

VIEWPOINT

The Epidemiology of Firearm Injuries in the US

The Need for Comprehensive, Real-time, Actionable Data

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Supplemental content

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The US stands out among developed countries for its high rates of firearm injury and related morbidity and mortality. Even though there is no comprehensive national resource that documents firearm-related injuries in real time, available data provide some insight into the epidemiology of firearm injury. This Viewpoint summarizes current data on firearm injuries in the US, discusses the limitations of available data sources, and proposes measures for a comprehensive system to track firearm injury and death.

Epidemiology

According to data from the Centers for Disease Control and Prevention (CDC), firearm injury caused 45 222 deaths in 2020 in the US, including 19 384 homicides (42.9%) and 24 292 suicides (53.7%), and was the leading cause of death among children and adolescents aged 1 through 19 years.¹ Firearm homicide rates began to rise in 2015 and reached a rate of 6.1 per 100 000 in 2020. Men and boys are at approximately 10-fold higher risk of both homicide and suicide compared with women and girls. In 2020, the homicide rate for Black men and boys aged 15 to 34 years was 110.9 per 100 000 (7400 total deaths) compared with 5.2 per 100 000 (1296 total deaths) for White men and boys of the same age. Firearm suicide rates have been increasing for more than a decade and reached a rate of 8.1 per 100 000 in 2020. Firearm suicide is most common in rural areas, with rates of 11.0 per 100 000 in 2020 (8364 total deaths), and White men older than 65 years have the highest incidence of firearm suicides, with 29.0 per 100 000 in 2020 (5567 total deaths).¹

Data from the national Healthcare Cost and Utilization Project suggest that there are approximately twice as many survivors of firearm injuries as there are deaths.² From 2009 through 2017, there were approximately 85 694 emergency department (ED) visits for firearm-related injuries each year, of which 40.5% were coded as assaults, 51.0% as unintentional injuries, and 2.9% as self-harm.² Unintentional injuries thus accounted for 1% of deaths, but 37% of total injuries, leaving major opportunities for prevention.²

Although mass shootings account for less than 1% of homicides in the US, their effect on public consciousness is outsized. Mass shootings are generally defined to involve 4 or more deaths, but varying definitions led different agencies to count between 8 and 525 mass shootings in 2022 (from January through August). Lower counts exclude shootings related to domestic violence or other crime, events that most often affect Black and Latinx individuals in the same urban, underresourced communities where firearm violence is most prevalent. The incidence of these community mass shootings has remained stable, whereas the number of high-profile public, active-shooter events has increased (such as re-

cent mass shootings in Highland Park, Illinois, Uvalde, Texas, and Buffalo, New York).³

Law enforcement shootings of civilians also merit public concern, although these account for less than 1% of firearm deaths, and 1.6% of nonfatal injuries.² Death rates are higher among Black individuals (1.49 mean quarterly rate per million, 2015-2020) and Native American individuals (1.74 mean quarterly rate per million, 2015-2020), than among White individuals (0.57 per mean quarterly rate per million, 2015-2020).⁴ Beyond loss of life, these killings have adverse effects on mental health and contribute to institutional mistrust in affected communities.⁵

The physical consequences among survivors of firearm injury range from graze wounds to penetrating injuries with multisystem involvement and paralysis. For many, physical recovery can be prolonged or incomplete, and return to work and school is challenging, but for some, it may be impossible. Beyond physical injury, the emotional and psychological aspects of firearm violence often include anger, worry, depression, and flashbacks, with up to 50% of individuals who sustained assault-related injury (including from firearms) developing posttraumatic stress disorder or depression.⁶ Recurrent violent injury is common, and survivors of firearm-related injury are at increased risk of subsequent firearm violence perpetration. Children and adults who witness firearm violence or lose a loved one to firearm injury are at elevated risk of depression, anxiety, and aggression. Parents living in neighborhoods where violence is common must often restrict their children's mobility to preserve their safety, with consequences that can impair youth development and contribute to chronic disease.

Need for Comprehensive, Real-time Data

In less than 3 years since the first US COVID-19 infection, coronavirus tracking and research databases have provided detailed data addressing the real-time incidence, risk factors, consequence, and treatments for COVID-19. Although public, real-time, national dashboards are available for COVID-19 cases, deaths, ED visits, and hospitalizations, similar data are not available for firearm injuries, even though EDs, trauma units, and intensive care units continue to receive and treat increasing numbers of patients with firearm-related injuries as part of an epidemic that has lasted for decades.

A small cadre of researchers with minimal funding has established a basic epidemiology of firearm injury by linking together limited data sets, but nearly all firearm injury research has focused on deaths. The most recent national data on firearm injury cases are from 2019, before COVID even began. Yet much less is known about the incidence and consequences of nonfatal firearm injury before and during the pandemic. Tracking deaths alone does not allow policy makers to measure the effectiveness of

prevention initiatives accurately. Prevention initiatives are further limited by the absence of data on firearm types, ammunition, purchase, and transfer patterns that are associated with injury and violence.

Sources of Data

According to an expert panel⁷ that conducted a thorough evaluation of firearm-related data sources in 2019 and a recent review,⁸ data sources on firearm injury are narrow, disordered, delayed, and poorly linked. Key data sources on firearm-related violence are summarized in the eTable in the Supplement, with the most comprehensive focusing on deaths. Health care data can provide national estimates of nonfatal injuries. Trauma registries provide rich clinical detail on a limited sample. Data sources using crowdsourcing, media reports, or other public sources attempt to provide more up-to-date information. The Gun Violence Archive provides daily reports of firearm assaults and homicides but may miss up to 50% of shootings, particularly nonfatal injuries.⁹ The Firearm Injury Surveillance Through Emergency Rooms,¹⁰ a new CDC pilot initiative, uses syndromic surveillance techniques similar to those used for infectious diseases like influenza and measles to track ED visits for firearm injury in near real time. Data on long-term outcomes of firearm injury are even more scarce, limited to insurance claims or dedicated research data collection.

Many local law enforcement agencies collect information on all shootings related to interpersonal violence, beyond reported crime. Some agencies publish this information in real time. However, data on the firearms used are particularly scarce. The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) can trace firearms recovered in crime to their original point of purchase when requested by local law enforcement, but the 2003 Tiahrt Amendment prohibits the ATF from sharing these data except for a criminal investigation. Firearm traces do not address use, transfer, or storage after initial purchase, all represent rich opportunities for prevention. Federally licensed firearm dealers track sales, but these records are rarely aggregated.⁷ The only direct information on firearm ownership or purchases comes from surveys, although researchers have used search engine trends as a proxy.⁷

Proposed Suggestions for Enhancing National Data

Data on firearm injury are inadequate to support a true public health approach to this disease. Short-term and long-term investments should expand the national data infrastructure to provide reliable, real-time information on the incidence, epidemiology, health out-

comes, and societal effects of firearm injury to inform and evaluate effective interventions.

First, enhancing existing data sources and improving their compatibility could fill many of the evidence gaps.⁷ As demonstrated by the COVID example, federal, state, and local policy makers can develop a culture and policy of transparency to make existing data more readily and promptly available. The nature, context, and intent of the firearm-related incident should be included, as should risk and protective factors at the level of the environment, community, and individual (the shooter and the injured individuals). Characteristics of firearms involved, including when, how, and where they were obtained are essential to prevention efforts. In many circumstances, friends, family, and community members hold immense knowledge and insight into the circumstances that lead to firearm violence but mobilizing this information for prevention and care remains a challenge without dedicated, trusted systems in place.

In the short-term, the Department Health and Human Services could combine existing national data on nonfatal injuries from the Healthcare Cost and Utilization Project with death data from the National Vital Statistics System to enable a public reporting of total counts of firearm injuries.² This merge could allow researchers to assess the effectiveness of policies on total cases of firearm-related injury across the 40 states that contribute data to the Healthcare Cost and Utilization Project.

Second, to bring health care data up to date, new investment could expand the Firearm Injury Surveillance Through Emergency Rooms data collection initiative beyond the 10 state and local health departments to generate real-time dashboards on ED visits for firearm injuries covering the 70% of US EDs (>6000 EDs) that participate in the CDC's BioSense surveillance platform. Likewise, the Department of Justice, through the Federal Bureau of Investigation and the Bureau of Justice Statistics could fund and support the National Incident-Based Reporting System (NIBRS) implementation to address major gaps in law enforcement data. Most importantly, nonfatal shootings could be explicitly identified in NIBRS.⁷

Conclusions

To address the ongoing epidemic of firearm violence in the US, comprehensive and actionable information about the scope and nature of firearm-related injuries is required. Without a robust evidence base, ineffective intervention will waste time and resources, and lives will be lost by underusing the strategies that work.

ARTICLE INFORMATION

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