Reducing a Suicidal Person's Access to Lethal Means of Suicide

A Research Agenda

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Reducing the availability of highly lethal and commonly used suicide methods has been associated with declines in suicide rates of as much as 30%–50% in other countries. The theory and evidence underlying means restriction is outlined. Most evidence of its efficacy comes from population-level interventions and natural experiments. In the U.S., where 51% of suicides are completed with firearms and household firearm ownership is common and likely to remain so, reducing a suicidal person's access to firearms will usually be accomplished not by fiat or other legislative initiative but rather by appealing to individual decision, for example, by counseling at-risk people and their families to temporarily store household firearms away from home or otherwise making household firearms inaccessible to the at-risk person until they have recovered. Providers, gatekeepers, and gun owner groups are important partners in this work. Research is needed in a number of areas: communications research to identify effective messages and messengers for "lethal means counseling," clinical trials to identify effective interventions, translational research to ensure broad uptake of these interventions across clinical and community settings, and foundational research to better understand method choice and substitution. Approaches to suicide methods other than firearms are discussed. Means restriction is one of the few empirically based strategies to substantially reduce the number of suicide deaths.

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Introduction

The National Action Alliance for Suicide Prevention established the Research Prioritization Task Force in 2010 to identify interventions capable of reducing the suicide rate by 20% over a 5-year period. Twelve goals emerged. We discuss the 12th: "reduce access to lethal means that people use to attempt suicide" (briefly, means restriction or means reduction).

A suicidal person's access to highly lethal means, or methods, of suicide can be reduced through (1) physically impeding access (e.g., using gun locks and bridge barriers); (2) reducing the lethality or toxicity of a given method (e.g., reducing carbon monoxide [CO] content of motor vehicle exhaust); or (3) reducing "cognitive access,"[1] that is, reducing a particular method's appeal or cognitive salience (e.g., discouraging media coverage of an emerging suicide method). We focus here largely on the first two approaches.

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Reducing access to lethal means saves lives when people who cannot readily obtain a highly lethal method either attempt with a method less likely to prove fatal or do not attempt at all (Figure 1). The rationale rests on four well-established observations. First, many suicidal crises are short-lived. A survey of people who had seriously considered suicide in the past year found that for about 30%, the suicidal period lasted under an hour.[2] Surveys of attempters have found that the interval between deciding on suicide and actually attempting was 10 minutes or less for 24%–74% of attempters (with the lower end of the range reported by a study of those nearly dying in their attempt).[3–5]

Second, the method people use in suicidal acts depends, to a non-trivial extent, on its ready availability.[6,7] Third, the proportion of attempts that result in death (case fatality ratio) varies dramatically across methods, ranging from a high of 85%–90% for firearms to a low of 1%–2% for the methods most commonly used in attempts—medication overdoses and sharp instrument wounds.[8] The lethality of the method readily available during a suicidal crisis therefore plays an important role in whether the person survives an attempt; intent matters, but means also matter.

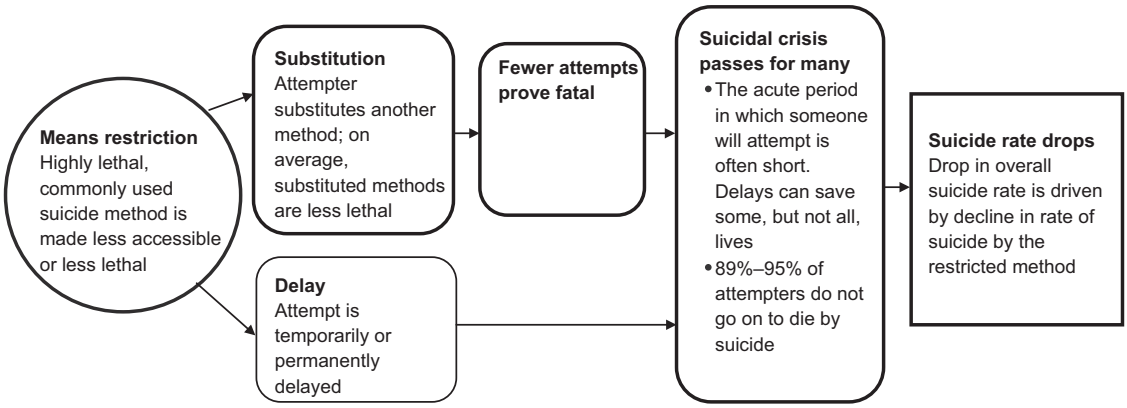

Figure 1. Conceptual model of how reducing access to a highly lethal and commonly used suicide method saves lives at the population level

Note: When the restriction is effectuated by making a highly lethal method less lethal at the population level (e.g., reducing carbon monoxide content of motor vehicle exhaust), the substitution is passive. That is, people attempting suicide with the method are unaware that, in effect, a less lethal method has been substituted for a more lethal method.

Fourth, approximately 90% of attempters who survive a nonfatal attempt will not go on to die by suicide thereafter,[9] a finding that holds true even in studies focusing only on medically serious attempts, such as jumping in front of a train.[10] Therefore, helping people survive periods of acute suicidal risk by reducing their access to highly lethal methods is likely to help many people survive in both the short and long term.

Reducing access to lethal means saves lives if the methods available for substitution, on balance, are less likely to prove lethal. Firearms account for more than half of suicides in the U.S. and have the highest case fatality ratio. A number of factors are theorized to influence the lethality of a given method. The first is inherent deadliness. For example, car exhaust with a high CO level will be more deadly than car exhaust with a low CO level. The second is ease of use. A method that requires technical knowledge is less accessible than one that does not.

The third is accessibility. Given the brief duration of some suicidal crises, a lethal dose of pills in the nightstand poses a greater danger than a prescription that must be hoarded over months to accumulate a lethal dose. Similarly, a gun in the closet poses a greater risk than a very high bridge 5 miles away, even if both methods have equal lethality if used. The fourth is ability to abort mid-attempt. More people start an attempt and abort it than carry it through[2]; therefore, methods that can be interrupted without harm mid-attempt—such as overdose, cutting, CO poisoning, and hanging/suffocation—offer a window of opportunity for rescue or change of heart that guns and jumps do not. The fifth factor is acceptability to the attempter. Although fire, for example, is universally accessible, it is rarely used in the U.S. for suicide.

At the population level, no measurable impact of means restriction on overall suicide rates is likely to be observed (even if, on balance, lives are saved) if the restricted method constitutes a very small proportion of all suicides or if the restricted method is of low lethality. If all sharp instruments magically disappeared, for example, in spite of their frequent use in suicide attempts there would be little measurable impact on suicide deaths, given their low case fatality ratio (sharps constitute only 2% of suicide deaths). Importantly, a possible, though unsubstantiated, unintended impact of reducing access to popular low-lethality methods may be an increase in suicide risk if attempters substitute more lethal methods.

Research Evidence on Means Restriction

Population-Level Natural Experiments

Before 1960, the leading suicide method in the United Kingdom was inhalation of domestic gas. Following discovery of a cheaper, nontoxic source of natural gas in the North Sea, gas suicides fell to nearly zero. Suicides by other methods increased somewhat, but, importantly, the net result was a drop of approximately 30% in the overall suicide rate.[11,12] These findings held in other countries where domestic gas was a leading method,[13,14] but not in those where gas accounted for a small proportion of total suicides.[15–17]

Natural experiments involving decreased toxicity of motor vehicle exhaust and reduced accessibility of barbiturates, firearms, and analgesics (as well as some population-level interventions described below) also illustrate that method-specific suicide rates drop when a method becomes less available or less lethal; however, whether the overall suicide rate drops is equivocal when the method is not commonly used or is of low lethality.[1,18–24]

Population-Level Interventions

Pesticides are the leading suicide method in Sri Lanka. In the 1990s, the Sri Lankan government placed restrictions on sales of the most highly human-toxic agents, following which overall suicide rates dropped by 50%.[25] Nearly 20,000 fewer suicides occurred in the 10 years following restrictions compared with the 10 previous years. The decline in suicide was driven by a decline in poisoning suicides; non-poisoning suicides did not decline, nor did nonfatal poisonings. The underlying behavior (swallowing pesticides in a suicide attempt) did not appear to change, but thousands of lives were saved because the lethality of the behavior diminished.

Pesticide poisoning was a highly lethal, common method of suicide prior to the policy changes. Its lethality dropped following changes; therefore, the overall suicide rate in Sri Lanka dropped driven exclusively by a drop in the pesticide suicide rate. A similarly dramatic drop in suicides was observed in Western Samoa when the pesticide paraquat became less available.[26]

Most studies in the United Kingdom on the impact that limiting access to the pain relievers co-proxamol (via market withdrawal)[27] and paracetamol (via pack size limits)[28] had on poisoning suicides found a significant decline in poisoning deaths by these agents without compensatory increase in other lethal poisonings. Given the small proportion of suicides overall that the two medications comprised, these studies did not look at impact on overall suicide deaths. However, Bateman's review concluded that pack size restrictions did not reduce paracetamol deaths.[29]

Jumping from a very great height is a highly lethal but uncommonly employed method in the U.S. Barriers have been installed at some popular jump sites, such as tall bridges. Most[30,31] (but importantly not all[32]) studies of the impact of these barriers have found that fewer suicides occurred at the protected site without evidence of a compensatory increase in jumping suicides from other sites. Most have not assessed impact on rates overall, given the small proportion that jumps typically constitute of suicides overall.

An intervention that found a net effect on overall suicide rates, albeit in a small population (i.e., 28 suicides annually on average pre-intervention), involved the Israeli Defense Force.[33] Soldier suicides occurred disproportionately on weekends and 90% involved firearms. A 2006 policy aimed at preventing suicide required soldiers to leave their weapons on base during weekend leave. The suicide rate decreased by 40%; weekend firearm suicides dropped significantly, with no significant change in weekday suicides, and no change in non-firearm suicides.

Firearms and Suicide in the U.S.

In the U.S., more suicides are completed with a firearm than by all other methods combined. About one in three homes contain firearms and 51% of all suicides involve firearms.[34] Miller et al.[34] have provided a review of U.S. firearm suicides. All U.S. case-control studies that have examined the issue[35–39] have found that the risk of suicide is two- to five-fold higher in gun-owning homes for all household members, with relative risk being especially high for youth and people without known psychopathology. The higher suicide risk is driven by a higher risk of firearm suicide, with no difference in non-gun suicides. Most studies, but not all, find that among gun households, suicide risk is lower when firearms are stored unloaded, locked, and separate from ammunition.[40]

A cohort study found that handgun purchasers in California were more than twice as likely to die by suicide as were their age/sex-matched peers throughout the 6-year study period, with the increase in risk attributable to an excess risk of firearm suicide.[41] Several ecologic studies in the U.S. bolster findings from the individual-level studies.[42] Time-series[43] and cross-sectional studies that have measured firearm prevalence in relation to suicide risk have consistently found a strong association between household firearm ownership rates and rates of overall and firearm suicide (and no significant association between household firearm prevalence and non-firearm suicide).

These findings do not appear to be accounted for by differences in underlying suicide risk among persons living in homes with guns. People living in homes with (versus without) guns, for example, are no more likely to screen positive for psychopathology or suicidal ideation, or to report having attempted suicide.[44–47] Importantly, the heightened risk of suicide associated with the presence of a household firearm applies not only to the gun owner but to all household members.[38,48] In aggregate, the literature on the firearm–suicide connection indicates that access to firearms does not serve as a proxy for an unmeasured third variable that drives suicide risk, but rather increases suicide risk by making it more likely that suicidal acts will involve guns and therefore, on average, prove fatal.

Applying the Lessons of Means Restriction to the U.S.

Suicide rates can be substantially reduced—without necessarily changing underlying mental illness or suicidal behavior—by making it more difficult to die in an act of

deliberate self-harm. Despite evidence across studies (including targeted interventions, natural experiments, case control, cohort, and ecologic studies) of its potential to save lives, means restriction historically has not been prioritized in the U.S.

One reason may be the misperception that reducing access requires embracing gun control, a politically polarizing issue. It need not. There are a variety of non-legislative approaches that respectfully engage the gun-owning community as partners in suicide prevention. Prime among them is "lethal means counseling"—advising people at risk for suicide, and their friends and family, to keep firearms away from the at-risk person until the person recovers. Below, we highlight suicide methods that may be useful targets for means restriction.

Firearms have several characteristics that make them particularly suitable targets: They are the leading suicide method in the U.S. (approximately 19,000 deaths a year)[49]; they are the most lethal[50] (substituted methods will be less likely to kill); they are both accessible and cognitively acceptable in U.S. culture; and an attempt with a gun once initiated cannot be reversed (unlike attempts with nearly every other method except jumping). If under an ideal scenario means restriction counseling reached all relevant households (households in which there is a gun and a suicidal person), and if counseling had modest results (one quarter of the households effectively kept the guns from the suicidal person), based on findings from case-control and ecologic studies, an estimated 3,600–3,900 lives would be saved in 1 year.[51] This approach is especially promising for youth, whose firearm suicides typically involve a family member's gun.[52]

Medication overdoses are by far the leading method of suicide attempt, with hundreds of thousands occurring each year.[53] Although the overall case fatality ratio for medications is below 2%, some medications are markedly more lethal than others, and overdoses account for more than 5,000 deaths annually in the U.S.[49] Interventions that reduce the medication load available to at-risk persons to a level that, even when taken all at once, will not pose a severe danger, may prevent deaths and reduce the severity of attempts. Because some of the more-lethal medications also are addictive (e.g., opioids and benzodiazepines), other advantages may accrue from reducing access.

The drop in deaths associated with motor vehicle exhaust suicides following wider use of catalytic converters suggests that more savings could be realized with further engineering changes.[21] Barriers at popular jumping sites, such as the Golden Gate Bridge—particularly when no sites nearby offer comparable acceptability and lethality—will likely save lives. At 700–800 jumping suicides annually in the U.S.,[49] and about the same number from motor vehicle exhaust, these approaches may save lives but their impact on overall suicide rates may not be apparent given their small numbers.[54] Examples of interventions and the mechanisms by which they could save lives are illustrated in Table 1.

Hanging/suffocation is the second-leading mechanism of suicide death in the U.S. and its use has increased in recent years.[49] This method is not amenable to physical means restriction techniques, except in controlled settings like prisons and hospitals. Because it still ranks relatively low among ideators as a planned method,[2] means restriction theory suggests that "cognitive access" might be reduced if efforts are made to avoid publicizing this method in traditional and social media. Similarly, care should be taken not to inadvertently increase acceptability of emerging suicide methods (such as highly lethal poisons or drug combinations) by publicizing them in traditional and social media.

Research Needs

The body of evidence on means reduction comes from studies examining changes in exposure to suicide methods resulting from natural experiments and interventions at the population level. Individual-level interventions are far more complex. They require identifying at-risk groups, learning the right messages to deliver, finding the right messengers to deliver them, and learning how to change behavior—not insignificant challenges. They also require changing practice among providers, healthcare/social service systems, families, and community organizations.

A small body of literature on parents of youth with psychiatric problems suggests that families who were counseled to reduce access to firearms and medications at home were more likely to do so than those not receiving such counseling.[55,58,59] This is encouraging, but more intervention research is needed in three broad categories: (1) communications research to identify and test the messages; (2) intervention evaluations to rigorously test the impact of selected interventions; and (3) translation and dissemination work to extend and adapt effective interventions to a variety of populations and settings. In addition, continued foundational research is needed to understand the dynamics governing method choice and planning and to develop a stronger surveillance infrastructure.

Communications Research

Communications research with at-risk individuals and their families and friends. Communications research should examine the attitudes and knowledge that at-risk

Table 1. Operational logic model: examples of means restriction interventions

		Outcomes (at population level)		
Inputs	**Outputs**	**Short**	**Medium**	**Long**
Train providers and gatekeepers on lethal means counseling[55,56]	Providers and gatekeepers counsel at-risk individuals and their families to make household guns inaccessible to at-risk person	Families take action (e.g., store guns with a friend or at a gun club)	At-risk individualsattempt with less lethal method or crisis passes before alternate attempt is made	Fewer suicides overall, driven by fewer firearm suicides
Train providers and gatekeepers on lethal means counseling	Physicians monitor prescriptions of at-risk individuals to keep total supply below toxic dose, advise families to dispose of unused medications, and substitute less toxic for more toxic medications when possible	Fewer pills on hand at home	Low-planned attempts occur with fewer pills	Lower severity of overdoses
Educate insurance companies on dangers of mandatory 90-day prescription policies	Amend 90-day prescription policies to allow opt-out for at-risk patients	At-risk patients continue receiving smaller quantities at each refill	Low-planned attempts occur with fewer pills	Lower severity of overdoses
Collaborate with gun-owning groups on suicide prevention and means restriction	Gun owner groups incorporate message in firearm safety training classes, brochures, and websites (sample message: Store all guns locked and unloaded; consider temporarily storing firearms offsite if a household member is at risk of suicide)	Families take action	At-risk individuals attempt with less lethal method or delay attempt; for many, crisis passes	Fewer suicides overall, driven by fewer firearm suicides
Induce motor vehicle manufacturers to make engineering changes	Reduce toxicity of motor vehicle exhaust; install carbon monoxide–sensing gadgets that shut off idling engines when highly toxic levels accumulate	Attempts with motor vehicle exhaust less likely to prove fatal	For many thwarted attempters, crisis passes	Fewer carbon monoxide suicides
Induce civil engineers to make engineering changes	Bridge barriers erected at targeted jump sites	Barriers prevent attempts by jumping	Most methods substituted for jumping are less lethal	Fewer jumping suicides
Educate hospital administrators about environmental changes to reduce inpatient suicides	Hospitals install collapsible curtain and shower rails and reduce other points of ligature in psychiatric wards[57]	Changes prevent attempts by hanging	Most other methods are unavailable in inpatient rooms	Fewer inpatient suicides overall, driven by fewer hanging suicides

individuals and their families hold regarding means restriction and evaluate the acceptability of various strategies, particularly regarding firearms, the method for which reduced access is likely to save the greatest number of lives.[60] Examples of useful research questions to pursue via focus groups, surveys, and other methodologies include the following:

1. Which specific messages and messengers on safe firearm storage are persuasive to people at risk of suicide and their families, and does the acceptability of the messages vary by reasons for gun ownership (e.g., self-defense, hunting, sport) and by other socioeconomic factors (e.g., political views, education level)?
2. Do mistaken assumptions about suicide (e.g., once suicidal, a person remains so; most attempts are well planned long in advance; one method is about as likely to kill as another) pose a barrier to means restriction? Does education on these issues increase families' safe storage behavior?
3. With whom, if anyone, are at-risk persons likely to feel most comfortable temporarily storing their firearms (e.g., a relative, Army buddy, storage facility, or police department)?
4. For whom is secure in-home locking (with another person holding the key) a more acceptable solution to off-site storage?
5. How should firearm safety messages be tailored when the suicidal person is a minor versus an adult, the gun

owner versus non-owning member of a gun household, a crisis line caller versus inpatient, or a person at acute versus chronic risk?

6. Regarding medication safety, is the protective effect of limiting a patient with an active overdose history to shorter prescription refills (e.g., weekly rather than monthly refills) outweighed by the deleterious consequences of poorer medication compliance? Would a lockable, electronic pill-dispensing machine prove more viable?

Communications research with providers and gatekeepers. A number of studies have indicated that behavioral health and medical providers do not routinely conduct lethal means counseling with at-risk groups.[61,62] Research aimed at remedying this should (1) identify attitudinal and informational barriers that impede and facilitate routine use of lethal means counseling by providers; and (2) evaluate training programs in lethal means counseling to identify the most effective approaches.

Messaging on firearms safety should be developed in partnership with a broad spectrum of invested parties including, importantly, gun owners, to ensure that messaging is relevant and helpful. Because many suicidal people do not explicitly seek help for their suicidal feelings, non-healthcare–related venues where suicidal people intersect with the system should be identified. The suicide risk of a person who has just been arrested on his third drunk driving charge may be as high as a patient who has been hospitalized for depression. Therefore, defense attorneys and others who see people in trouble (e.g., clergy, batterers' counselors, social service personnel, probation/parole officers, marriage counselors, divorce attorneys) may be useful "gatekeepers" to refer people at risk and convey firearm safety messages.

Communications research with gun owner groups. Gun owner groups such as gun shops, shooting and hunting clubs, firearm rights groups, gun magazines, and firearm training classes offer an environment in which to deliver a basic rule of firearm safety: Be alert to signs of suicide in household members and keep guns from them until they recover.[63] Gun owner groups typically have a strong safety culture focused on preventing the 600 unintentional firearm deaths that occur annually in the U.S.; expanding that focus to prevent the 19,000 firearm suicides is a natural next step.[49]

Communications research with these groups could (1) identify facilitators and barriers to gun owner organizations embracing the role of reducing the misuse of firearms in suicide; (2) collaborate with gun owner groups to develop communications tools such as brochures, posters, training modules, and sample newsletter blurbs; and (3) test "uptake" of these communications tools (the extent to which groups use the tools when provided).

The ultimate goal of communications research is to develop an interdisciplinary approach that will make reducing a suicidal person's ready access to firearms as "normative" in 10 years as the "friends don't let friends drive drunk" message[64] is today. In addition to messaging research outlined above, research is needed to clarify whether broad-scale media campaigns that raise awareness about suicide and warn families to keep guns from those at risk exert a protective, neutral, or harmful effect (the latter by normalizing suicide).[65]

Intervention Outcomes Research

Controlled clinical trials. As effective messages are developed, rigorous studies are needed to test the impact of lethal means counseling. Although these necessarily will be on a small scale as protocols are tested,[55] ideally, they will be tested in populations large enough (e.g., Veterans Affairs, military, large healthcare network) to detect changes in suicide outcomes. In smaller populations, impact on individuals' self-reported storage of guns and medications should be tested as interim outcome measures. Because these studies are conducted with suicidal individuals, researchers must attend carefully to human subjects considerations to protect study subjects.

Other outcomes research. At the same time, evaluations aimed at other approaches should be undertaken, including (1) technical interventions (e.g., locked electronic pill dispensers, algorithms to flag potentially dangerous prescribing in electronic medical records, personalized firearms that can only be fired by the gun owner); (2) policy interventions (e.g., amend insurance companies' mandatory 90-day prescription policies to exempt patients at risk of overdose); and (3) outreach interventions (e.g., incorporate suicide awareness/means restriction messages in firearm safety materials).

Translation/Dissemination Research

The next step after effective methods of lethal means counseling (and other interventions) are identified, is institutionalizing these practices in standard clinical care among medical and behavioral health providers, and among non-traditional groups like firearm safety instructors and defense attorneys. Translation research will help identify the most effective strategies to promote implementation of effective interventions. As lethal means

counseling becomes more widespread, it will be necessary to find safe storage and disposal options for firearms and toxic medications.

Foundational Research

In concert with developing, testing, and disseminating interventions, we must deepen our understanding of the factors that govern method choice and deliberation in suicidal behavior, and incorporate what is learned, iteratively, into ongoing interventions. Unanswered questions include the following:

1. When a suicidal person's access to a lethal method is blocked, what determines whether he or she substitutes a more lethal versus less lethal method, or abandons an attempt entirely?
2. Under what conditions might blocking access to a low-lethality method (e.g., locking the medicine cabinet) have an unintended harmful effect of leading attempters to substitute more lethal methods?
3. What role do online and personal social networks play in method choice and technical knowledge?
4. Have method-specific case fatality ratios changed over time as the capacity for greater technical knowledge of methods increases and medical interventions change?
5. Have prescribing practices affected the severity of attempts?
6. How do gun storage practices affect suicide risk to the gun owner and household members by age and sex?
7. Among youth who die by firearm suicide, does the source of the firearm (e.g., parent's gun, youth's gun acquired illegally) vary across racial/ethnic/socioeconomic groups?

Foundational research relies upon the existence of accessible, current, and valid data. The National Violent Death Reporting System provides detailed information on suicide deaths and should be expanded from its current 18 states to all 50.[66] The Behavioral Risk Factor Surveillance System has supplied valuable information on state- and national-level gun ownership rates and storage practices; however, its gun items have not been asked since 2004 and should be repeated every 2–3 years.[67] Linked hospital, pharmacy, and death certificate data will enable researchers to examine the impact of prescribing and method switching.

Changing the Paradigm

Currently, the suicide prevention field focuses on identifying people at risk and getting them into treatment. A challenge facing the field is to shift the paradigm such that researchers, practitioners, patients, and the broader population understand that reducing a suicidal person's access to lethal means also has important life-saving potential. A first step is educating researchers and practitioners during training and continuing education about the evidence base.

Reducing the availability of highly lethal and commonly used suicide methods has been associated with declines in suicide rates of as much as 30%–50% in other countries. Research on how to apply these lessons to the U.S.—including communications research to identify effective messages and messengers, clinical trials and other intervention research to identify effective interventions, and translational research to ensure broad uptake of these interventions—has the potential to substantially reduce the number of suicide deaths.

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