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## Rethinking Suicide Prevention as a Public Health Issue

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Advances in injury prevention and control are among the most important public health achievements in the United States in the past century.<sup>1</sup> Progress in injury prevention and control, however, is largely limited to reductions in fatalities from unintentional mechanisms, such as motor vehicle crashes, occupational mishaps, drowning, and fires and burns. There is little success in preventing intentional injuries, in particular self-injury. In fact, suicide rates in the United States have remained at a high level for many decades and have trended upward in recent years.<sup>2</sup> The stagnation in suicide prevention is not for lack of trying.<sup>3</sup> In light of the ongoing COVID-19 pandemic, the worsening opioid crisis, and the rising prevalence of depression and other mental health problems, the study by Bandara and colleagues<sup>4</sup> offers a glimmer of hope and a window of opportunity for rethinking suicide prevention.

Many self-injury acts are impulsive behaviors taking place during an emergent personal crisis. Limiting the access to lethal means, particularly through environmental modification and engineering, is one of the few interventions with proven effectiveness to reduce suicides. For instance, studies from different countries have shown that installing physical barriers in bridges could reduce suicides in these hotspots by over 90%.<sup>5</sup> Interventions targeting suicide hotspots, however, are often hindered by two concerns: the potential substitution effect and the economic costs. The substitution effect refers to the possible shifting of suicides from treated hotspots to untreated neighboring sites or other means. Although research indicates that there is no measurable increase in suicides in untreated neighboring sites following the installation of physical barriers in bridges, it is less clear to what extent shifting to other means, such as firearms and medications, may occur. Given that hotspots account for only a small fraction of the total suicide mortality, it is difficult to dispel the concern about the potential substitution effect. Evidence from other studies, however, indicates that the substitution effect, if any, is unlikely to offset entirely the effect of interventions that limit the access to lethal means. A case in point is the marked decline in suicide rates in China in the past two decades after the government tightened regulations about the production, sale, and storage of highly lethal pesticides that were often used for committing suicide in rural areas.<sup>6</sup>

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The Bandara et al study<sup>4</sup> provides valuable evidence for addressing the second concern about hotspot-based interventions to reduce suicides. Using standard health economics methods, the authors estimated the costs saved and the return on investment ratio associated with the installation of physical barriers at 26 bridge and cliff sites identified as suicide hotspots in Australia. Their results indicate that the intervention at the 7 bridge sites alone would save USD 270 million over 10 years, with a return on investment ratio of 2.4. Moreover, their sensitivity analyses suggest that the intervention would remain cost-effective under assumptions of inflated maintenance costs. It is worth noting that the estimated cost-effectiveness reported by Bandara et al<sup>4</sup> is likely conservative because the intervention costs are based on retrofitting physical barriers in the identified suicide hotspots and because reductions in injuries and fatalities from unintentional falls resulting from the installation of physical barriers in the study sites are not included in the intervention effect. In general, it is costlier to remedy an environmental hazard through retrofitting than eliminate the risk by design during the planning phase. Fortunately, as pointed out by Bandara et al,<sup>4</sup> installation of physical barriers in bridges, cliffs and other hotspots has become the best practice for suicide prevention in Australia, England, and Scotland. Progress is also evident in the United States; fences and safety nets have been installed in the Golden Gate Bridge and the George Washington Bridge after hundreds of people ended their lives by jumping off these bridges. Furthermore, the concept of *safety by design* is being increasingly adopted by civil engineers, as demonstrated by safety fences in the newly constructed Gov. Mario Cuomo Bridge over the Hudson River in New York.

The US National Strategy for Suicide Prevention aims to reduce the suicide rate by 20% by 2025.<sup>3</sup> To achieve this goal, it is urgent to shift the paradigm for suicide prevention from a clinically oriented disease management model to a public health based injury prevention model. Under the injury prevention model, the term *suicide prevention* should be replaced by the term *self-injury prevention* or *self-harm prevention* and prevention strategies guided by the Haddon Matrix.<sup>7</sup> Replacing *suicide* with *self-injury* is not merely semantic. Rather, it recognizes the fact that suicidality is a spectrum of intentional injury inflicted by oneself and paves the way for embracing the energy transfer model underlying injury causation and technologically and environmentally centered harm-reduction approaches to injury prevention. The paradigm shift from suicide prevention to self-injury prevention may also help avoid the stigma associated with suicide and related mental health problems.

Injury refers to damages to human tissues and organs resulting from acute or cumulative transfer of energy that exceeds the tolerance level of the specific human tissue or organ, or from the interference with proper energy exchange that is essential for maintaining normal physiological functions.<sup>7</sup> Identification of energy as the common etiologic agent for most injuries is an important milestone in the development of injury science, which led to the clarification of vectors that carry the etiologic agent of injury, such as a moving car and a flying bullet, and the formulation of the conceptual framework for guiding injury prevention strategies, commonly known as the Haddon Matrix.<sup>7</sup> (In the scenario of suicide by jumping off a bridge, the bridge can be viewed as the vector carrying the potential mechanical energy.) The Haddon Matrix combines the three temporal phases of injury – pre-injury, injury, and post-injury – with the epidemiologic triad of agent, host, and environment. In the pre-injury phase, countermeasures are directed toward reducing exposures and preventing

injury from happening; in the injury phase, interventions are aimed at mitigating the frequency and severity of injury given exposure; and in the post-injury phase, control strategies are developed to decrease the case fatality and increase recovery given injury.

Within the Haddon Matrix, the environment element includes both physical and social conditions and prevention strategies targeting the agent and the environment elements take priority over those related to the host element. The emphasis on the agent and the environment rather than the human host is based on two considerations. First, most vectors carrying the etiologic agent of injury and many environmental factors contributing to injury occurrence and outcomes are readily modifiable through engineering, technology, and policy solutions. Second, the human host is universally susceptible to injury but changing human behavior is notoriously difficult and usually takes many years and requires multifaceted interventions.

Clinical approaches to suicide prevention, such as screening for risk factors and treating psychiatric disorders, focus on the host element. These approaches are necessary but insufficient to reduce suicide rates on the population level. It is time to integrate these clinical approaches into the conceptual framework for self-injury prevention grounded on the Haddon Matrix. The cost-effectiveness of installing physical barriers in bridges and cliffs to reduce suicides in these hotspots, as reported by Bandara and colleagues,<sup>4</sup> is especially instructive for developing and implementing engineering- and technology-based strategies aimed at environmental factors and major vectors carrying the etiologic agent, such as firearms and drugs, to reduce self-injury rates in the United States.

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