical Center

Howard Goldman, MD, PhD
Professor of Psychiatry
University of Maryland School of Medicine

Marsha Linehan, PhD, ABPP
Professor of Psychology and Adjunct Professor
  of Psychiatry and Behavioral Sciences,
  University of Washington
Director, Behavioral Research & Therapy Clinics

J. John Mann, MD, PhD
The Paul Janssen Professor of Translational
  Neuroscience, Department of Psychiatry
Columbia University
Director, Molecular Imaging and the
  Neuropathology Division
New York State Psychiatric Institute

Thomas Niederkrotenthaler, MD, PhD, MMS
Assistant Professor, Suicide Research Unit,
  Center for Public Health
Medical University of Vienna

Bernice Pescosolido, PhD
Distinguished Professor of Sociology
Indiana University
Director
Indiana Consortium for Mental Health Services
  Research

Nina Schooler, PhD
Professor of Psychiatry
SUNY Downstate Medical Center
Adjunct Professor of Psychiatry
Georgetown University School of Medicine
Senior Research Psychologist
Veterans Affairs VISN 5 Mental Illness Research,
  Education, and Clinical Center
Senior Research Scientist
Zucker Hillside Hospital

Robert Simon, MD, DLFAPA
Clinical Professor of Psychiatry and Director,
  Program of Psychiatry and Law
Georgetown University School of Medicine
Adjunct Professor of Psychiatry, F. Edward
  Hebért School of Medicine
Uniformed Services University of the Health
  Services

Amy Wenzel, PhD
Clinical Assistant Professor of Psychiatry,
  Department of Psychiatry, Perelman School of
  Medicine
University of Pennsylvania

Carlos Zarate, MD
Chief, Experimental Therapeutics and
  Pathophysiology Branch, Division Intramural
  Research Program, National Institute of
  Mental Health
U.S. Department of Health and Human Services

Readers

Joan Asarnow, PhD
Professor, Psychiatry and Biobehavioral
  Sciences
UCLA David Geffen School of Medicine

J. Michael Bostwick, MD
Department of Psychiatry and Psychology
Mayo Clinic

Madelyn Gould, PhD, MPH
Professor of Clinical Epidemiology (in
  Psychiatry), Deputy Director of Research
  Training Program in Child Psychiatry,
Columbia University/New York State Psychiatric
  Institute

Todd Gould, MD
Associate Professor of Psychiatry
University of Maryland

Gretchen Haas, PhD
Associate Professor of Psychiatry
University of Pittsburgh

Nav Kapur, MD, MBChB, MMedSC, FRPsych
Professor of Psychiatry and Population Health,
  Centre for Suicide Prevention, Community
  Based Medicine
The University of Manchester

Tom Laughren, MD
Regulatory Consultant, National Institute of
  Mental Health
U.S. Department of Health and Human Services

Richard McKeon, PhD, MPH
Chief, Suicide Prevention Branch, Substance
  Abuse and Mental Health Services
  Administration
U.S. Department of Health and Human Services

Jerry Reed, PhD, MSW
Vice President
Education Development Center, Inc.
Director, Center for the Study and Prevention of
  Injury, Violence, and Suicide
Suicide Prevention Resource Center
Co-Director
Injury Control Research Center for Suicide
  Prevention

Gregory Simon, MD MPH
Senior Scientific Investigator, Center for Health
  Studies/Behavioral Health Service
Group Health Cooperative

Leif Solberg, MD
Associate Medical Director
HealthPartners Medical Group
Clinical Director, Care Improvement Research
HealthPartners Research Foundation
Clinical Professor, Department of Family
  Practice and Community Health
University of Minnesota

Marcia Valenstein, MD, MS
Associate Professor, Department of Psychiatry
University of Michigan
Research Scientist,
VA Health Services Research and
  Development/Serious Mental Illness
  Treatment Research and Evaluation Center
Staff Physician
Veterans Affairs Ann Arbor Health System

Research Prioritization Task Force
NIH Support Staff and Other Contributors

Lisa Alberts
Clearance Officer and Freedom of Information Act Coordinator, Office of Science Policy, Planning, and Communications, National Institute of Mental Health, National Institutes of Health, National Institutes of Health
U.S. Department of Health and Human Services

Shelli Avenevoli, PhD
Chief, Developmental Trajectories of Mental Disorders Branch, Division of Developmental Translational Research, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Crystal Barksdale, PhD
Senior Research Analyst
SRA International, Inc.

Adele Blackler, PhD
Cancer Research Fellow, National Cancer Institute; *(Formerly)* Post-doctoral Fellow, National Institute of Mental Health,
U.S. Department of Health and Human Services

Katrina Bledsoe, PhD
Evaluation Scientist
Suicide Prevention Resource Center
Education Development Center, Inc.

Yancy Bodenstein, MS, MPH
Chief, Reports and Analysis Branch, Office of Science Policy, Planning and Communication, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Chelsea Booth, PhD
Public Health Advisor, Suicide Prevention Branch, Substance Abuse and Mental Health Services Administration
U.S. Department of Health and Human Services

Liza Bundesen, PhD
Acting Branch Chief, Science Policy and Evaluation Branch, Office of Science, Policy, Planning, and Community, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Lisa Capoccia, MPH
Assistant Manager, Clinical Initiatives
Suicide Prevention Resource Center
Education Development Center, Inc.

Michelle Colder Carras
Graduate Student, Department of Mental Health, Bloomberg School of Public Health
Johns Hopkins University

Cynthia (Cindy) Claassen, PhD (Contractor)
Associate Professor, Psychiatry & Behavioral Health
University of North Texas Health Science Center

Lisa Colpe, PhD, MPH
Chief, Office of Clinical and Population Epidemiology Research, Division of Services and Intervention Research, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Alex Crosby, MD, MPH
Medical Epidemiologist, U.S. Centers for Disease Control and Prevention
U.S. Department of Health and Human Services

Siddhartha Dalal, PhD
Adjunct Staff Member
RAND Corporation

Laurie Davidson, MA
Project Manager, Provider Initiatives
Suicide Prevention Resource Center
Education Development Center, Inc.

Jovier Evans, PhD
Program Officer, Geriatrics Research Branch,
  Division of Adult Translational Research and
  Treatment Development, National Institute of
  Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Holly Garriock, PhD
Program Chief of Trajectories of Depression,
  Emotion Regulation & Suicidality Program,
  Developmental Trajectories of Mental Disorders
  Branch, Division of Developmental Transitional
  Research, National Institute of Mental Health,
  National Institutes of Health
U.S. Department of Health and Human Services

Amy Goldstein, PhD
Associate Director for Prevention; Chief, Child and
  Adolescent Preventive Intervention Program,
  Division of Services and Intervention Research,
  National Institute of Mental Health, National
  Institutes of Health
U.S. Department of Health and Human Services

Ekwenzi Gray, PhD
Director of University Drug Education and
  Prevention Program, Counseling Center
Howard University

Ann Haas, PhD
Senior Director of Education and Prevention
American Foundation for Suicide Prevention

Judy Harvilchuck-Laurenson, PhD (Contractor)
Division of Services and Intervention Research,
  National Institute of Mental Health, National
  Institutes of Health
U.S. Department of Health and Human Services

Janet Heekin
Research Librarian, National Institutes of Health
  Library, National Institutes of Health
U.S. Department of Health and Human Services

Robert K. Heinssen, PhD, ABPP
Director, Division of Services and Intervention
  Research, National Institute of Mental Health,
  National Institutes of Health
U.S. Department of Health and Human Services

Maureen Iselin (Contractor)
Scientific Communication Editor, Division of
  Services and Intervention Research, National
  Institute of Mental Health, National Institutes of
  Health
U.S. Department of Health and Human Services

Gail Jaffe, MSW, MPH
Senior Prevention Specialist
Suicide Prevention Resource Center
Education Development Center, Inc.

Denise Juliano-Bult, MSW
Chief, Systems Research and Disparities in Mental
  Health Services Research Programs, Division of
  Services and Intervention Research, National
  Institute of Mental Health, National Institutes of
  Health
U.S. Department of Health and Human Services

Barbara Tatem Kelley
Juvenile Justice Program Specialist
U.S. Department of Justice

Dmitry Khodyakov, PhD
Sociologist, RAND Health
RAND Corporation

Colleen Labbe, MS
Senior Science Writer/Public Liaison, Office of
  Science, Policy, Planning and Communications,
  National Institute of Arthritis and
  Musculoskeletal and Skin Diseases; *(Formerly)*
  Office of Science Policy, Planning and
  Communications, National Institute of Mental
  Health, National Institutes of Health
U.S. Department of Health and Human Services

Matthew Lang, PhD
Assistant Professor, Economics and Assistant
   Professor, Modern Language & International
   Economics
Xavier University

René Lento
PhD Candidate in Clinical Psychology
The Catholic University of America

Frances L. Lynch, PhD (Contractor)
Senior Investigator, The Center for Health
   Research
Kaiser Permanente

Samantha Matlin, PhD
Special Advisor to the Commissioner for Policy
   Development and Research
   City of Philadelphia Department of Behavioral
   Health & Intellectual disAbility Services

Robert Mays, PhD
Deputy Director for Administration and Chief,
   Office of Rural Mental Health Research,
   National Institute of Mental Health, National
   Institutes of Health
U.S. Department of Health and Human Services

Sherry Davis Molock, PhD, M.Div. (Contractor)
Associate Professor of Clinical Psychology,
   Department of Psychology
George Washington University
(Formerly) Senior Advisor for Outreach &
   Engagement Research, Office of Constituency
   Relations & Public Liaison, National Institute of
   Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Lisa Nichols, PhD
Science Policy Analyst, National Science Board
   Office
National Science Foundation
(Formerly) Office of Science, Policy, Planning and
   Communications, National Institute of Mental
   Health, National Institutes of Health
U.S. Department of Health and Human Services

Kathleen M. O'Leary, MSW
Chief, Women's Program, Office for Research on
   Disparities and Global Mental Health, National
   Institute of Mental Health, National Institutes of
   Health
U.S. Department of Health and Human Services

Jason H. Padgett, MPA, MSM
Task Force Liaison, Secretariat, National Action
   Alliance for Suicide Prevention
Suicide Prevention Resource Center
Center for the Study and Prevention of Injury,
   Violence, and Suicide
Education Development Center, Inc.

Jane L. Pearson, PhD
Lead of the Support Staff for the Research
   Prioritization Task Force; Chair, Suicide Research
   Consortium, Division of Services and
   Intervention Research, National Institute of
   Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

LeShawndra N. Price, PhD
Health Scientist Administrator, Office for Research
   on Disparities and Global Mental Health,
   National Institute of Mental Health, National
   Institutes of Health
U.S. Department of Health and Human Services

Beverly Pringle, PhD
Chief, Global Mental Health Research, Office for
   Research on Disparities and Global Mental
   Health, National Institute of Mental Health,
   National Institutes of Health
U.S. Department of Health and Human Services

Rex Robison, PhD, MLS
Librarian
National Library of Medicine
(Formerly) Informationist, National Institute of
   Health Library, National Institutes of Health
U.S. Department of Health and Human Services

Mercedes Rubio, PhD
Program Chief, Psychopathology Risk and Protective Factors Research Program, Division of Adult Translational Research and Treatment Development, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Joel Sherrill, PhD
Chief, Psychosocial Treatment Research Program, Child & Adolescent Treatment & Preventive Intervention Branch, Division of Services and Intervention Research, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Keisha Shropshire, MPH, CHES
Health Science Analyst, Science Policy and Evaluation Branch, Office of Science Policy, Planning, and Communication, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Galia Siegel, PhD (Contractor)
Consultant, Division of Services and Intervention Research, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Belinda Sims, PhD
Health Scientist Administrator, Division of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, National Institutes of Health
U.S. Department of Health and Human Services

Jacob Solomon
Research Assistant
RAND

Anne Sperling, PhD
Science Policy Analyst, Science Policy and Evaluation Branch, Office of Science Policy, Planning, and Communication, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Trevor Summerfield
Manager of Federal Policy
American Foundation for Suicide Prevention

Benedetto Vitiello, MD
Chief, Treatment and Prevention Intervention Branch, Division of Services and Intervention Research, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Gemma Weiblinger, MA
Director, Office of Constituency Relations and Public Liaison, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

Peggy West, PhD, MSW
Senior Advisor
Suicide Prevention Resource Center
Education Development Center, Inc.

Eileen Zeller, MPH
Lead Public Health Advisor, Center for Mental Health Services, Division of Prevention, Traumatic Stress and Special Programs, Suicide Prevention Branch, Substance Abuse and Mental Health Services Administration
U.S. Department of Health and Human Services

David Zielinski, PhD
Chief, Science Policy and Planning Branch, Office of Science Policy, Planning and Communications, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institutes of Health; *(Formerly)* Science Policy Analyst, Science Policy and Evaluation Branch, Office of Science Policy, Planning, and Communications, National Institute of Mental Health, National Institutes of Health
U.S. Department of Health and Human Services

VIII.) Glossary of Terms

Aspirational Goal—a research-oriented goal developed from the Research Prioritization Task Force's Stakeholder Survey, which, if implemented successfully, would help reduce the rates of suicide attempts and deaths.

Attributable risk—the amount or proportion of incidence of disease or death (or risk of disease or death) in individuals exposed to a specific risk factor that can be attributed to exposure to that factor; the difference in the risk for unexposed versus exposed individuals.

Boundaried population—a population defined by a service setting or organizational function. Individuals can be counted for denominator needs, and in theory, be engaged in prevention efforts. Examples include: youth enrolled in school; veterans who receive care from the Veterans health administration; older adults who receive Medicare; incarcerated individuals in jails and prisons; and individuals seen in emergency care settings.

Boundaried setting—the contexts and organizations where individuals at risk for suicide might be reached and engaged in prevention activities (e.g., a school system, a substance abuse treatment system, incarceration, probation and parole). These activities could include self-referral, screening, or gatekeeper efforts.

Burden—the impact suicide has on society, measured by morbidity (attempts), mortality (deaths), and other indicators.

Cohort studies—a study design where one or more samples (cohorts) are followed prospectively and subsequent status evaluations with respect to a disease or outcome are conducted to determine which initial participants' exposure characteristics (risk factors) are associated with it.

Collaborative care—an approach to care where health specialists work with primary care providers to provide support and/or case management to improve the quality of care. Characteristics of this type of care often include patient education and support; consultation/liaison from specialist to primary care provider; evidence-based care; and coordination of care and follow-up to enhance outcomes (e.g., relapse prevention), specifically through improved adherence.

Common data element (CDE)—a data element that is common to multiple data sets across different studies. The use of CDEs is typically promoted to improve data quality, and promote data sharing to allow for meta-analysis.

Connectedness—closeness to an individual, group, or individuals within a specific organization; perceived caring by others; satisfaction with relationship to others; or feeling loved and wanted by others.

Contagion—a phenomenon whereby susceptible persons are influenced toward suicidal behavior through knowledge of another person's suicidal acts.

Delphi process—a systematic, iterative approach to reach consensus; includes steps to become informed by others' opinions.

Discussant—a suicide research topic expert who was asked to respond to and discuss proposed research pathways within key Questions, as a part of this research agenda development process.

Epidemiology—study of patterns, risk factors, and effects of health and disease conditions on a defined population.

Epigenetics—the study of chemical reactions that switch parts of the genome off and on at strategic times, sometimes in reaction to environmental factors.

Exome sequencing—this analytic technique focuses on the part of the genome best understood to date—the exomes of genes. This approach is used to understand high-penetrance allelic variation and its relationship to phenotype.

Gatekeeper —an individual in a community who has face-to-face contact with large numbers of community members as part of their usual routine. They may be trained to identify persons at risk of suicide and refer them to treatment or supporting services as appropriate. Examples include clergy, first responders, pharmacists, caregivers, and those employed in institutional settings, such as schools, prisons, and the military.

Harmonized—finding comparability among different measures or approaches.   Often used in combination with common data element efforts so that studies can be pooled and outcomes across studies considered.

Healthcare Effectiveness Data and Information Set (HEDIS)—is a tool used by more than 90% of America's health plans to measure performance on important dimensions of care and service. HEDIS consists of 75 measures across eight domains of care. Consistency in measurement allows for performance comparisons across health plans.

Help-seeking—in mental health, the action of obtaining care or assistance for a mental health problem, as a part of a coping process to deal with an illness or condition. In research, most often the care or assistance studied is that provided by health professionals or faith leaders. Other research has described individuals finding assistance from peers and family members.

Intervention—a strategy or approach that is intended to prevent an outcome or to alter the course of an existing condition (such as providing lithium for bipolar disorders, educating providers about suicide prevention, or reducing access to lethal means among individuals with suicide risk).

Low base rate—relative to other disorders or conditions, a less frequent occurrence, resulting in significant challenges when attempting to scientifically predict or model the condition.

Means—the instrument or object used to carry out a self-destructive act (e.g., chemicals, medications, illicit drugs, firearms, etc.).

Meta-analysis—quantitative statistical analysis that is applied to separate but similar studies by different researchers and that involves pooling the data and using the pooled data to test the strength of the results.

Methodological roadblock—a critical, unresolved challenge that is clearly limiting progress along an important suicide prevention research pathway.

microRNA—a small, non-coding RNA molecule found in plants and animals, which regulate the expression of genes.

Morbidity—the relative frequency of illness or injury or the illness or injury rate, in a community or population.

Mortality—the relative frequency of death, or the death rate, in a community or population.

Natural experiments—experiments where interventions are delivered but not 'controlled' in an experimental way. For example, examining the impact of a state alcohol access law or policy change on suicide outcomes.

New research paradigm—a novel way of thinking about suicidal behavior and avenues for its prevention.

Overview expert—within the Research Prioritization Task Force process, a scientist capable of considering a broad array of proposed research pathways, who was asked to consider information from various sources and assist in identifying research areas that have the potential to reduce the burden of suicide.

Postvention—response to and care for individuals affected in the aftermath of a suicide attempt or suicide death.

Practical Randomized Trial—(also called pragmatic trial). Differs from traditional randomized control trials by including a balance of internal and external validity, design fidelity and local adaptation, real life settings and populations, and contextual assessments. Stakeholders are engaged in all study phases including study design, conducting the study, collecting data, interpreting results, and disseminating findings.

Prevention—a strategy or approach that reduces the likelihood of risk of onset or delays the onset of adverse health problems, or reduces the harm resulting from conditions or behaviors.

Prodrome—an early symptom, or set of symptoms, that might indicate the start of a disorder or condition, or disease before the disorder or condition is fully evident.

Protective factors—factors that make it less likely individuals will develop a disorder. Protective factors may encompass biological, psychological, or social factors in the individual, family, and environment.

Psychometrics—referring to the adequacy of psychological measurement or scale (reliability—whether a scale could produce similar findings over multiple administrations; validity—whether a scale predicts behavior it was intended to forecast). These are properties considered important in clinical applications.

Qualitative analysis—a way to summarize phenomena that are difficult to quantify mathematically, such as beliefs, meanings, attributes, and symbols; it may involve using content analyses as a scientific approach to consolidate data.

Quality improvement—In reference to healthcare, ongoing changes made in care structure and process in order to achieve effective services and optimal patient outcomes. With regard to suicide research, root cause analysis may be initially used to examine health care structures and processes to determine what components of care should change to further reduce suicide risk.

Reader—a suicide researcher or other expert who was asked to review the prioritized research agenda.

Randomized control trial (RCT)—a research study in which the study subjects, after assessment of eligibility and recruitment, but before the intervention to be studied begins, are randomly assigned to receive one or other of the alternative treatments under study.

Research pathway—research methods or studies that if accomplished, would advance scientific understanding to reach an objective or goal.

Resilience—capacities within a person that promote positive outcomes, such as mental health and well-being, and provide protection from factors that might otherwise place that person at risk for adverse health outcomes.

Risk factors—factors that make it more likely individuals will develop a disorder. Risk factors may encompass biological, psychological, or social factors in the individual, family, and environment.

Root cause analysis (RCA)—a step-by-step method that leads to the discovery of an error's first or root cause. RCA uses a systematic approach to identify the progression of actions and consequences that led to an undesired event. In the context of suicide prevention, an RCA investigation means tracing the cause and effect trail from a suicide attempt or death back to the root cause.

Screening—administration of an assessment tool to identify persons in need of more in-depth evaluation or treatment.

Stakeholders—entities—including organizations, groups, and individuals—that are affected by and contribute to decisions, consultations, and policies.

Suicidal behaviors—behaviors related to suicide, including preparatory acts, as well as suicide attempts and deaths.

Suicide attempt—non-fatal, self-directed, potentially injurious behavior with any intent to die as a result of the behavior. A suicide attempt may or may not result in injury.

Suicide death—death caused by self-directed, injurious behavior with any intent to die as a result of the behavior.

Suicide ideation—thinking about, considering, or planning for suicide.

Surveillance—the ongoing, systematic collection, analysis, and interpretation of health data with timely dissemination of findings.

Topic expert—a suicide researcher who was asked to summarize the state of suicide research in a particular topic area and recommend needed research pathways in that area for this research agenda development process.

Veterans Administration Suicide Prevention Coordinators—staff at Veterans Administration Medical Centers who connect with and support Veterans and providers in times of crisis. Other duties can include: the monitoring and evaluation of data on attempts and current deaths from suicide for the medical center; develop and implement new strategies for outreach and intervention with high risk Veterans; coordinate inpatient environment of care processes.

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The National Action Alliance for Suicide Prevention is the public-private partnership advancing the *National Strategy for Suicide Prevention* (NSSP) (http://actionallianceforsuicideprevention.org/NSSP) by championing suicide prevention as a national priority, catalyzing efforts to implement high-priority objectives of the NSSP, and cultivating the resources needed to sustain progress. The Action Alliance envisions a nation free from the tragic experience of suicide. For electronic copies of this document or for additional information about the Action Alliance and its task forces, please visit http://www.actionallianceforsuicideprevention.org.