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Commentary

Firearms, pesticides, and suicide: A look back for a way forward

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The United States (US) has seen a continuous rise in suicide rates since 2005, a trend that suggests a general failure of traditional interventions alone. With the dawn of a new decade – and with a global pandemic raising concerns about an impending spike in suicide rates (Gunnell et al., 2020) – comes an opportunity to reflect on past strategies and adjust future directions. Specifically, additional attention to environmental approaches may help reverse the trend of rising rates. Environmental approaches, typically referred to as “means safety,” involve making a specific method (“means”) for suicide less deadly or less available. In the US, any such approach must focus primarily on firearms, which have the highest case-fatality rate and account for approximately half of all suicide deaths (Conner et al., 2019). Countless questions remain about firearm-focused means safety interventions, including how, where, and with whom to design and implement them (Allchin et al., 2019).

Some answers may come from international experiences in reducing suicide by pesticide ingestion. While suicide rates were increasing in the US, an opposite trend emerged in parts of Asia where pesticide ingestion was a major cause of suicide. Success on this front was achieved largely through bans of several particularly lethal pesticides (Gunnell et al., 2017), highlighting the importance of high-level policy change in effecting widespread change. Yet there were also studies on the effectiveness of safer household pesticide storage, including through provision of lockable storage boxes. Unfortunately – and importantly for the firearm suicide field – randomized controlled trials have not found evidence that these storage interventions reduced pesticide-related suicide rates (Pearson et al., 2017). A 2019 systematic review on pesticide suicide prevention concluded efforts focused on in-home storage should end, with energy instead shifted to community-based, centralized storage options (Reifels et al., 2019). Notably, this systematic review was funded by the pesticide industry and, while

methodologically sound, overstated the promise of community-based programming (Knipe and Eddleston, 2019).

The experience from pesticides – that banning certain types had the biggest impact on suicide prevention – might suggest the parallel action of banning certain types of firearms in the US. But such bans are, in 2020, politically unrealistic on a national level and typically only have support in states with low firearm ownership rates (Mann and Michel, 2016). Although public support for certain types of firearm legislation (e.g., banning assault-style weapons or high-capacity magazines) has increased in recent years (Pew Research Center, 2019), persistent political divides are a significant obstacle to implementation (Winker et al., 2020). In the US, there are other types of firearm legislation (e.g. extreme risk protection orders, firearm licensing) that might impact suicide rates (Swanson et al., 2017); however, current political reality renders federal implementation of such laws unlikely. Furthermore, legislation generally addresses the issue of firearm access at the point of purchase (e.g. waiting periods) or at specific times of readily documented acute risk to self or others (e.g. extreme risk protection orders) and, in this sense, does not offer a solution relevant to the approximately 300 million firearms already in circulation within the US. A complete ban on all firearms in the United States, including removal of existing firearms from citizens' homes, is unlikely to occur anytime in the near future, especially given Constitutional considerations.

In response, many stakeholders have instead promoted efforts focused on safer storage of firearms in the home and temporary and voluntary storage of firearms away from home during times of crisis. These approaches are analogous to promoting safer sex (rather than abstinence-only) in sex education courses for teenagers. They recognize that removing the source of risk would provide the greatest reduction in the unwanted outcome (e.g. firearm access and suicide, sex and sexually transmitted diseases or pregnancy among teenagers), but they

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assume some level of risk will remain present and they therefore take a “harm reduction” approach to prevention. Such approaches include “gun shop projects,” (Polzer et al., 2020) lethal means counseling by clinicians, and public education or public service announcements (Prevent Firearm Suicide, n.d.). These efforts offer many potential strengths, including collaborations that involve the support of the firearms community (Brassard, 2016) and a less politically charged nature that allows important private and public stakeholders to openly endorse the approach. The energy behind this approach, however, has outpaced the science, as there are no data capable of addressing the extent to which these approaches affect home firearm storage or suicide rates.

Safe storage efforts may be the most palatable and have the greatest potential for dissemination and implementation, but experiences from the pesticide field should lead to questions about whether this approach will yield the desired effect. Prior pesticide storage studies have shown the importance of attention to details like the type of storage device (e.g., size, inclusion of lock) (Hawton et al., 2009), perceptions of the population (e.g., convenience, understanding of link between access and suicide risk) (Konradsen et al., 2007), and community buy-in (e.g., feasibility of central community storage, training of retailers to recognize at-risk customers) (Weerasinghe et al., 2018). Similar research focused on firearm suicide within the US is needed in to address a range of related questions regarding the efficacy and acceptability of specific storage methods (e.g. cable locks), local obstacles to legal temporary transfer of firearms during times of elevated risk (Gibbons et al., 2020), and knowledge gaps regarding available options for out of home storage of personal firearms (Konradsen et al., 2007; Weerasinghe et al., 2018; Gibbons et al., 2020; Kelly et al., 2020).

The current situation can thus be summarized as resting upon an evidence-base comprised of effective but politically unfeasible legislation and unproven but popular home storage campaigns, with uneasy alliances and occasional open conflicts between stakeholders. That firearms play a profoundly meaningful role in American suicide is undeniable. Yet this truth does not provide clarity on questions that must be answered to guide a national strategy. The response should not, and cannot, be to give up; if anything, in the face of rising suicide rates, we must redouble our efforts on a path of (1) discovery, (2) innovation, and (3) collaboration.

First, we must invest in science. Progress was made in preventing pesticide suicide because the situation was treated as a public health crisis and was studied and confronted accordingly - although the battle was not without political challenges or interference by lobbyists seeking to increase profits for their clients (including through funding research) (Gunnell et al., 2018; Pearson et al., 2015). To produce similar results for firearm suicide in the US, we need a well-funded, non-partisan research investment that allows scientists the freedom to ask the necessary questions – even politically uncomfortable ones about legislation – and to collect the necessary data so as to facilitate a surge in knowledge that can promote effective changes in our regional and national strategies. Application of a public health model and associated strategies will be critical in designing a comprehensive, effective approach to firearm suicide prevention (Prevent Firearm Suicide, n.d.; Eddleston et al., 2006).

Second, we must also consider effectiveness from angles beyond changes in the suicide rate. Particularly with primary prevention approaches, the effect of implementing safer in-home storage approaches on suicide rates will be unclear due issues of sample size and power to detect changes, especially in samples without acute suicide risk. As such, we need to consider the “mechanism” of interventions like lethal means counseling, public service announcements, gun shop projects, and other similar efforts (Allchin et al., 2019). That is, do they impact knowledge of the role of firearms in suicide, or attitudes towards firearm storage? (Barber and Miller, 2014; Anestis et al., 2018) Why are interventions used, or not? Intrinsic motivation, prompted by community-based research in which firearm owners are directly engaged, may

be the most effective method for scalable and sustainable change. In this sense, interacting directly with the gun owning community itself, rather than through the filter of firearm-related organizations, may offer the greatest opportunity for change.

Third, we must build collaborations engaging stakeholders committed to open-mindedness and compromise. We will not solve firearm suicide without firearm owners, so their culture and perspectives must be heard, respected, and incorporated into programs and interventions. Perspectives from the pesticide field again can be useful; for pesticides, as with firearms, training of retailers about suicide prevention may be a desirable and feasible intervention (Polzer et al., 2020; Weerasinghe et al., 2018). Stakeholders should also be included in research early, from the design phase, to clarify research questions, facilitate recruitment, and inform interpretation of results (Betz et al., 2020). At the same time, pandering to impulses contradicted by science will cost lives, so the firearm owning community needs to be willing to consider options they do not prefer but are nonetheless the best options available for saving lives at a community level.

The US is facing a firearm suicide epidemic, one likely worsened by the COVID-19 pandemic and its associated spike in mental distress and gun sales (Gunnell et al., 2020). But epidemics can be halted when those in a position to effect change appreciate the scope of the problem and are able to step up to address it effectively. With the start of a new decade, and with the dramatic changes in work and life brought by COVID-19, comes the opportunity to forge a path. We must ensure this path is one of productive partnerships, proper investment in research, broad implementation of effective interventions, and leverage of prior public health lessons to develop innovative solutions.

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References

- Allchin, A., Chaplin, V., Horwitz, J., 2019. Limiting access to lethal means: applying the social ecological model for firearm suicide prevention. *Inj Prev* 25, i44–i48. <https://doi.org/10.1136/injuryprev-2018-042809>.
- Anestis, M.D., Butterworth, S.E., Houtsuma, C., 2018. Perceptions of firearms and suicide: the role of misinformation in storage practices and openness to means safety measures. *J. Affect. Disord.* 227, 530–535. <https://doi.org/10.1016/j.jad.2017.11.057>.
- Barber, C.W., Miller, M.J., 2014. Reducing a suicidal person’s access to lethal means of suicide: a research agenda. *Am. J. Prev. Med.* 9 (47), S264–S272. <https://doi.org/10.1016/j.amepre.2014.05.028>.
- Betz, M.E., Knoepke, C.E., Simpson, S., Siry, B.J., Clement, A., Saunders, T., et al., 2020. An interactive web-based lethal means safety decision aid for suicidal adults (lock to live): pilot randomized controlled trial. *J. Med. Internet Res.* 22. <https://doi.org/10.2196/16253>.
- Brassard, B., 2016. NSSF-AIFSP Suicide Prevention Partnership. National Shooting Sports Foundation. <http://www.nssfblog.com/nssf-afsp-suicide-prevention-partnership/> (Accessed 1 May 2020).
- Conner, A., Azrael, D., Miller, M., 2019. Suicide case-fatality rates in the United States, 2007 to 2014: a nationwide population-based study. *Ann. Intern. Med.* <https://doi.org/10.7326/m19-1324>.
- Eddleston, M., Buckley, N.A., Gunnell, D., Dawson, A.H., Konradsen, F., 2006. Identification of strategies to prevent death after pesticide self-poisoning using a Haddon matrix. *Inj. Prev.* 12, 333–337. <https://doi.org/10.1136/ip.2006.012641>.
- Gibbons, M.J., Fan, M.D., Rowhani-Rahbar, A., Rivara, F.P., 2020. Legal liability for returning firearms to suicidal persons who voluntarily surrender them in 50 US states. *Am. J. Public Health* e1–e4. <https://doi.org/10.2105/AJPH.2019.305545>.
- Gunnell, D., Knipe, D., Chang, S.S., Pearson, M., Konradsen, F., Lee, W.J., et al., 2017. Prevention of suicide with regulations aimed at restricting access to highly hazardous pesticides: a systematic review of the international evidence. *Lancet Glob. Health* 5, e1026–e1037. [https://doi.org/10.1016/S2214-109X\(17\)30299-1](https://doi.org/10.1016/S2214-109X(17)30299-1).
- Gunnell, D., Appleby, L., Arensman, E., Hawton, K., John, A., Kapur, N., et al., 2020. Suicide risk and prevention during the COVID-19 pandemic. *Lancet Psychiatry*. [https://doi.org/10.1016/S2215-0366\(20\)30171-1](https://doi.org/10.1016/S2215-0366(20)30171-1).
- Gunnell, D., Knipe, D., Hussey, I., 2018. Pesticides and suicide prevention – why research needs to be put into practice. *The Conversation*. <http://theconversation.com/pesticides-and-suicide-prevention-why-research-needs-to-be-put-into-practice-102533>, Accessed date: 1 May 2020.
- Hawton, K., Ratnayeke, L., Simkin, S., Harriss, L., Scott, V., 2009. Evaluation of

- acceptability and use of lockable storage devices for pesticides in Sri Lanka that might assist in prevention of self-poisoning. *BMC Public Health* 9, 69. <https://doi.org/10.1186/1471-2458-9-69>.
- Kelly, T., Brandspigel, S., Polzer, E., Betz, M.E., 2020. Firearm storage maps: a pragmatic approach to reduce firearm suicide during times of risk. *Ann. Intern. Med.* <https://doi.org/10.7326/m19-2944>.
- Knipe, D.W., Eddleston, M., 2019. Response to Reifels et al., suicide and life-threatening behavior. *Suicide Life Threat. Behav.* 49, 1782–1783. <https://doi.org/10.1111/sltb.12546>.
- Konradsen, F., Pieris, R., Weerasinghe, M., van der Hoek, W., Eddleston, M., Dawson, A.H., 2007. Community uptake of safe storage boxes to reduce self-poisoning from pesticides in rural Sri Lanka. *BMC Public Health* 7, 13. <https://doi.org/10.1186/1471-2458-7-13>.
- Mann, J.J., Michel, C.A., 2016. Prevention of firearm suicide in the United States: what works and what is possible. *Am. J. Psychiatry* 173, 969–979. <https://doi.org/10.1176/appi.ajp.2016.16010069>.
- Pearson, M., Zwi, A.B., Buckley, N.A., Manuweera, G., Fernando, R., Dawson, A.H., et al., 2015. Policymaking ‘under the radar’: a case study of pesticide regulation to prevent intentional poisoning in Sri Lanka. *Health Policy Plan.* 30, 56–67. <https://doi.org/10.1093/heapol/czt096>.
- Pearson, M., Metcalfe, C., Jayamanne, S., Gunnell, D., Weerasinghe, M., Pieris, R., et al., 2017. Effectiveness of household lockable pesticide storage to reduce pesticide self-poisoning in rural Asia: a community-based, cluster-randomised controlled trial. *Lancet* 390, 1863–1872. [https://doi.org/10.1016/S0140-6736\(17\)31961-X](https://doi.org/10.1016/S0140-6736(17)31961-X).
- Pew Research Center, 2019. NW 1615 L. St, Suite 800 Washington, M. Share of Americans who favor stricter gun laws has increased since 2017. <https://www.pewresearch.org/fact-tank/2019/10/16/share-of-americans-who-favor-stricter-gun-laws-has-increased-since-2017/> (Accessed 1 May 2020).
- Polzer, E., Brandspigel, S., Kelly, T., Betz, M., 2020. ‘Gun shop projects’ for suicide prevention in the USA: current state and future directions. *Inj Prev.* <https://doi.org/10.1136/injuryprev-2020-043648>.
- Prevent Firearm Suicide Prevent firearm suicide. <https://preventfirearmsuicide.efsgv.org/> (Accessed 30 April 2020).
- Reifels, L., Mishara, B.L., Dargis, L., Vijayakumar, L., Phillips, M.R., Pirkis, J., 2019. Outcomes of community-based suicide prevention approaches that involve reducing access to pesticides: a systematic literature review. *Suicide Life Threat. Behav.* 49, 1019–1031. <https://doi.org/10.1111/sltb.12503>.
- Swanson, J.W., Norko, M.A., Lin, H., Alanis-Hirsch, K., Frisman, L.K., Baranoski, M.V., et al., 2017. Implementation and effectiveness of Connecticut’s risk-based gun removal law: does it prevent suicides? *Law Contemp. Probs.* 80, 179–208.
- Weerasinghe, M., Konradsen, F., Eddleston, M., Pearson, M., Jayamanne, S., Gunnell, D., et al., 2018. Potential interventions for preventing pesticide self-poisoning by restricting access through vendors in Sri Lanka. *Crisis* 39, 479–488. <https://doi.org/10.1027/0227-5910/a000525>.
- Winker, M., Rowhani-Rahbar, A., Rivara, F.P., 2020. US gun violence and deaths. *BMJ* 368. <https://doi.org/10.1136/bmj.m1074>.