Curr Psychiatry Rep (2016) 18: 96
DOI 10.1007/s11920-016-0731-0

MOOD DISORDERS (MA OQUENDO AND MF GRUNEBAUM, SECTION EDITORS)

Recent Advances in Means Safety as a Suicide Prevention Strategy

Hyejin M. Jin [1] · Lauren R. Khazem [1] · Michael D. Anestis [1]

Published online: 14 September 2016
© Springer Science+Business Media New York 2016

Abstract Despite advances in theory and the development and implementation of evidence-based treatments, the United States suicide rate has been rising continuously for over a decade. Although this does not indicate that traditional treatment approaches should be abandoned, it does highlight the need to supplement such approaches with alternatives. One seemingly highly valuable option is means safety, defined as the reduced access to and/or increased safe storage of potentially lethal methods for suicide. This paper provides a review of the current literature on the prevalence of six methods for suicide and preventative efforts aimed to reduce suicide rates. The majority of means safety interventions seem promising given that these methods are common and highly lethal. However, cultural and practical barriers will need to be taken into consideration when implementing these plans. Overall, means safety efforts and preventative measures seem to be promising ways to reduce the national suicide rate if implemented.

Keywords Suicide · Means safety · Means restriction · Firearms

Introduction

Suicide, the 10th leading cause of death in the United States, is difficult to predict and prevent. Traditional prevention approaches center on the provision of psychotherapy and/or psychopharmacology; however, despite impressive improvements in such approaches in recent years, the national suicide rate continues to climb [1], highlighting the need to address the issue from multiple angles. One such approach could be means safety, which involves efforts to decrease access to and/or increase the safe storage of specific methods for suicide.

Our aim in this review is to discuss recent research on means safety across suicide methods and to integrate those findings into the broader literature on these points. Although we reference earlier work, our review focuses on research published between 2013 and 2016, with articles selected through consultation with online databases (PsycInfo, PubMed) and the reference sections of relevant manuscripts. Importantly, we will not use the common term "means restriction" in this review, as both anecdotal and empirical evidence suggests that the term "restriction" may represent a barrier to the successful implementation of such approaches [2•]. Given that the vast majority of means safety approaches involve increased safety in storage or voluntary and temporary removal of access rather than involuntary removal of means (e.g., guns) against an individual's will, the term means safety also appears to simply better represent the nature of the intervention.

Firearms

Regardless of method, suicide is a difficult topic for many to discuss. In the United States (US), this problem is compounded by the nature of the most commonly used method for death by suicide: firearms. Gun ownership is a politically charged issue and the topic is often avoided entirely. When conversations emerge on a national level, they are often in response to mass shootings and high profile homicides, which, although tragic, are much rarer events than are firearm

This article is part of the Topical Collection on *Mood Disorders*

✉ Michael D. Anestis
michael.anestis@usm.edu

[1] Department of Psychology, University of Southern Mississippi, 118 College Drive, Box #5025, Hattiesburg, MS 39406, USA

suicides. Indeed, over 60 % of all firearm deaths in the US are suicides, meaning that the majority of gun deaths are suicides and the majority of suicides are gun deaths [1]. The disconnect between the focus of the conversation and the reality of gun deaths is a reflection of the general lack of knowledge regarding the relationship between guns and suicide and the literature supporting firearms-related means safety in suicide prevention. Fortunately, although the findings are underpublicized and have only been implemented sporadically in real world settings, the literature base on this topic is robust, offering reason for hope in means safety as a vital tool in efforts to reverse the decade long pattern of annually increasing suicide rates.

Each year, despite accounting for only a small fraction of overall suicide attempts, approximately half of all US suicides result from self-inflicted gunshot wounds [1]. Recent research has echoed earlier findings on this topic, demonstrating repeatedly that gun ownership is associated not only with statewide firearm suicide rates, but also with overall suicide rates [3–7]. A common critique of such findings is that researchers might fail to account for important confounders that might better explain the association between gun ownership and suicide; however, these studies have demonstrated that the association between gun ownership and suicide rates holds even after accounting for mental illness, substance use, non-lethal suicide attempts, antidepressant use, and other variables proposed as potentially more useful explanations. Such results do not discount the importance of mental illness in suicide, but rather highlight the incremental utility of considering firearms independent of such factors in understanding risk. The fact that gun ownership predicts overall suicide rates and not simply firearm suicide rates is vital, as suicide prevention centered on changing the way individuals die by suicide rather than preventing individuals from dying by suicide would be of no value.

Demographic factors might play an important role in the problem of firearm suicide in the US. Several of the groups most likely to use firearms in a suicide attempt (e.g., men in general, older adult males, soldiers) have been shown to underutilize mental health resources and to underreport suicidal ideation [8–12]. As a result, such individuals are less likely to be identified as high risk by traditional risk assessment methods. Further compounding that problem is that individuals who die by suicide using a firearm are substantially less likely to have prior suicide attempts (by any method) than are individuals who die by suicide using methods other than guns [13]. In this sense, individuals vulnerable to dying by suicide using the most common method in the US may avoid the mental health care system altogether, underreport their symptoms in a manner that invalidates risk assessment protocols, and never show up in emergency rooms following non-fatal suicide attempts. As such, prevention efforts centered on these individuals need to involve approaches that extend beyond traditional methods. The most commonly proposed solutions on this front involve means safety, either through legislation or the promotion of safe storage.

With respect to legislation, recent research has reported that state laws regulating access and exposure to handguns are associated with both firearm and overall suicide rates, even after accounting for important demographic and geographic factors (e.g., race, education, population density) [14••, 15]. These laws included requiring a license to own a handgun, a permit to purchase a handgun, the registration of handguns, universal background checks, mandatory waiting periods, the use of gun locks, and the restriction of the open carrying of handguns. Effect sizes in these analyses range from small to large in scope, with most qualifying as medium or large (${}_{p}\eta^2$ range = .04–.34) [16], indicating potentially massive clinical value. It should be noted, however, that cultural and political factors will likely prevent the implementation of such laws in many states with high rates of gun ownership and, in this sense, the practical value of such approaches may prove limited.

In response to such concerns, a second line of research has focused on mean safety efforts involving safe storage. Consistent with earlier work on this topic, recent studies have supported the utility of storing personal firearms unloaded and in a secure location (e.g., gun safe). For instance, Khazem and colleagues [17] recruited a large sample of firearm owning military personnel and found that the association between current suicidal ideation and the belief that suicide was likely in the future was significantly stronger among soldiers who stored their gun loaded and in a non-secure location (e.g., bedside table). Furthermore, soldiers who stored their guns unsafely exhibited significantly higher levels of fearlessness about death, a key factor in facilitating the transition from suicidal ideation to suicide attempt within several prominent theories of suicide [18, 19]. Efforts to promote safe storage have recently centered on gun shop dealers, with researchers developing materials promoting safe storage and the temporary (and voluntary) removal of firearms from the house during moments of crisis [20•]. Although such work is in its early stages and it is not yet clear if the approach has an impact on suicidal behavior among gun owners, results indicate that, even among gun owners who do not believe that temporary removal of a firearm from the house would be beneficial, a relatively high percentage are willing to display such materials in their store. Such work may thus represent an important entry point among gun owners for suicide prevention efforts, creating the possibility of a cultural shift toward safe storage of guns as a method of suicide prevention. Taken together, these findings provide robust support for the importance of gun access in suicide and reason for hope that, if widely implemented, means safety efforts might help reduce the national suicide rate.

Hanging/Strangulation/Suffocation

Suffocation ranked as the second most common method of suicide in 2014, accounting for 26.7 % (11,407) of suicide deaths [1]. Despite the commonality of this method, a dearth of recent research exists examining the effectiveness of hanging-specific means safety efforts. Lee and colleagues [21] proposed a surveillance system using 3-D technology to classify suicide attempts by hanging with 95 % accuracy for use in prisons, a setting in which hanging is a common method of suicide [22]. The use of such a system would allow security personnel to intervene in the event of an attempted hanging. The extent to which a system is effective and affordable, however, remains unknown.

Prevention efforts implemented in inpatient settings may have applications for use in the general population. Baker and colleagues [23] recommend installing breakaway closet bars, lowering the height of anchor points, and increasing knowledge about suicide risk. However, the effectiveness of these interventions has not been tested in settings frequented by the general population.

Intentional Overdose

In 2010, 17.1 % of pharmaceutical-related deaths were classified as suicides [24]. Furthermore, in 2014, overdose on medications accounted for 11.03 % (4717) of deaths by suicide. Previous episodes of self-poisoning have been indicated as a strong predictor of subsequent death by suicide [25, 26]. The accessibility of opioid medications has been associated with increased suicide attempt frequency, particularly among females [27]. Furthermore, individuals prescribed minor tranquilizers have also been observed as more likely to use these medications in an intentional overdose [28]. In one study, 76 % of individuals who died by suicide after an overdose used multiple medications [29]. Gjelsvik, Heyerdahl, Lunn, and Hawton [30] observed that physicians may significantly increase these individuals' (particularly females) medication load after their suicide attempts. Furthermore, the authors observed that these individuals' physicians did not replace tricyclic antidepressants with selective serotonin reuptake inhibitors, which are less lethal when ingested with the intention of overdose [31].

Despite the strong evidence supporting the need for suicide prevention efforts aimed at safety regarding medication use, little research has examined the effects of suicide prevention efforts targeting self-poisoning with medications. In 2003, the Food and Drug Administration began publicizing the risk of suicide associated with antidepressant use. These warnings were associated with an increase in nonlethal psychotropic drug poisonings among male adolescents and young adults [32]. In England and Wales, the restriction of the sizes of medication pack sizes has been associated with a decrease in overdose-related suicides 15 years later [33], indicating a potential means of effective suicide prevention. However, Bateman's [34] review of subsequent research argues that these effects are likely small in nature. Recently, the effects of blister packaging of medications on the reduction of overdoses have been examined [35], and although there was no difference in rates of overdose between those receiving medications with or without blister packaging, this form of medication delivery may have implications for suicide prevention efforts. Compared to medications that are packaged in bottles, those in blister packaging may require greater effort and time to use in a suicide attempt as individuals must take individual pills out of the packaging, whereas medications in bottles may be taken in greater quantities at once. Furthermore, the extra time and effort involved in overdose from medications in blister packaging may allow individuals more time to reconsider attempting suicide. The current state of the literature on blister packaging as a suicide prevention tool does not provide sufficient information for us to effectively evaluate the efficacy of this approach; however, we believe further research in this area would prove highly valuable.

Gas Inhalation

In 2014, 2.6 % of suicide decedents died by intentionally self-poisoning utilizing gas or vapors [1]. Furthermore, between the years of 1999 and 2012, carbon monoxide (CO) poisoning was indicated as the second most common non-medical poisoning death, and the rate of utilization of this method did not change [36]. In San Diego County, California, inhaled toxins are utilized in 81 % of non-pharmaceutical related suicides [37], indicating that the commonality of the method may vary geographically. Worldwide, helium inhalation has become an increasingly common method of suicide [38–40], which may be due, in part, to the accessibility of information regarding its use in a suicide attempt [41].

With respect to means safety efforts specific to this method, it should be noted that the decreased rate of fatal and nonfatal motor vehicle-related CO poisonings in the US between 1985 and 2013 is correlated with reductions in CO emissions from vehicles and, potentially, the U.S. Clean Air Act of 1970 and the invention of catalytic converters in 1975 [42]. Prevention efforts aimed at restricting access to these means has been indicated as potentially effective in other countries, which is particularly noteworthy as suicides utilizing this method have increased in Eastern/Southeast Asian countries [43]. For instance, in New Taipei City, Taiwan, after stores were mandated to move charcoal bags from open shelves to behind locked areas, suicides in the area decreased, while suicides in control areas remained constant, indicating that a suicide displacement effect did not occur [44]. These data indicate that means safety interventions and legislation may be well served in preventing intentional poisonings utilizing gases.

Jumping

In 2014, falls were classified as the 4th most common method for death by suicide, accounting for 994 deaths [1]. Many of these falls occur at bridges, and more popular bridges may be classified as suicide hotspots. Cox and colleagues [45] conducted a meta-analysis of suicide prevention efforts aimed at suicide hotspots and identified restricting access to areas by installation of physical barriers as an effective. Pirkis and colleagues [46••] provided further support to the implementation of safety barriers, as restricting access to suicide hotspots was associated with a decrease in the overall yearly suicide rate. Concerns about displacement of suicides to other bridges after these prevention efforts are implemented have largely not been supported. Specifically, after the installation of a safety barrier on a bridge in Montreal, suicides by jumping from the bridge decreased, and there was no evidence of displacement to other bridges in the surrounding areas [47]. However, Pirkis and colleagues [48] noted in their meta-analysis that, although the installation of safety barriers was associated with an 86 % decrease in suicides per year from jumping from these bridges, there was a 44 % increase in suicides from jumping from nearby hotspots. However, the authors also note that despite this increase in suicides, there was a 28 % net decrease in suicides in the cities included in the study. Further research indicates that after a barrier was removed from a bridge in New Zealand in 1996, suicides from the bridge increased fivefold, leading to the decision to reinstall the barrier in 2003. After reinstallation of the barrier, no suicides from the bridge were observed [49], providing further evidence supporting the effectiveness of bridge barriers in suicide prevention.

Alcohol

Alcohol use is prevalent in the United States [50] and there is an assumption among many researchers and clinicians that alcohol and suicide are highly related. Although not a suicide attempt method itself, for reasons detailed below, alcohol may nonetheless represent a useful tool for means safety efforts geared toward suicide prevention.

One rationale for potentially considering alcohol in means safety efforts is the role that it might play in facilitating a subsection of suicide attempts. For example, alcohol is often consumed with other medications, such as sedatives, anxiolytics, tranquilizers, and over-the-counter medications, so as to intensify the lethality of the overdose as the primary method [31]. In this sense, although the alcohol itself was not fatal and did not represent a suicide attempt method, its use during an attempt had the potential to render an otherwise inert or at least less dangerous method lethal. In support of this, in a sample of recent suicide attempters, 12.73 % had overdosed on alcohol and other drugs [51] and 38 % of 4377 decedents in Sweden who died by drowning had non-zero blood alcohol concentrations (BAC), with the mean concentration being 1.8 g/l [52].

There are multiple mechanisms that have been proposed through which alcohol could potentially facilitate suicidal behavior. Alcohol lowers an individual's inhibitions [53], thereby possibly making it easier to make a lethal or near-lethal attempt. Alcohol also affects motor control, which could render accidental death more likely when an individual is contemplating a suicide attempt (e.g., accidentally pulling the trigger of a gun while considering whether or not to do so) [54]. Furthermore, Hufford [55] suggested several mechanisms in which alcohol increases proximal risk for suicidal behavior. Specifically, Hufford [55] proposed that alcohol may have the potential to increase psychological distress and aggressiveness, initiate suicidal action via suicide-specific alcohol expectancies, and constrict cognition and prevent the usage of alternative coping strategies to regulate emotions [55–57]. It is also possible that alcohol is used to remove psychological barriers that make it difficult to make an attempt by increasing courage and decreasing the fears and the pain associated with death [58]. In this sense, alcohol may be used as a way to overcome humans' innate fear of death and self-preservation tendencies [18].

Somewhat in contrast to these possibilities and to the common belief that alcohol frequently plays a proximal role in suicidal behavior, a recent meta-analysis of 92 studies found that suicide decedents rarely have alcohol in their system at the time of death [59]. Only 33.6 % [60] of the 167,894 decedents had non-zero BAC, meaning that 66.4 % of those who died by suicide did not consume any alcohol preceding their death. Of those who had, only a portion exhibited BAC levels consistent with intoxication and, in every sample in which such data were available, urine alcohol content levels were higher than BAC, indicating that alcohol was not consumed immediately prior to the suicide attempt, but rather had already largely been metabolized. Future work examining the precise nature of the association between acute alcohol use and suicidal behavior should examine the possibility that some individuals, in the process of "coming down" from alcohol intoxication, experience a worsening of distress that facilitates a suicide attempt.

Although the precise role of acute alcohol use in death by suicide remains somewhat unclear, means safety efforts that involve alcohol may nonetheless offer value in suicide prevention. Importantly, means safety is not synonymous with prohibition. Rather, such approaches would involve managing access and consumption at times of risk and adjusting environments to optimize the reach of any means safety effort. As one example, several studies have examined the effect of limiting the density of retail alcohol outlets (i.e., physical locations wherein individuals can purchase alcohol) on alcohol-

related harmful outcomes, including suicide. In one meta-analysis, Campbell and colleagues [61] found that limiting the physical accessibility to alcohol and thereby increasing the distance of travel to and from alcohol outlets resulted in a reduction in accessibility, increase in prices of alcohol, decreased exposure to alcohol, decreased alcohol consumption, and ultimately decreased the rates of suicide for males in the surrounding areas. Thus, a possible effective means safety approach for alcohol would be enacting a state-level policy regarding alcohol accessibility such that specific locations are not overly saturated with inventory. Furthermore, storing alcohol in a locked cabinet so that it is out of sight may be another effective way for individuals not to consume it at times of distress or when experiencing suicidal ideation. Lastly, mental health providers can also implement safety planning interventions to mitigate suicide risk and provide an opportunity for individuals to devise a list of internal coping and socialization strategies [62]. Ensuring that consumers are aware of the possible lethality of alcohol when mixed with other substances and making it more difficult to access them may be a potential way in which alcohol can be consumed without irrevocable consequences.

Conclusion

Suicide is a pronounced public health concern, and substantial efforts have been aimed toward better understanding, preventing, and intervening when individuals are at risk. Many risk factors for suicide have been identified, and several evidence-based treatments have been developed across diverse populations. Nonetheless, despite advances in theories and the development of effective treatments such as dialectical behavior therapy [63], the national suicide rate has been continuously rising for over a decade [1]. Thus, a different approach may be necessary in order to reduce the overall suicide rate. Means safety, which is a modification of the environment to decrease access to methods that are used for attempts, has gained attention over the years and is reported to have the strongest empirical support amongst the many other interventions [64, 65]. We believe that the evidence discussed above demonstrates unambiguously that means safety approaches have the potential to yield meaningful reductions in suicidal behavior across methods, whether the approach is centered on the specific method by which an individual might attempt suicide (e.g., firearms) or on other factors that might indirectly facilitate death by suicide (e.g., alcohol).

Means safety can be implemented in various ways, from complete removal of the method to creating barriers that interfere with accessibility. Means safety is especially effective for methods that are common, highly lethal, and which account for a significant percentage of deaths [66]. Within the US, this thus highlights the importance of means safety approaches that focus primarily upon firearms, as the majority of gun deaths are suicides and the majority of suicides are gun deaths [1]. In some states, laws have being implemented to reduce accessibility to and increase the safe storage of guns (particularly handguns), including universal background checks and requiring the use of gun locks in at least some circumstances [14••, 15]. The results from studies examining the impact of these laws indicate that such approaches have the potential to be of great value; however, cultural barriers likely limit the plausibility of legislative solutions in many high gun ownership areas. As such, newer research examining the utility of safe storage has gained increasing attention. Results from such studies [17] are promising; however, more work in this area is needed to determine the specific forms of safe storage (e.g., using a gun safe, keeping the gun unloaded, temporarily allowing a trusted individual to keep a gun away from the home during times of crisis) exhibit the most robust effects on suicidal behavior.

Research on means safety with respect to jumping from high places (e.g., bridges) has also produced unambiguously meaningful effects with respect to suicide prevention. In particular, physical barriers to impede efforts to jump off of bridges have been very effective and removal of such barriers has resulted in increased suicidal behavior [49].There was a dearth of research and empirical data on hanging, intentional overdose, and alcohol. However, researchers have put forth suggestions for means safety, such as surveillance systems in jails to prevent hanging, blister packaging for medications, and state laws to regulate the physical accessibility of alcohol, which all seem promising as methods to increase safety and decrease the use of such methods in suicide attempts.

Empirical data suggests that means safety can be extremely effective, especially when the method is common, highly lethal, and supported by the community [67]. The methods covered in the present review are common, and there are many broad-based means safety interventions that have been or likely will be implemented in the near future. In order for these interventions to be effective, broad community support and participation, as well as the leadership of policy makers are necessary. Although these means safety and restriction methods seem promising, there is a need to investigate the increasing suicide rates with a multifaceted approach as to address the many complicated factors involved in suicide.

Compliance with Ethical Standards

Conflict of Interest Hyejin M. Jin, Lauren, R. Khazem, and Michael D. Anestis declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:

- • Of importance
- •• Of major importance

1. Centers for Disease Control and Prevention. (2016). Web-Based Injury Statistics Query and Reporting System (WISQARS). Available at http://www.cdc.gov/injury/wisqars/index.html
2. • Stanley IH, Hom MA, Rogers ML, Anestis MD, Joiner TE. Discussing firearm ownership and access as part of suicide risk assessment and prevention: "means safety" versus "means restriction.". Arch Suicide Res. 2016;13:1–17. **We believe this reference is of importance because it speaks to the importance of wording when considering means safety approaches. The more commonly used term "means restriction" may diminish the odds of individuals accepting safety recommendations, particularly in areas with cultural values that emphasize potentially high risk behavior such as gun ownership.**
3. Miller M, Barber C, White RA, Azrael D. Firearms and suicide in the United States: is risk independent of underlying suicidal behavior? Am J Epidemiol. 2013;178:946–55.
4. Miller M, Lippmann SJ, Azrael D, Hemenway D. Household firearm ownership and rates of suicide across the 50 United States. J Traum. 2007;62:1029–34.
5. Miller M, Swanson SA, Azrael D. Are we missing something pertinent? A bias analysis of unmeasured confounding in the firearm-suicide literature. Epidemiol Rev. 2016;38:62–9.
6. Miller M, Warren M, Hemenway D, Azrael D. Firearms and suicide in US cities. Inj Prev. 2015;21:e116–9.
7. Opoliner A, Azrael D, Barber C, Fitzmaurice G, Miller M. Explaining geographic patterns of suicide in the US: the role of firearms and antidepressants. In Epidemiol. 2014;1:6. doi:10.1186/2197-1714-1-6.
8. Anestis MD, Green BA. The impact of varying levels of confidentiality on disclosure of suicidal thoughts in a sample of United States National Guard personnel. J Clin Psychol. 2015;71:1023–30.
9. Cukrowicz KC, Jahn DR, Graham RD, Poindexter EK, Williams RB. Suicide risk in older adults: evaluating models of risk and predicting excess zeros in a primary care sample. J Abnorm Psychol. 2013;122:1021–30.
10. Duberstein PR, Conwell Y, Seidlitz L, Lyness JM, Cox C, Caine ED. Age and suicidal ideation in older depressed inpatients. Am J Geriatr Psychiatry. 1999;7:289–96.
11. Kessler RC, Brown RL, Broman CL. Sex differences in psychiatric help-seeking: evidence from four large-scale surveys. J Health Soc Behav. 1981;22:49–64.
12. Kim PY, Britt TW, Klocko RP, Riviere LA, Adler AB. Stigma, negative attitudes about treatment, and utilization of mental health care among soldiers. Military Psychol. 2011;23:65–81.
13. Anestis MD. Prior suicide attempts are less common in suicide decedents who died by firearms relative to those who died by other means. J Affect Disord. 2016;189:106–9.
14. •• Anestis MD, Anestis JC. Suicide rates and statewide laws regulating access and exposure to handguns. Am J Public Health. 2015;105:2049–58. **We believe this citation to be of great importance, as it demonstrates robust support for legislative means safety approaches specific to firearms. Given that firearms are the most common suicide death method in the US, mean safety efforts focused primarily on the method are likely to yield the most pronounced effect on national suicide rates.**
15. Anestis MD, Khazem LR, Law KC, Houtsma C, LeTard R, Moberg F, et al. The association between state laws regulating handgun ownership and suicide rates. Am J Public Health. 2015;105:2059–67.
16. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale: Erlbaum; 1988.
17. Khazem LR, Houtsma C, Gratz KL, Tull MT, Green BA, Anestis MD. Firearms matter: the moderating role of firearm storage in the association between current suicidal ideation and likelihood of future suicide attempts among United States military personnel. Military Psychol. 2016;28:25–33.
18. Joiner TE. Why people die by suicide. Cambridge: Harvard University Press; 2005.
19. Klonsky ED, May AM. The Three-Step Theory (3ST): a new theory of suicide rooted in the "ideation to action" framework. Int J Cognit Ther. 2015;8:114–29.
20. • Vriniotis M, Barber C, Frank E, Demicco R, the New Hampshire Firearm Safety Coalition. A suicide prevention campaign for firearm dealers in New Hampshire. Suicide Life-Threat Behav. 2015;45:157–63. **We believe this reference is of importance because it represents an emerging line of research considering non-legislative approaches to firearms-based means safety. This approach reaches out to gun owning communities in a collaborative fashion that might ultimately result in more potent effects than are seen in legislative options.**
21. Lee S, Kim H, Lee S, Kim Y, Lee D, Ju J, et al. Detection of a suicide by hanging based on a 3-D image analysis. IEEE Sens J. 2014;14:2934–5.
22. Hawton K, Linsell L, Adeniji T, Sariaslan A, Fazel S. Self-harm in prisons in England and Wales: an epidemiological study of prevalence, risk factors, clustering, and subsequent suicide. Lancet. 2014;383:1147–54.
23. Baker SP, Hu G, Wilcox HC, Baker TD. Increase in suicide by hanging/suffocation in the US, 2000–2010. Am J Prev Med. 2013;44:146–9.
24. Jones CM, Mack KA, Paulozzi LJ. Pharmaceutical overdose deaths, United States, 2010. JAMA. 2013;309:657–9.
25. Finkelstein Y, Macdonald EM, Hollands S, Sivilotti ML, Hutson JR, Mamdani MM, et al. Risk of suicide following deliberate self-poisoning. JAMA Psychiat. 2015;72:570–5.
26. Finkelstein Y, Macdonald EM, Hollands S, Sivilotti ML, Hutson JR, Mamdani MM, et al. Repetition of intentional drug overdose: a population-based study. Clin Toxicol. 2016;54:585–9.
27. Davis JM, Searles VB, Severtson SG, Dart RC, Bucher-Bartelson B. Seasonal variation in suicidal behavior with prescription opioid medication. J Affect Disord. 2014;158:30–6.
28. Corcoran P, Heavey B, Griffin E, Perry IJ, Arensman E. Psychotropic medication involved in intentional drug overdose: implications for treatment. Neuropsychiatry. 2013;3(3):285–93.
29. Szymanski LJ, Aurelius MB, Szymanski SA, Lathrop SL. Suicidal drug overdoses in New Mexico: a 5-year retrospective review. J Foren Sci. 2016;61:661–5.
30. Gjelsvik B, Heyerdahl F, Lunn D, Hawton K. Change in access to prescribed medication following an episode of deliberate self-poisoning: a multilevel approach. PloS one. 2014;9:e98086.
31. White AM, MacInnes E, Hingson RW, Pan IJ. Hospitalizations for suicide-related drug poisonings and co-occurring alcohol overdoses in adolescents (ages 12-17) and young adults (18-24) in the United States, 1999-2008: results from the nationwide inpatient sample. Suicide Life-Threat Behav. 2013;43:198–212.
32. Lu CY, Zhang F, Lakoma MD, Madden JM, Rusinak D, Penfold RB, et al. Changes in antidepressant use by young people and suicidal behavior after FDA warnings and media coverage: quasi-experimental study. BMJ. 2014;348:g3596.
33. Hawton K, Bergen H, Simkin S, Dodd S, Pocock P, Bernal W, et al. Long term effect of reduced pack sizes of paracetamol on poisoning deaths and liver transplant activity in England and Wales: interrupted time series analyses. BMJ. 2013;346:f403.

34. Bateman DN. Pack size and paracetamol overdose: 16 years later. Clin Toxicol. 2014;52:821–3.
35. Gutierrez PM, Brenner LA, Wortzel H, Leitner R, Harwood JE. Blister packaging medication to increase treatment adherence and clinical response: impact on suicide-related morbidity and mortality. Denver: US. Denver Research Institute; 2014.
36. Sircar K, Clower J, Kyong Shin M, Bailey C, King M, Yip F. Carbon monoxide poisoning deaths in the United States, 1999 to 2012. Am J Emerg Med. 2015;33(9):1140–5.
37. Cantrell L, Lucas J. Suicide by non-pharmaceutical poisons in San Diego County. Clin Toxicol. 2014;52(3):171–5.
38. Chang SS, Cheng Q, Lee ES, Yip PS. Suicide by gassing in Hong Kong 2005–2013: emerging trends and characteristics of suicide by helium inhalation. J Affect Disord. 2016;192:162–6.
39. Gunnell D, Coope C, Fearn V, Wells C, Chang S-S, Haw-ton K, et al. Suicide by gasses in England & Wales 2001-2011: evidence of the emergence of new methods of suicide. J Affect Disord. 2015;170:190–5.
40. Hassamal S, Keyser-Marcus L, Crouse Barden E, Hobron K, Bhattachan A, Pandurangi A. A brief analysis of suicide methods and trends in Virginia from 2003–2012. BioMed Res Int. 2015. doi:10.1155/2015/104036.
41. Gunnell D, Derges J, Chang SS, Biddle L. Searching for suicide methods. Crisis. 2015;5:325–31.
42. Hampson NB, Holm JR. Suicidal carbon monoxide poisoning has decreased with controls on automobile emissions. Undersea Hyperbar Med. 2015;42:159–64.
43. Chang SS, Chen YY, Yip PS, Lee WJ, Hagihara A, Gunnell D. Regional changes in charcoal-burning suicide rates in east/southeast Asia from 1995 to 2011: a time trend analysis. PLoS Med. 2014;11:e1001622.
44. Chen YY, Chen F, Chang SS, Wong J, Yip PS. Assessing the efficacy of restricting access to barbecue charcoal for suicide prevention in Taiwan: a community-based intervention trial. PloS one. 2015;10:e0133809.
45. Cox GR, Owens C, Robinson J, Nicholas A, Lockley A, Williamson M, et al. Interventions to reduce suicides at suicide hotspots: a systematic review. BMC Public Health. 2013;13:1.
46.•• Pirkis J, Too LS, Spittal MJ, Krysinska K, Robinson J, Cheung YTD. Interventions to reduce suicides at suicide hotspots: a systematic review and meta-analysis. Lancet Psychiatr. 2015;2:994–1001. **We believe this citation to be of great importance because it provides compelling evidence for means safety approaches that extent beyond firearms and the United States. The results from this study also provide a robust counterargument to the notion of means substitution.**
47. Perron S, Burrows S, Fournier M, Perron PA, Ouellet F. Installation of a bridge barrier as a suicide prevention strategy in Montreal, Quebec, Canada. Am J Public Health. 2013;103:1235–9.
48. Pirkis J, Spittal MJ, Cox G, Robinson J, Cheung YTD, Studdert D. The effectiveness of structural interventions at suicide hotspots: a meta-analysis. Int J Epidemiol. 2013;42:541–8.
49. Beautrais AL, Gibb SJ, Fergusson DM, Horwood LJ, Larkin GL. Removing bridge barriers stimulates suicides: an unfortunate natural experiment. Aust New Zeal J Psychiatr. 2009;43:495–7.
50. Centers for Disease Control and Prevention. Health behaviors of adults: United States, 2008–2010. Vital Health Stat. 2013;10:1–184. Available at http://www.cdc.gov/nchs/data/series/sr_10/sr10_257.pdf.
51. Bagge CL, Glenn CR, Lee HJ. Quantifying the impact of recent negative life events on suicide attempts. J Abnorm Psychol. 2013;122:359–68.
52. Ahlm K, Saveman BI, Bjornstig U. Drowning deaths in Sweden with emphasis on the presence of alcohol and drugs – a retrospective study, 1992-2009. BMC Public Health. 2013;13:216.
53. Goldsmith SK, Pellmar TC, Kleinman AM, Bunney WE. Reducing suicide: a national imperative. Washington: National Academy of Sciences; 2002.
54. Welte J, Abel E, Wieczorek W. The role of alcohol in suicides in Erie County NY 1972–84. Public Health Rep. 1988;103:648–52.
55. Hufford MR. Alcohol and suicidal behavior. Clin Psychol Rev. 2001;21:797–811.
56. Brady J. The association between alcohol misuse and suicidal behaviour. Alcohol Alcohol. 2006;41:473–8.
57. Cherpitel CJ, Borges GLG, Wilcox HC. Acute alcohol use and suicidal behavior: a review of the literature. Alcohol Clin Exp Res. 2004; 28:18s–28s.
58. Bagge CL, Sher KJ. Adolescent alcohol involvement and suicide attempts: toward the development of a conceptual framework. Clin Psychol Rev. 2008;28:1283–96.
59. Anestis MD, Joiner T, Hanson JE, Gutierrez PM. The modal suicide decedent did not consume alcohol just prior to the time of death: an analysis with implications for understanding suicidal behavior. J Abnorm Psychol. 2014;123:835–40.
60. Conner KR. Commentary on "The modal suicide decedent did not consume alcohol just prior to the time of death: an analysis with implications for understanding suicidal behavior". J Abnorm Psychol. 2015;124:457–9.
61. Campbell CA, Hahn RA, Elder R, Brewer R, Chattopadhyay S, Fielding J, et al. The effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. Am J Prev Med. 2009;37:556–69.
62. Stanley B, Brown GK. Safety planning intervention: a brief intervention to mitigate suicide risk. Cognit Behav Pract. 2011;18:256–64.
63. Linehan MM. Cognitive behavioral therapy of borderline personality disorder. New York: Guilford Press; 1993.
64. Mann JJ, Apter A, Bertolote J, et al. Suicide prevention strategies: a systematic review. JAMA. 2005;294:2064–74.
65. Daigle MS. Suicide prevention through means restriction: assessing the risk of substitution: a critical review and synthesis. Accid Anal Prev. 2005;37:625–32.
66. Chen YY, Wu KC-C, Yip PSF. Suicide prevention through restricting access to suicide means and hotspots. In: O'Connor RC, Platt S, Gordon J, editors. International handbook of suicide prevention: research, policy, and practice. Chichester: Wiley; 2011. p. 545–60.
67. Yip PSF, Caine E, Yousuf S, Chang SS, Wu KCC, Chen YY. Means restriction for suicide prevention. Lancet. 2012;379:2393–9.