

## Insights from population health science to inform research on firearms



The firearm epidemic in the USA is a pressing public health concern that has catalysed a recent surge of academic interest and community activism.<sup>1</sup> On Feb 14, 2018, the mass shooting at a high school in Parkland, FL, USA, motivated surviving students to rally young people nationwide to advocate for solutions to the long-standing problem of gun violence in the USA. The resulting March for Our Lives drew 800 000 supporters to Washington, DC, USA, in tandem with 800 coordinated marches in cities around the world.

Concurrently, US Congress cleared the Centers for Disease Control and Prevention to resume research on the public health consequences of gun violence, after decades of inaction in this field. As research advances, three concepts—anchored on three principles of population health science—could sharpen our understanding and inform the public conversation around firearms.<sup>2</sup>

The first concept, inspired by population health science, suggests that health can be thought of as a continuum.<sup>2</sup> In the context of firearm violence, this concept pushes us to think about the complexity of firearm mortality and to broaden the scope of inquiry to include non-fatal injuries and the social and economic effects of firearms.

Gun deaths are heterogeneous. Among the approximately 36 000 annual gun deaths in the USA, almost 60% are suicides, 1% are unintentional discharges, and the remaining 40% are homicides.<sup>3</sup> Furthermore, the epidemiological features of homicides and suicides are distinctly different. Additionally, about 100 firearm deaths and one mass shooting happen daily in the USA; however, high-visibility mass shootings account for just over 1% of total gun deaths in the USA.<sup>3</sup>

Compared with firearm fatalities, about twice as many non-fatal firearm injuries are recorded daily in the USA. Many survivors of firearm injuries deal with life-changing disability, pain, paralysis, and disfigurement. The economic costs of firearm injuries were estimated at US\$734.6 million per year in the USA for the period 2006–14, just for the initial admission to hospital of those injured. Long-term medical and rehabilitation expenses and indirect costs of lost productivity would substantially inflate these costs.<sup>4</sup>

The consequences of firearms also extend to psychological harm.<sup>5,6</sup> Inferring from work on other traumatic events, people who are injured by a firearm have a 40–50% likelihood of developing a mental health disorder, while the prevalence of developing a mental disorder among the family members and classmates of those who are unexpectedly killed by use of a firearm is up to 10%.<sup>7</sup> Other groups involved in shootings can also have psychological consequences, including all people present at the shooting scene, emergency responders, parents and family members of the victims, and community citizens at large. Mass shootings are broadcast to a wide audience and circulated instantly through social media in a manner that could trigger pervasive psychological distress among all groups involved.

Understanding the population health continuum of firearm consequences shifts research away from a singular focus on firearm mortality towards a more encompassing perspective that includes the physical, psychological, and social effects of the firearm epidemic.

The second concept to be considered is how small changes in ubiquitous causes of harm can result in more substantial changes in the health of populations than larger changes in rarer causes of harm. This principle calls for a focus on the forces that underlie the health of populations. In the USA, gun ownership is seen as a right that dates back to the founding of the nation. A central reality for the firearm discussion in the USA is that the country is awash with firearms and sales have proliferated in the past 10 years.<sup>8</sup> Almost 300 million firearms are registered to approximately 27% of US citizens. Most adult US citizens can lawfully buy firearms with few restrictions, and guns are present in more than a third of US homes, frequently within easy reach of multiple household members. Moreover, for the remaining two-thirds of households, direct access to firearms only requires a gun purchase.

Nearly universal access to guns in the USA is a typical example of a ubiquitous driver of population health. Gun availability is a strong determinant of gun injury, and the presence of firearms in the home is associated with increased risks of firearm-mediated homicide and suicide.<sup>8,9</sup>

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If the consequences of firearms are to be mitigated, reducing the ubiquity of firearms should be central to any solution for the gun epidemic. This potential solution calls strongly for research on access to guns, and suggests that, without such work, finding solutions that can make a real difference to the firearm epidemic will be very difficult. Focusing on research and policies that improve the safety of gun use could be more efficacious in promoting population health than focusing on interventions for rarer causes of harm, such as mass shootings. Focusing on policies (eg, introducing universal background checks, improving safe storage, and restricting gun sales to people older than 21 years) that can reduce ubiquitous access to guns could better serve the health of populations.

The third concept to be considered is that the magnitude of an effect of exposure on human harm is dependent on the prevalence of the factors that interact with that exposure. Co-occurring causes influence the association between the foundational determinant—in this case, firearms—and its consequences, suggesting that the other factors that interact with the core exposure cannot be ignored. This principle suggests that focusing on firearms alone is not sufficient to change the trajectory of the firearm epidemic and that research should strategically expand to also focus on prevalent co-occurring causes.

An example of such a factor that interacts with the exposure is a strong social gun culture.<sup>10</sup> Population-wide firearm ownership has long been a fundamental characteristic of American society. Yet, the gun owners and their families are at the greatest risk of harm because of their proximity to the firearm hazard. Therefore, this principle suggests that we need to consider the important co-occurring factors—eg, economic instability, depression contributing to suicide, and gun culture—if the harms of firearm violence are to be minimised.

Now, in the aftermath of the Parkland shooting, a new dynamic might be surfacing in which emerging influences are also working to counterbalance

traditional gun culture. It is too early to determine the influence that the self-described mass-shooting generation could achieve, but certainly, the opening salvo, featuring brash, youthful voices addressing audiences of millions of marchers and media viewers, was impressive to witness.

In conclusion, the public health approach to firearms is now gaining traction in public discussions. We suggest that a population health science approach could successfully guide research and inform public health action. This approach would argue for a focus on the full continuum of health consequences of firearms, a determined focus on research that can identify how to best regulate availability and access to guns, and work that identifies how to best deal with a gun culture that influences the firearm–health relationship.

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We declare no competing interests.

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