Firearm injuries: A preventable daily tragedy

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Introduction

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Gun violence in the U.S. is a major public health issue as it is the leading cause of premature death—homicide, suicide, and accidental shootings. It is now at epidemic levels.

It is baffling why this has not been recognized as the health crisis that it is when in 2020 there were 45,222 firearm-related deaths in the U.S., or more than 110 per day, according to the Centers for Disease Control and Prevention (CDC).[1] This was more than any other year on record. Forty-three percent, or 18,585 were homicides; and 54 percent or 24,420 were suicides,[1] representing a 14 percent increase from the year before, a 25 percent increase from five years earlier, and a 43 percent increase from a decade prior.[1] And, there is a huge gender and race/ethnicity difference. The vast majority of victims, 86 percent,[2] were males, and for young people, 15 years-old to 24 years-old, homicide is the leading cause of death for non-Hispanic Blacks, the second leading cause for Hispanics, and the fourth leading cause for non-Hispanic whites.[3] Firearm-related deaths now exceed motor vehicle deaths in the U.S. because of seatbelt laws and other safety measures implemented to reduce automobile accident death and injury.[1]

America leads high income nations in gun violence with 12 deaths per 100,000 population compared to Switzerland at slightly more than two gun deaths per 100,000 population.[1] Assault by firearms accounts for 70 percent of nonfatal firearm-related injuries, and unintentional injury accounts for 20 percent. Gun violence leads to complex health care costs, employee and employer loss of work, permanent or temporary disability, financial ramifications,

and social disruption. Gun violence is estimated to cost $557 billion a year in the U.S.[4] Federal, state, and local governments are spending a combined average of nearly $35 million each day to deal with the aftermath of gun violence across the country.[4]

Guns are a weapon of choice for homicide and suicide. Attempts of suicide by firearm result in death 85 percent of the time compared to other methods like drug overdose.[5]

It is unfortunate that mass shootings have become somewhat "normalized" in our society with an abundance of media coverage. As of August 20, there have been 425 mass shootings year-to-date (an incident in which four or more people are shot or killed, not including the shooter).[6] This is in comparison to a total of 269 in 2014; 335 in 2015; 382 in 2016; 346 in 2017; 336 in 2018; 417 in 2019; and 611 in 2020.[6] However, most gun violence does not involve mass shootings.

Preventing death, disability, and injury from gun violence and firearms requires a public health approach, just as it does for other epidemics. It involves a scientific and epidemiologic approach to better understand the causes of gun violence, and to identify policies and programs that are effective in decreasing gun violence in combination with initiatives to implement preventive measures and interventions that are shown to work. As with many other public health risks, gun violence can be prevented or reduced through comprehensive public health measures including data and facts from investigations; research; better data and documentation of risk factors including easy access to firearms by high-risk people; education around gun safety and safely securing firearms.

The history of gun proliferation and gun violence in the U.S. is complex; however, it is a key resource to better understanding of how to implement effective interventions. Many physicians and surgeons, epidemiologists, and public health specialists do not know that the firearms industry, the National Rifle Association, and others lobbied Congress against fully funding research to better understand gun violence and inform the public health response with data, facts, and evidence in support of interventions to reduce gun violence.

The National Firearms Act (NFA) of 1934 was the first major federal gun control legislation requiring the registration of certain firearms, the levying of taxes on the sale and manufacture of firearms, and restrictions on the sale and ownership of high-risk weapons, such as machine guns. The NFA was subsequently amended in 1938 to provide additional regulations. Then, in 1939, the Supreme Court in U.S. vs. Miller upheld the National Firearms Act.

In 1968, the Gun Control Act expanded the NFA and the Federal Firearms Act, ending mail-order sales of all firearms and ammunition and banning the sale of guns to minors, felons, fugitives, illegal drug users, persons with mental illnesses, and dishonorably discharged veterans. These provisions were put into place as a response to the assassination of Martin Luther King, Jr.

Between 1986 and 2004 many of the restrictions were eased, and in 2004 the ban on the sale of specific assault weapons expired.

In 1996, federal firearm injury prevention research was essentially stopped by the 1996 Federal Omnibus Consolidated Appropriations Act.[7] This was in reaction to a CDC-funded study demonstrating that firearm ownership was a risk factor for homicide in the home. It removed $2.6 million from the CDC budget, and a rider that "none of the funds made available for injury prevention and control at the Centers for Disease Control and Prevention may be used to advocate or promote gun control."[7] The CDC ceased all firearm-related research. This ban was then expanded in 2012 to include other agencies in the U.S. Department of Health and Human Services, further limiting research related to gun violence. In addition, the Consolidated Appropriations Act of 2012 funding the National Institutes of Health, stated that "none of the funds made available in this title may be used, in whole or in part, to advocate or promote gun control."[7]

In 2015, Congress amended the Public Health Service Act (PHSA) to include gun violence-related injury as an acceptable area of research for the CDC. However, the PHSA and subsequent bills to include this as an acceptable area of research have failed.

In 2019, for the first time in more than 20 years, Congress passed legislation directing $25 million for gun violence research for the National Institutes of Health and the CDC.[8] Then in 2022, the Bipartisan Safer Communities Act provided $750 million for state grants to implement crisis intervention programs, and $2 billion for community-based violence prevention strategies to reduce gun-related injuries.[8]

Unfortunately, epidemiological data on firearm injury remain sparse and with too little crucial detail, and current federal gun laws have failed to decrease, or end, gun violence in America.

The principle that gun violence is preventable has been established; however, there needs to be better epidemiologic data to validate which interventions are most effective.

A comprehensive public health approach to keep families and communities safe involves the use of core public health principles and programs, including better research and

investigation to track gun-related deaths and injuries, i.e., a national database like other diseases; assessment and documentation on the impact of interventions; identifying and ameliorating risk factors; community resources, support and funding; and implementing successful prevention strategies.

All physicians should familiarize themselves with the data surrounding gun violence and related support efforts in their communities, states, and nationally. They need to know the facts—between 1968 and 2017, there were 1.5 million deaths from firearms, which is more than the number of soldiers killed in every U.S. conflict since the War of Independence in 1775. We all must also realize that the issue is a highly political issue that must be dealt with as a public health crisis for the betterment of our nation.

Since 2015, 52 medical and health organizations have joined a call to action to address firearm injury as a public health threat. This was an effort by organizations representing clinicians, consumers, families of firearm injury victims, researchers, public health professionals, and other health advocates.[9]

The American College of Physicians, in 2019, put forth seven evidence-based policy recommendations that professional medical organizations believe can reduce firearm-related injury and death in the United States:[9]

1. Background Checks for Firearm Purchases—Comprehensive criminal background checks for all firearm purchases, including sales by gun dealers, sales at gun shows, private sales, and transfers between individuals with limited exceptions should be required.
- Research on Firearm Injury and Death—Research to help better understand the causes and consequences of firearm-related injury and death and to identify, test, and implement strategies to reduce these events is important.
- Safe Storage of Firearms—Safe storage is essential to reducing the risk for unintentional or intentional injuries or deaths from firearms, particularly in homes with children, adolescents, people with dementia, people with substance use disorders, and the small subset of people with serious mental illnesses that are associated with greater risk of harming themselves and/or others.
- Mental Health Care—Improved access to mental health care but with caution against broadly including all individuals with a mental health or substance use disorder in a category of individuals prohibited from purchasing firearms.
- Extreme Risk Protection Orders—Extreme risk protection order (ERPO) laws, which allow families and law enforcement to petition a judge to temporarily remove firearms from individuals at imminent risk for using them to harm themselves or others, should be enacted in a manner consistent with due process.
- Physician Counseling of Patients and "Gag Laws"—Physicians can and must be able to advise their patients on issues that affect their health, including counseling at-risk patients about mitigating the risks associated with firearms in the home and firearm safety.
- Firearms With Features Designed to Increase Rapid and Extended Killing Capacity—A common-sense approach to reducing casualties in mass shooting situations must effectively address high-capacity magazines and firearms.

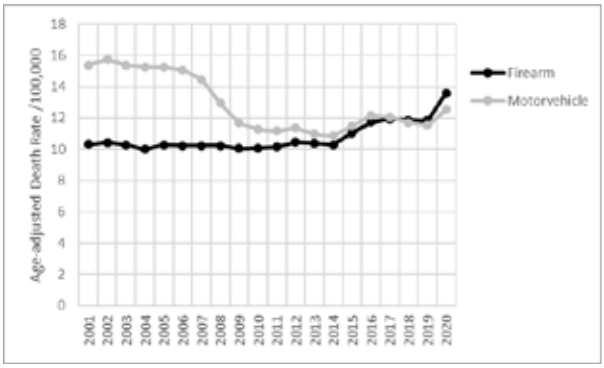
Gun violence is an epidemic that we cannot ignore, and therefore must enlighten ourselves to all facets, using data, and education to become better informed. All physicians need to take the responsibility for delving into the data to be able to make informed choices, provide better care for patients, and discuss possible solutions, and preventive care measures.

The following editorial was written for *The Pharos* by a world-renowned trauma surgeon with more than 36 years as Chief of Trauma Surgery at a public safety net hospital, and *Editor Emeriti of the Journal of Trauma and Acute Care Surgery*; a public health physician who has more than 20 years of experience in health services and health outcomes research, and is internationally known for her research in post-injury care and as a co-investigator in the NIH-funded, 20-year Trauma Center Grant; and an Internal Medicine specialist who works with patients and families who have been victims of gun violence.

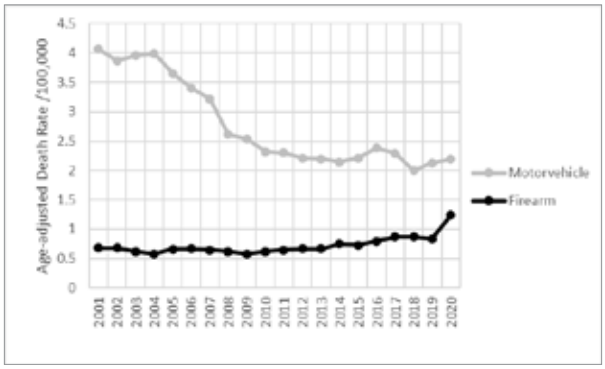
Firearm injuries: A preventable daily tragedy

Angela Sauaia, MD, PhD, Sarah Van Duzer-Moore, MD, and Ernest E. Moore, MD

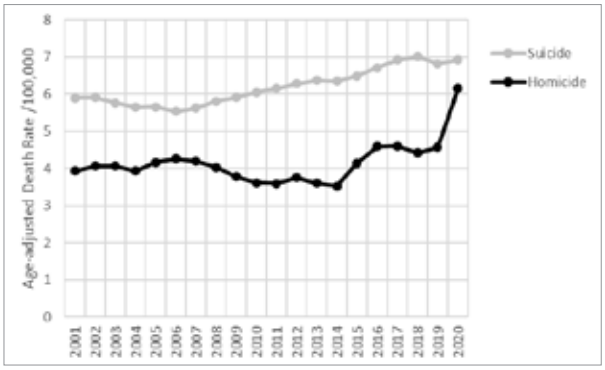
Much like the COVID-19 pandemic, firearm injuries, also known as gunshot wounds (GSW), have become a public health epidemic.[10] Firearm-related events present a type of contagion effect with copycat episodes often following a publicized event[11] (more appropriately described as "generalized imitation"[12]). Similar to a virus, firearms mutate over time, but different from most viruses, this human-made agent has evolved to be even more lethal. Despite a morbidity and case-fatality rate much higher than most viral pandemics, it is much less likely to be the focus of research and public health policies. Similar to COVID-19, it has attracted conflicting but passionate opinions and political posturing, often with little evidence to support either side.



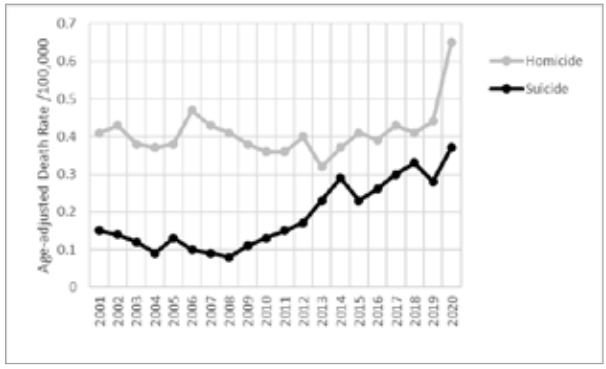
A. Age-adjusted death rates due to firearms and motorvehicles crashes



C. Age-adjusted death rate in children 0-14 years old by agent over time



B. Age-adjusted firearm-related death rates over time by intent



D. Age-adjusted firearm-related death rates in children 0-14 years by intent over time

Figure 1: Adjusted death rates by agent and intent over time for all individuals (A, B) and children 0-14years (C, D). Source: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Available from URL: www.cdc.gov/injury/wisqars. Accessed 08/15/2022

Mass shootings have called attention to the power of firearms in causing multiple deaths and devastating injuries in an exceedingly short time by a single perpetrator. However, these senseless mass shootings represent less than two percent of the annual toll of firearms. Trauma and emergency care providers have worked tirelessly to alert communities and policy-makers to the daily tragedy caused by firearm injuries.

In 2019, about 40,000 people died from a gun injury, and about twice as many are estimated to have suffered non-lethal injuries.[13,14] According to a 2021 United States Government Accountability Office (GAO) report,[13] these injuries resulted in close to 30,000 hospital stays, and 50,000 emergency room visits, costing society more than $1 billion.

Children are not immune as firearms are now the leading cause of death in those 1-19 years of age.[14] We now fear a bullet more than any other threat to the health of our children. In comparison, none of similarly large or wealthy countries reported firearm deaths in the top four causes of child mortality.[15] Overall, firearm injuries claimed the lives of 207 children 0-11 years of age from January to August 2022, threatening to surpass the 313 deceased children in all of 2021, according to data from the non-profit organization Gun Violence Archive.[6]

After a decline in the 1990s, which was sustained throughout the 2000s, firearm-related injuries are increasing (Figure 1).[14,16] Although there was an acceleration during the years of the COVID-19 pandemic, a decrease is not anticipated once the pandemic recedes, as the upward trend preceded it, starting in 2014. As reported by the CDC, the rate of gun deaths of children 14-years-old and younger rose by roughly 50 percent from the end of 2019 to the end of 2020.[1]

Very few health conditions have a fatality rate at 30 percent, i.e., one in three GSW victims perishes.[14] It is one of

the few such lethal conditions for which there is a single, known, avoidable cause. Yet it is the only lethal condition for which there was a controversial congressional ban on funding, known as the 1996 Dickey Amendment.[17] While the ban has targeted advocacy, not research, it was quite efficient in suppressing the funding stream.[17] Jay Dickey, the House Representative who proposed the amendment, reversed his position on gun-related research following the mass shooting in a movie theater in Aurora, Colorado, in 2012. In a 2012 *Washington Post* editorial, written in partnership with Mark Rosenberg (founding director of the CDC's National Center for Injury Prevention and Control, and opponent of the amendment in 1996), Dickey called for research funding for firearm death prevention:

> The same evidence-based approach that is saving millions of lives from motor-vehicle crashes, as well as from smoking, cancer, and HIV/AIDS, can help reduce the toll of deaths and injuries from gun violence.[18]

An analysis quantifying federal research dollars by leading causes of death for children and adolescents from 2008 to 2017 in the U.S. showed that pediatric firearm injury prevention research received roughly three percent of the annual $37 million that would be needed based on the mortality burden.[19]

Stark and Shah[17] showed that firearm injuries were the least-researched cause of death from 2004 to 2015, with only 4.5 percent of the publications predicted (38,897 predicted, 1,738 observed). Similarly, Cunningham and colleagues[19] observed that publications devoted to prevention of firearm injuries in children and adolescents in the decade ending in 2017 was much lower than predicted based on mortality. Cunningham, the study's lead author, who was awarded an NIH grant to build capacity for researching firearm injuries in children, relayed that at the beginning of her research, "No mentor of mine would touch it." [19]

Complex circumstances

Several data sources are needed to understand the complexity of circumstances involved in firearm injuries, from the type of firearm, intent, and circumstances to number and severity of injuries, complications, ultimate causes of death, and long-term consequences, as well as costs. Researchers should be able to access integrated, curated data from police, emergency medical services, hospitals, rehabilitation and long-term-care centers, and autopsy/coroners reports. Although there have been sizable improvements in epidemiological data (e.g., CDC's WISQARS™, an interactive, online database with fatal/nonfatal injuries, violent death, and cost of injury data[14]) firearm injury data remain sparse and difficult to integrate, especially in relation to the type of gun, (e.g., assault rifle, shotgun, handgun, bullet specifications, number of bullets, etc.). The GAO report[13] stated that, "GAO identified studies that estimated lifetime costs of these injuries, but the estimates relied on data from over 20 years ago, making them no longer a reliable indicator of costs." The same GAO report states "The estimated number of non-fatal firearm injuries was not available from CDC for 2019 due to data reliability concerns." A query of the CDC's WISQARS™ conducted August 8, on the overall number of non-fatal, gun-related injuries in 2020, 2019, or 2018 (the most recent years with available data) produced no results because the estimate was considered unstable.[14] While the CDC's position of not reporting an unstable estimate is scientifically sound, it highlights the need for better data.

Existing clinical datasets suffer from low quality. Thiels et al.,[20] showed that missing clinical data was much greater in firearm incidents compared to other injuries in the national trauma data bank. Lack of training to gather information in the sensitive circumstances surrounding gun-related episodes is likely a major culprit.

Integrated, high quality datasets

There is an urgent need for better data and solutions to dataset merging. Similar to any highly lethal and morbid condition, i.e., cancer, COVID-19, HIV/AIDS, tuberculosis, etc., every phase of firearm injuries needs to be documented, from primary to tertiary prevention. Ideally, for every firearm injury event (at least those that require medical attention), researchers need to have access to detailed information, such as:

1. Weapon acquisition: geolocation, purchase mechanisms, reasons and circumstances surrounding the access, choice;
2. Type of weapon: destructive potential of each weapon and ammunition;
3. Weapon/ammunition storage and locking;
4. Intent of the event: self-harm, legal intervention, accidental, assault;
5. Circumstances and behavioral aspects prior to the event, during and after the event: premeditated, impulse, self-defense, domestic violence, abuse, bullying, suicide attempt, mental illness, etc.;
6. Demographic characteristics and social determinants associated with the perpetrator and victim(s);

7. Clinical data: number of bullets and injuries, severity of each injury, physiologic status, treatment and complications, and if appropriate, mandatory autopsy; and
8. Long-term follow-up: physical and psychological consequences of the event, both for perpetrator and victim.

The above list, although extensive but far from complete, does not differ much from existing registries for other major illnesses, endemics, and pandemics. Given the sensitive nature of the information, confidentiality is of utmost importance, yet dedicated staff and technology to allow researcher-independent merging of diverse datasets is pivotal to a comprehensive understanding of firearm injuries that can lead to data-driven intervention design.

Investment in firearm research

There has been much progress in the area of firearm research over the past several years, with sizable budgets assigned to firearm research for the NIH and the CDC. However, these dollars are a fraction of what investigators predicted would be necessary based on mortality. Mark Rosenberg, MD, in an interview in response to the recent allocation of $25 million in federal funds said, "Instead of a funding stream, we have a funding dribble."[21]

Given the lack of basic infrastructure to conduct firearm research, few engaged researchers and centers, and the historical lag, it will take a while for these funds to generate evidence. Rosenberg, in a recent article in the *Annual Review of Public Health*,[21] proposed a pragmatic firearm research agenda:

> First, what is the problem: How many people get shot, who are they, where does it happen, what is the relationship between the shooter and the victim, what other types of damage are incurred, and are the shootings increasing or decreasing?
>
> Second, what are the causes: What is the role of alcohol and drugs; what is the role of gangs, poverty, and systemic racism; what is the role of mental illness, robbery, and domestic violence; what is the role of private gun ownership (both positive and negative) and easy access to guns? What are the factors that protect us, such as stable families and safe environments?
>
> Third, what works: Which practices, interventions, policies, and laws work best to prevent these deaths and injuries?
>
> And fourth, how do you do it: How do you implement the findings and translate them into policies, legislation, and practices that can be scaled up?

Assault rifle access

Mass shootings are the net result of a deranged individual combined with access to an assault rifle. Few would debate the need for improved mental health care in the U.S., but the typical mass shooter is usually not recognized as mentally ill by those in the community.

In the U.S., mass-shooting homicides were reduced during the years of the federal assault weapons ban (1994–2004).[22] The law banning assault weapons expired in 2004 and death from mass shootings rose exponentially.

Surveys consistently show that the majority of Americans support a ban on assault weapons.[23] Australia's 1996 National Firearms Agreement (NFA), which banned several types of firearms, has been exhaustively studied, and summarized in a report of the RAND corporation.[24] The report concluded that overall, evidence was not as strong for the NFA's effect on firearm homicides, but the evidence suggested that the NFA effectively reduced feminicides (the killing of a female, in particular by a man on account of her gender). During 23 years following the NFA, which was motivated by a mass shooting, there were zero mass shootings in Australia.

Deliberately fatal

An assault rifle, by design, is intended to deliver fatal wounds to multiple individuals within a short time period. The Las Vegas shooting, October 1, 2017, is a testament to the effectiveness of the AR-15 (and other weapons) for its intended mass-lethality purpose. The AR-15, the most commonly used rifle in U.S. mass shootings, is the civilian version of the military assault rifle (M-16 or M-4). The effectiveness of the AR-15 is based on its ability to deliver small sized, high velocity bullets in rapid sequence.

The killing potential of a gun is primarily based on the amount of energy imparted by the bullet when it strikes the body. The bullet energy (kinetic energy) = ½ bullet weight (mass) x the speed of the bullet when fired (velocity) squared; i.e., KE = ½ MV^2. Thus, velocity is the dominant factor in determining the killing potential. The 9mm handgun is generally regarded as an effective weapon as its bullet travels at 1,200 feet per second (ft/s) and delivers a KE = 400 foot pounds (ft lb). By comparison, the AR-15 bullet travels at 3,251 ft/s and delivers 1,300 ft lb.

Tissue destruction of the AR-15 is further enhanced by the phenomenon referred to as cavitation, which is the capacity to destroy tissue beyond the direct pathway of the bullet, and well documented to occur with high velocity (greater than 2,500 ft lb) bullets. A typical 9mm wound to the liver will produce a pathway of tissue destruction in the order of one inch-two inches. In comparison, an AR-15 will pulverize

the liver, perhaps best illustrated by dropping a watermelon on to concrete.[25]

A confusing but critical concept to those unfamiliar with firearms is the major difference in the energy between an AR-15 and a typical hunting rifle. The kinetic energy of a fired bullet will be exerted on the shooter as recoil due to Newton's Third Law of Motion (every action has an equal and opposite reaction). The AR-15 1,300 ft lb, compares to the typical hunting rifle, which is between 2,600 ft lb-4,000 ft lb. However, the recoil of a hunting rifle precludes rapid firing on a target because of the recoil motion of the gun and its impact on the shooter. Thus, while providing ample bullet speed to inflict a lethal wound, the moderate energy of the AR-15, with little or no recoil, allows shooting as rapidly as the trigger can be pulled.

The efficiency of the AR-15 is further compounded by large capacity ammunition magazines that permit feeding 30 or more bullets into the gun without reloading.

Counseling approaches for smoking, alcohol, obesity, seat belts, and child safety seats have been the focus of much health services research. Thus, it is anticipated that we will need in-depth research focused on how to deliver the life-saving message that the assault rifle should be limited to military and law enforcement.[26]

Evidence-based interventions

Production of scientific evidence is crucial for the utilization of the resources for interventions provided by the Bipartisan Safer Communities Act. Several interventions have shown promising results and should become part of protocols and guidelines as well as included in the training of health care providers.[26]

Screening of individuals at risk for domestic violence

Forty-four percent of homicides of women are perpetrated by an intimate partner, and half of those incidents involve a firearm.[27] Screening for intimate partner violence is recommended by the U.S. Preventive Services Task Force for women of reproductive age, and if positive, followed by provision or referral of ongoing support services.[27]

Counseling for firearm storage/locking

It is estimated that 110 children under 14 years of age are killed annually by unintentional firearm injury, often by another child.[28,29] Exposure to unsafely stored firearms, which occurs in more than 40 percent of homes with children and firearms, is a significant risk factor for children and adolescent injury.[30-33] Physician counseling has shown to improve safe firearm storage habits.[34,35] A 2018 qualitative study observed that high-profile gun-related incidents, such as the Sandy Hook and Las Vegas mass shootings, made it easier for clinicians to initiate questions about firearm storage in the home.[36] Although clinicians in the study suggested that the results of the screening be included in the electronic medical record (EMR), interviewed gun-owners were concerned about potential detrimental implications of such documentation, which could damage the patient-physician trust. An alternative would be to have firearm safety intervention (not the screening) integrated to the EMR.

Safety Check is an evidence-based, office counseling intervention for increasing parental safe firearm storage.[37] Tested in a cluster-randomized control trial, the program trained pediatric providers to counsel families on using firearm cable locks and resulted in substantial increase in safe storage of firearms at six months after the counseling. Distribution of free, participant-selected firearm lockers also improves safe storage practices.[37]

Suicide Counseling

Firearms are implicated in approximately half of suicides, and have the highest case fatality rate of any suicide instrument.[14,38] However, the vast majority of individuals surviving an episode of suicidal ideation, or attempted suicide, do not later die by suicide.[39] Until recently, legislation in several states prohibited physicians from routinely asking patients about firearm ownership and entering information into patient records. These laws were overturned in June 2017, and since then, health care provider questioning and counseling about firearm access is legal in all states.[40]

Lethal means counseling is an evidence-based intervention that focuses on reducing access to firearms for suicide.[41-45] Combining it with the provision of safety devices (i.e., gun locks) enhances the results.[46] The American Medical Association (AMA) encourages physicians to educate and counsel patients about firearm safety with "free and open communication with their patients regarding firearm safety and the use of gun locks in their homes."[47] The AMA recommendation is not restricted to patients at risk, but extends to all patients.

Lock to Live is an NIH-funded, online decision aid developed by Betz and colleagues, which is now under evaluation. If proven effective, it should be a valuable tool in the health care armamentarium.[48] This group also developed a map of Colorado and Washington listing businesses and law enforcement agencies willing to consider requests for temporary, voluntary gun storage. The group is working on the scientific evaluation of the impact of these maps.

Screening of individuals at-risk for firearm injuries

Urban hospital emergency departments (ED) are a critical access point for identifying high-risk individuals. The SaFETy Score is a four-question tool that is associated with firearm violence:[49]

1. In the past six months, including today, how often did you get into a serious physical fight?
2. How many of your friends have carried a knife, razor, or gun?
3. In the past six months, how often have you heard guns being shot?
4. How often, in the past six months, including today, has someone pulled a gun on you?

The provider can then follow a scoring index to assist with patient recommendations.

Counseling of individuals and communities exposed to firearm violence

The Bipartisan Safer Communities Act includes $28 million to support trauma-informed care in schools, and $40 million over four years to improve treatment and services for children, adolescents, and families who have experienced traumatic events, such as firearm-related violence.[8]

Trauma-informed care is a pillar of the counseling of individuals and communities experiencing gun related violence. In the health care setting, trauma-informed care does not criminalize those affected, avoiding pejorative terms, suggestion of blame, referral to prior involvement with law enforcement or violence.

The SafERteens randomized trial of brief motivational interventions to youth presenting to an urban ED who reported past year alcohol use and aggression has shown benefits extending up to the one-year follow-up.[50,51] The same group has expanded this intervention to youth presenting to the ED for non-injury related care regardless of past history of violence. They have observed increased self-efficacy for avoiding fighting, and a decrease in the frequency of violent aggression at a two-month follow-up in a quasi-experimental study.[52] The effects of these brief interventions were modest and somewhat inconsistent across outcomes and serial follow-ups; however, even modest effects can offer hope given this is an inexpensive, brief intervention and the condition is highly lethal and morbid.

Health care providers may also choose to refer at-risk youth to evidence-based programs such as the Youth Empowerment Solutions (YES), an after-school active learning program designed to engage middle school youth in multi-systematic promotive behaviors at the individual-, interpersonal-, and community-level within the context of institutional disadvantages, including racism.[53] This program has shown benefits in prosocial behaviors through empowerment, and reduction of aggressive behaviors a year after the conclusion of the program, with a more pronounced effect among racism vulnerable individuals.

Hospital-based violence intervention programs (HVIP)

HVIPs combine a brief in-hospital intervention with intensive community-based case management and services to high-risk patients to reduce re-injury and retaliation through enhancement of protective mechanisms.[26] While the HVIP programs vary by hospital, the following components are deemed essential:[54]

a. Recognition that violence is preventable and there are modifiable risk factors associated with violent injury, including access to high quality education, lack of job opportunities, post-traumatic stress disorder, substance use, and lack of positive role models.
b. Take advantage of the "golden or teachable moment" at the hospital.
c. Approach using culturally competent case managers who can develop rapport with clients.
d. Address individual needs with long-term commitment.
e. Use trauma-informed approach and linkages to mental health resources.
f. Introduce risk-reduction resources via strong community partnerships and knowledge of landscape (e.g., access to job training, education, substance use treatment, domestic violence agencies).

In addition to the HVIP violence prevention specialist, the team should include physicians, case managers, nurses, social workers, and counselors.

Non-randomized studies have found the re-injury rate to be lower than those reported in patients who did not undergo HVIP.[55,56] Randomized studies have found mixed results, with those showing benefits being more intensive, suggesting an intervention dose effect.[57,58] Pediatric randomized studies of similar, but less comprehensive programs, have shown modest, sometimes conflicting effects.[26,59] Most studies were highly limited by unavoidable loss to follow-up. More research will be needed to assess the effectiveness of HVIPs.

Training health care providers to assess risk and provide counseling

Clinicians who lack training are less likely to screen

and counsel on firearm safety.[60] A 2016 systematic review showed that a minority of residency programs (including preventive medicine) offered firearm injury prevention instruction.[61]This review preceded the 2017 revocation of state gag laws; since then this type of training is becoming more frequent, but is far from widespread.[62-65] The NIH-funded Firearm Safety Among Children & Teens Consortium has training videos modeling conversations with parents about safe firearm storage in a nonjudgmental way.[63]

Guns do not kill people, neither do cigarettes, cars, motorcycles, fast food, alcohol, illegal and/or prescription drugs, or sweetened beverages. Society supports vigorous collection of data along with enforcement of evidence-based medical counseling, required warnings, safety devices, tax increases, age limits, and strict regulations to lessen harmful effects. It is time for our community to address, and not ignore, the firearm related deaths in a comprehensive way based on well-established scientific and sociological research principles.

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