



Firearm-Related Injuries and Deaths in Children and Youth

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Firearms are the leading cause of death in children and youth 0 to 24 years of age in the United States. In 2020, firearms resulted in 10 197 deaths (fatality rate 9.91 per 100 000 youth 0–24 years old). Firearms are the leading mechanism of death in pediatric suicides and homicides. Increased access to firearms is associated with increased rates of firearm deaths. Substantial disparities in firearm injuries and deaths exist by age, sex, race, ethnicity, and sexual orientation and gender identity and for deaths related to legal intervention. Barriers to firearm access can decrease the risk to youth for firearm suicide, homicide, unintentional shooting injury, and death. Given the high lethality of firearms and the impulsivity associated with suicidal ideation, removing firearms from the home or securely storing them—referred to as lethal means restriction of firearms—is critical, especially for youth at risk for suicide. Primary care-, emergency department-, mental health-, hospital-, and community-based intervention programs can effectively screen and intervene for individuals at risk for harming themselves or others. The delivery of anticipatory guidance coupled with safety equipment provision improves firearm safer storage. Strong state-level firearm legislation is associated with decreased rates of firearm injuries and death. This includes legislation focused on comprehensive firearm licensing strategies and extreme risk protection order laws. A firm commitment to confront this public health crisis with a multipronged approach engaging all stakeholders, including individuals, families, clinicians, health systems, communities, public health advocates, firearm owners and nonowners, and policy makers, is essential to address the worsening firearm crisis facing US youth today.

Firearms were the leading cause of death in children and youth (referred to as youth hereafter) 0 to 24 years of age in the United States in 2020. Among all causes of death, firearms were responsible

abstract

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for the most deaths in this age group, accounting for 10 197 deaths, compared with 8309 motor vehicle-related deaths (Fig 1).^{1,2} Compared with other high-income countries (as designated by the Organization for Economic Cooperation and Development), the United States has the highest rates of firearm deaths in children and youth.^{3,4} Although the other 28 high-income countries combined have over twice the US population, in 2015, 7241 American youth were killed by firearms compared with 685 youth in all the other high-income countries combined.⁵ Among children 5 to 14 years of age, the rate of firearm-related suicide in the United States is 8 times higher than similar high-income countries.⁶

Over the past decade, rates of homicides and suicides from firearms in US youth, especially those 15 to 24 years of age, have increased by 14% and 39%, respectively.^{4,7} Among all youth firearm deaths, homicides account for 58%, suicides account for 37%, unintentional shootings account for 2%, and legal intervention accounts for 1%. There are significant disparities by race and ethnicity

(Figs 2 and 3) as well as gender (Fig 4 A–C).^{2,8} There are substantial health care costs associated with firearm fatalities and nonfatal injuries. One study of firearm and motor vehicle crash injury visits for children 0 to 18 years of age found the mean individual hospital cost for a firearm injury was 5 times greater than for a motor vehicle injury.⁹ Previously healthy children had an over sixfold increase in health care expenditures in the year following a nonfatal firearm injury.¹⁰ These costs do not even begin to account for the short- and long-term mental health costs of the individuals and their families and communities.

These outcomes are not inevitable. These sobering statistics are the result of constitutional, historical, legal, and social policy decisions¹¹ and, as such, can be addressed through similar means. Firearm injuries and deaths from suicide and unintentional shootings, along with many homicides among youth, are preventable when there are barriers to youth having access to loaded firearms. For those at risk for suicide, removing firearms from the home or securing them with the unloaded firearm locked away

separately from the ammunition is referred to as lethal means restriction.^{12–14} In addition, homicides can be reduced through hospital- and community-based interventions using trauma-informed, culturally appropriate approaches.¹⁵ In this technical report, we first present the epidemiology of firearm injuries and deaths in children and youth. Next, we review the evidence related to harm reduction and the prevention of firearm injuries and deaths with risk screening and hospital and community-based interventions, including lethal means restriction, safe firearm storage counseling, and violence interruption and intervention programs. Finally, we discuss the effectiveness of policy and legislation in preventing firearm injuries and deaths. This technical report accompanies the policy statement, “Firearm-Related Injuries and Deaths in Children and Youth.”¹⁶

EPIDEMIOLOGY

Suicide

In 2020, more than 6000 US youth 15 to 24 years of age died by suicide.² Firearms, the most lethal means of suicide,¹⁷ are the cause of death in one-third of suicides among those 10 to 14 years of age and half of all suicides among those 20 to 24 years of age.^{2,18} Although youth firearm suicides decreased from 1994 to 2007, they have increased 53% since then (Fig 2).^{19–21}

Several studies have demonstrated an independent relationship between access to firearms and suicide.^{22–24} Approximately 80% of firearm-related suicides take place in the home of the youth or a relative, with the firearm belonging to either the youth or parent or caregiver in 90% of cases.²⁵ Approximately 40% of US households with children have firearms, of which 15% stored at

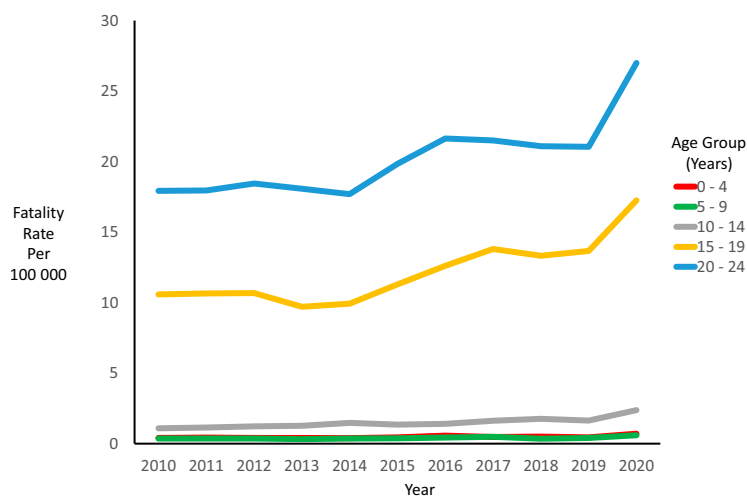


FIGURE 1

Total firearm fatality rates in youth 0 to 24 years, 2010 to 2020. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

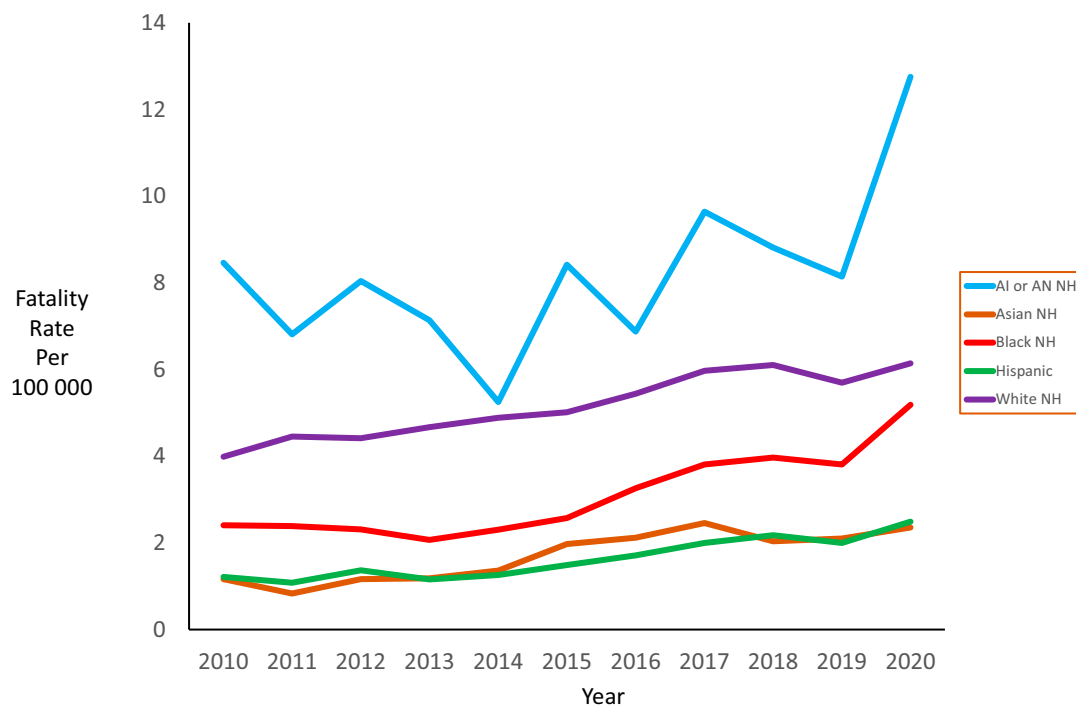


FIGURE 2

Suicide firearm fatality rates in youth 10 to 24 years by race and ethnicity, 2010 to 2020. AI or AN, American Indian or Alaskan Native; NH, non-Hispanic. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

least 1 firearm loaded and unlocked, the storage method with the highest risk.²⁶ Firearms may still be unsafely stored in the presence of youth with self-harm risk factors living in the home.^{27,28} In a nationally representative survey, adolescents with risk factors for suicide were equally as likely to report easy access to firearms at home as adolescents without suicide risk factors.²⁹ In addition, although firearm access is an individual risk factor for firearm suicide, poverty is a risk factor for firearm suicide at the individual and community level.^{30,31}

Homicide

Firearm-related homicide was the third leading cause of death for US youth in 2020,² and rates have increased over 60% from 2014 to 2020 (Fig 3).⁴ Overall, 15% of deaths among children and adolescents are caused by firearms, and over half of those deaths are a

result of homicide.^{4,32} The majority of firearm-related homicide deaths occur among youth, with homicide epidemiologic trends varying by age group (Fig 4B). Among all children and youth, the most common circumstance precipitating firearm homicide is an argument, accounting for 34% of deaths for younger children and 40% of teenagers. Among victims 0 to 12 years of age, 31% are related to intimate partner violence, 28% are related to another crime, and in 15%, the victim was a bystander. Among teenagers 13 to 17 years of age, 31% are precipitated by another crime, 21% are gang related, and 13% are drug related. The majority (85%) of younger children (0–12 years old) were killed at home, with over two-thirds of the perpetrators over 25 years old, and almost half of these homicides included multiple victims. In contrast, teen homicides are more likely perpetrated by

those 13 to 24 years of age and were equally likely to occur in a home or on the street. Almost always, the lethal weapon is a handgun.³²

Unintentional Deaths

Among the 222 unintentional firearms deaths among children and youth in 2020, 93 deaths (42%) occurred in children 0 to 14 years of age. Compared with intentional firearm injuries, youth sustaining unintentional injuries have lower mortality rates.³³ From 2010 to 2019, unintentional firearm injuries accounted for 24.3% of all firearm-related deaths among children (0–10 years) and 1.8% among adolescents and young adults (15–24 years).³⁴ Although unintentional injuries have decreased since 2002,³² US children 0 to 14 years of age have disproportionately higher rates of unintentional firearm death compared with other high-income countries.³⁵

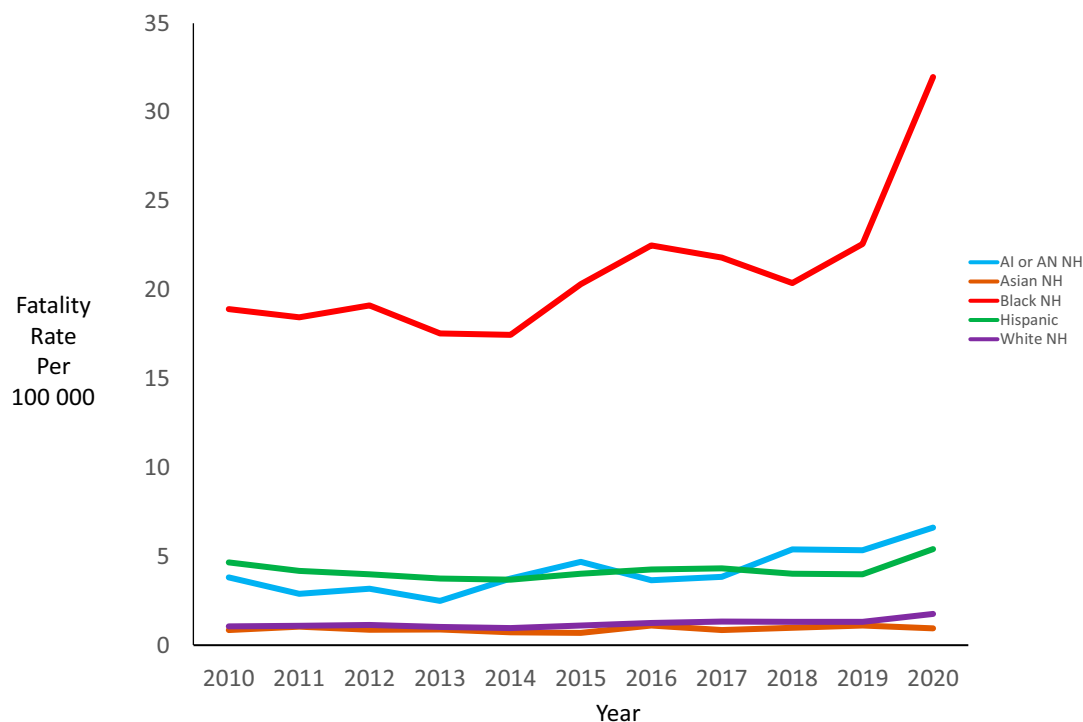


FIGURE 3

Homicide firearm fatality rate in youth 5 to 24 years by race and ethnicity, 2010 to 2020. AI or AN, American Indian or Alaskan Native; NH, non-Hispanic. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

Approximately 80% of unintentional firearm-related deaths of young children occur in the home³⁶ when they are playing with a firearm.³² The vast majority of these incidents are self-inflicted, and when not self-inflicted, the shooters themselves are often young children.³⁶

Nonfatal Firearm Injuries

From 2010 to 2019, there were an estimated 391 592 emergency department (ED) visits in the United States among children and youth 0 to 24 years of age for firearm injuries.² An in-depth analysis of 178 299 firearm injuries among youth 0 to 21 years of age in the Nationwide Emergency Department Sample demonstrated a male majority (89.0%), a mean age of 17.9 years, and 43% enrolled in public insurance. The intent of the shooting was unintentional in 39.4%, assault in 37.7%, and self-harm in 1.7%.³⁷ These firearm-related injuries,

regardless of intent, can result in long-term physical, developmental, and psychiatric consequences with ongoing costs to the child and medical system.^{10,38} And these consequences do not account for the unmeasurable emotional and psychosocial costs for the child, family members, and community at large.³⁹

School Shootings

School shootings represent a relatively new phenomenon over the last half-century, and the United States has the highest rate of school shootings in the world.⁴⁰ The frequency of school shootings has increased dramatically. Between 1966 and 2008, there were 44 school shootings documented in the United States, averaging 1 per year.⁴⁰ Between 2013 and 2015, by contrast, there were 154 reported events, averaging 1 per week.⁴¹ Although school shootings are responsible for fewer than 1% of all firearm deaths among children 0 to

17 years of age in the United States, they receive a tremendous amount of attention.^{32,42} Mass school shootings, involving multiple victims and perpetrated by a current or former member of the school, which garner the greatest attention, account for only 13% of all school shootings.^{43,44} These tragedies are distinguished from other mass shootings in that the assailants tend to be younger, under 20 years old.⁴⁵ The role of mental health disorders in mass shootings remains unclear.⁴² Studies have reported a ban on semiautomatic, military-style firearms⁴⁶ and on large-capacity magazines is associated with decreases in both the incidence of, and number of people killed in, mass shootings.^{47,48} Policies addressing mental health and access as well as purchase and ownership of large-capacity magazines and military-style weapons could potentially reduce mass shootings in schools as well.⁴²

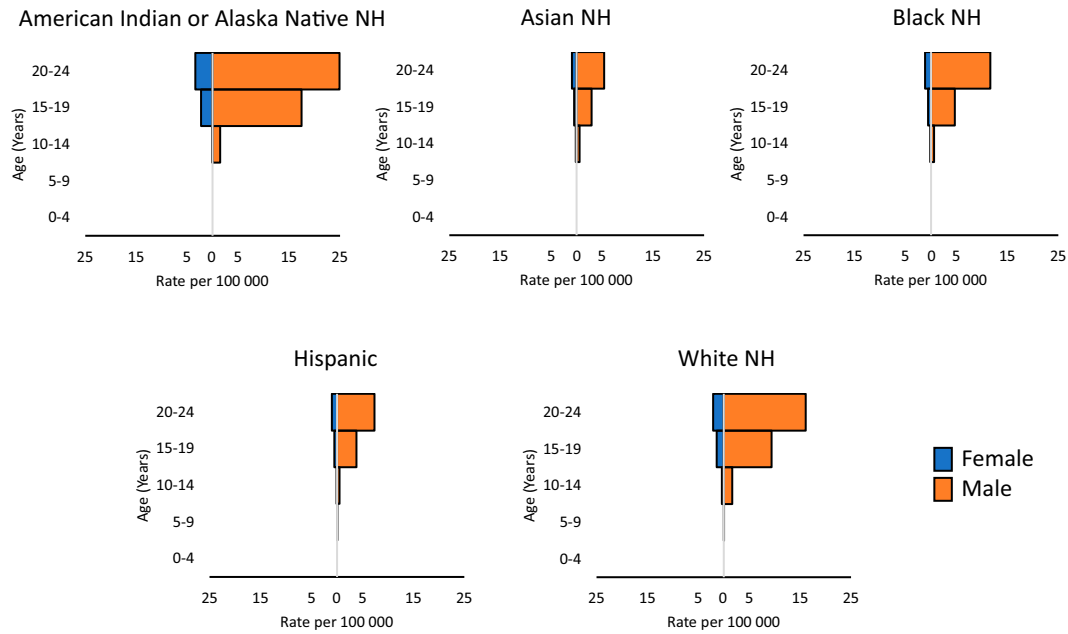


FIGURE 4A

Suicide firearm fatality rates by race and ethnicity, average 2010 to 2020. NH, non-Hispanic. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

Disparities and Differential Impacts in Firearm Injuries and Deaths in Children and Youth

The epidemiology of injuries and deaths by firearms has demonstrated long-standing differential impacts by age, gender, race and ethnicity, and

sexual orientation and gender identity (Fig 4 A–C).⁴⁹ Most firearm-related suicides in youth are among male (89%) and older youth (33% occur among youth 15 to 19 years old and 61% among young adults 20 to 24 years old).² In 2019, lesbian, gay, or

bisexual youth attempted suicide at 4.5 fold higher rates than heterosexual youth, and transgender youth attempted suicide at 6.3 fold higher rates than cisgender males;^{50,51} however, data on firearm suicides among LGBTQ+ youth are limited.⁵²

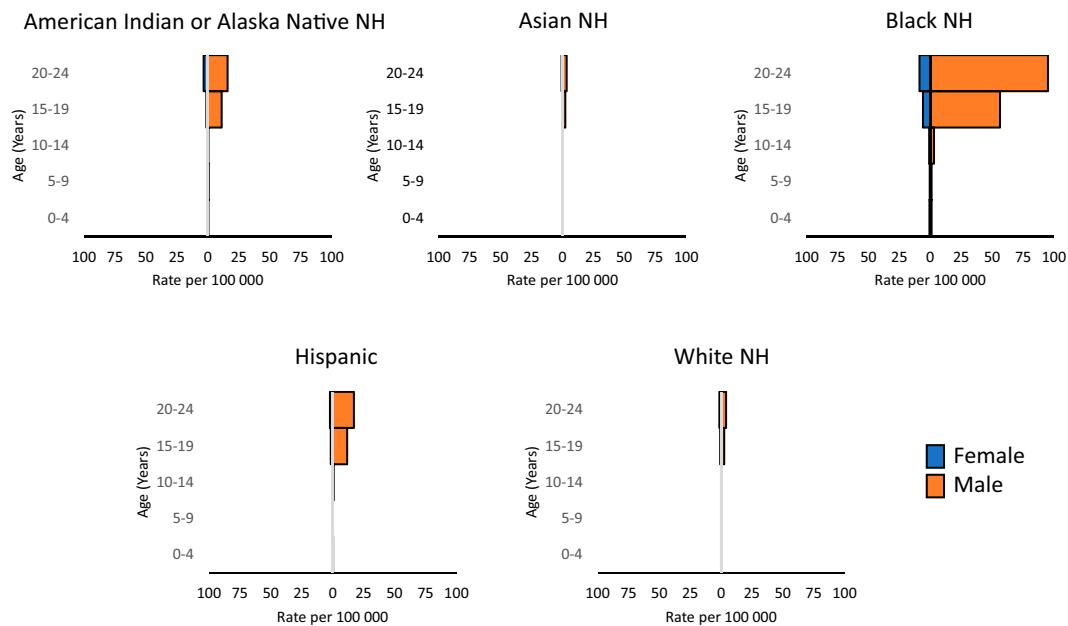


FIGURE 4B

Homicide firearm fatality rates by race and ethnicity, average 2010 to 2020. NH, non-Hispanic. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

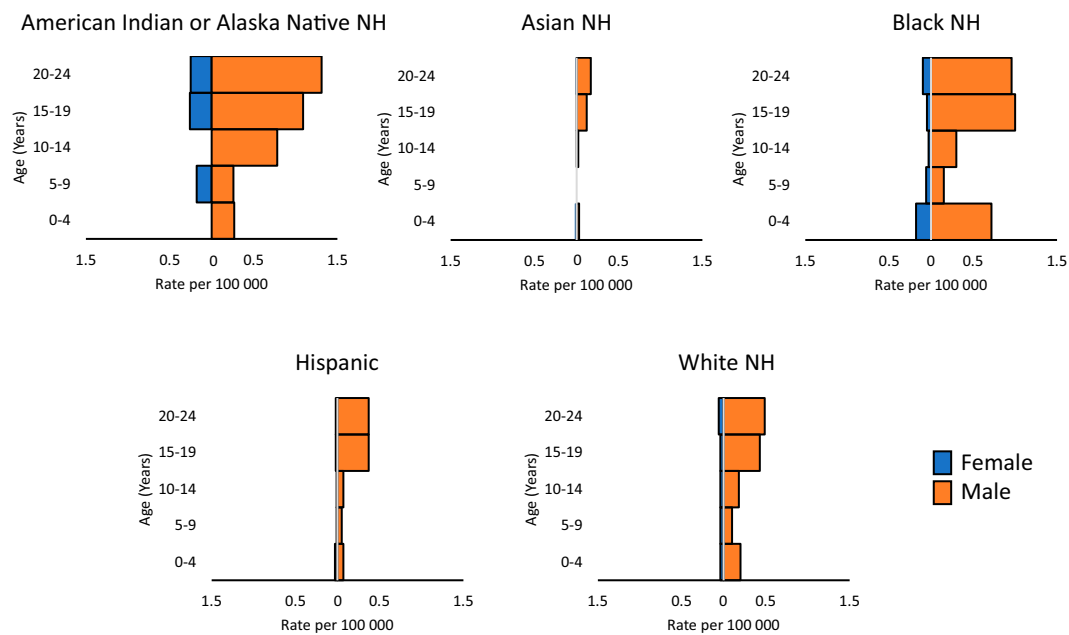


FIGURE 4C

Unintentional firearm fatality rates by race and ethnicity, average 2010 to 2020. NH, non-Hispanic. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

Regional differences exist as well, with youth residing in the south having almost 3 times the odds of hospitalization for a firearm-related suicide attempt compared with those living in the northeast.⁵³ Youth firearm-suicide rates vary from a low of 0.5 per 100 000 (New Jersey) to a high of 11.2 (Alaska), with some of the highest rates of firearm-related suicide found in the Western states (Fig 5).³² There are also racial and ethnic disparities in firearm-related suicides (Fig 4A), with Indigenous male youth having the highest rates of firearm suicide, followed by white male youth.⁵⁴

Firearm homicide rates are also significantly greater for male youth (87%). As with other injuries, there is significant regional variation ranging from 0.4 per 100 000 (Hawaii) to a high of 19.2 (District of Columbia) (Fig 6).³² A large proportion of the racial and ethnic disparities in firearm injury and death among youth are driven by the disparities in firearm-related homicide (Fig 4B). Black youth have firearm homicide rates 2 to 4 times that of Hispanic and

Indigenous peers, respectively, and 10 times that of white and Asian youth.³² Further, firearm-related deaths attributable to legal intervention disproportionately affect youth of color.^{55,56} Reasons for these disparities derive from long-standing complex systems of harm, including structural racism, poverty concentrated across generations into specific neighborhoods, explicit and implicit racial biases, and other complex sociocultural and interpersonal and individual factors.^{11,57} Single-victim school shootings occur more often in communities of marginalized racial and ethnic groups, whereas shootings with multiple victims tend to occur in white-majority schools, which should prompt more research regarding the circumstances and contextual details of these shootings.^{58,59} Deeper analyses are also merited into the associated problem of weapon carrying in US schools,⁶⁰ the disproportionate policing of Black and Hispanic youth,⁶¹ and the approaches to prevention. For unintentional firearm injuries, Black children also carry a disproportionate burden

when compared with their white and Hispanic peers. However, the highest rates occur in American Indian and Alaska Native non-Hispanic children, whereas the lowest rates occur in Asian non-Hispanic children (Fig 4C).^{32,62}

International Perspectives on Firearm Injuries and Deaths

Firearm injuries remain a significant cause of morbidity and mortality across the globe. Central and South American countries have the highest rates of firearm deaths in youth.⁵ In 2015, the US rates of firearm deaths were significantly higher than rates of all other high-income countries combined, with 90% of all firearm deaths globally occurring in the United States.³ Much of this disproportionate risk for firearm injury and death of US youth is because the United States has the highest rate of firearm ownership per capita in the world (120 firearms per 100 people).^{3,63} This risk is also attributable to the types of firearms owned in the United States; 47% of all firearms are handguns,⁶⁴ and 72% of firearm

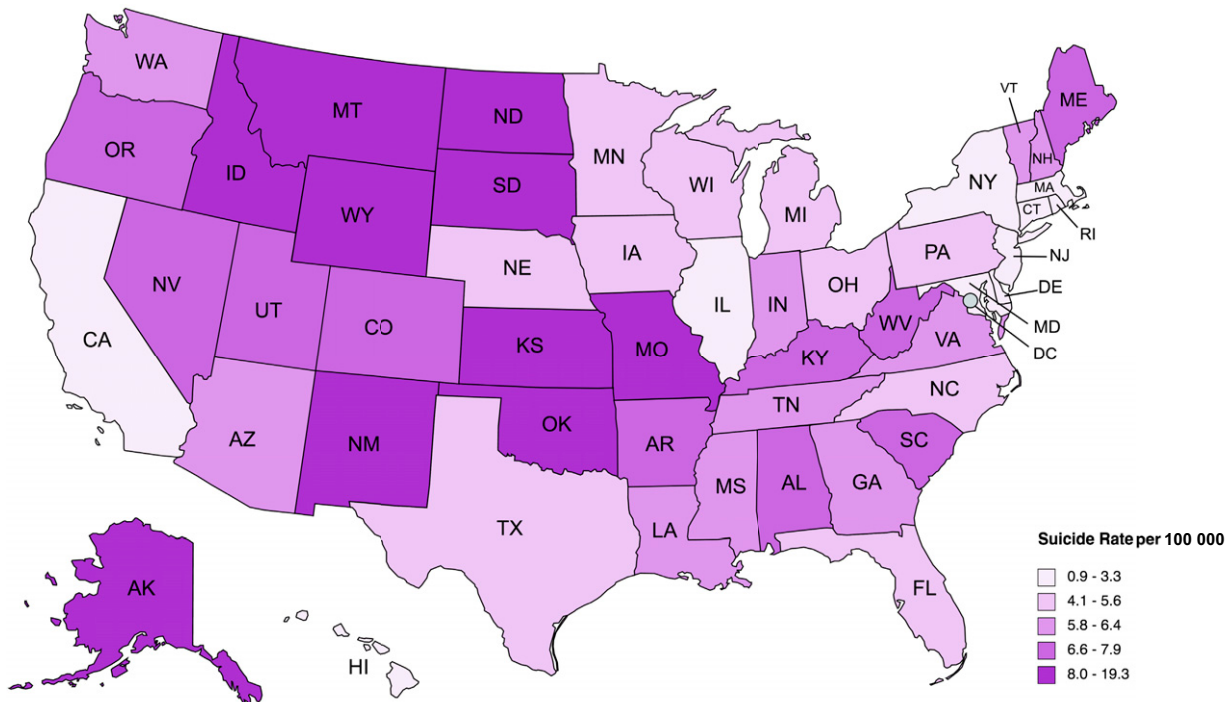


FIGURE 5
Suicide firearm fatality rates in youth 10 to 24 years, average 2016 to 2020. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

owners own at least 1 handgun.⁶⁵ In contrast, Canada has 34 firearms per 100 people,⁶³ and 91% are long guns (rifles and shotguns).⁶⁶

Reasons for Firearm Ownership

The Second Amendment states, “A well-regulated Militia, being necessary to the security of a free State, the right of the people to keep and bear arms, shall not be infringed.”⁶⁷ Now, more than 200 years after its ratification, there are more than 400 million firearms in the United States.^{68,69} Overall firearm ownership has increased this century by 30%,⁷⁰ and in 2019 an estimated 37% of United States households owned firearms.⁷¹ Firearm purchasing and ownership has been influenced by numerous societal events, including elections, mass shootings, a global pandemic, and racial protests.^{69,72} In 2020 with the syndemic of the COVID-19 pandemic and the racial reckoning following the murder of George

Floyd, firearm background checks increased by over 30% to a peak of 39 million.

In the 1990s, hunting was the primary reason for firearm ownership.⁷³ As of 2019, 66% of United States firearm owners report they own firearms for protection⁷⁴; however, firearms are used for self-defense in <1% of crimes.⁷⁵ The average firearm owner has approximately 5 firearms, and 14% of US firearm owners, approximately 3% of the US population, own half of the US firearm stock.⁶⁴ Geographically, firearm ownership varies by state (Fig 7) and is more concentrated in rural areas, with 48% of households having a firearm in their home in rural regions versus 25% and 23% suburbs and urban areas, respectively.⁷⁶⁻⁷⁸

Adults can legally purchase firearms from federally licensed stores or shows, family or friends, websites, or pawn shops. Illegal

obtainment occurs via straw purchases, firearm trafficking, or theft.⁷⁸ Straw purchasing, in which a buyer attempts to purchase a firearm for someone else, occurs more than 30 000 times annually.⁷⁹ By federal law, licensed dealers may not sell handguns to youth until they are 21 years of age or a long gun (eg, rifle, shotgun) until they are 18 years of age. Unlicensed individuals (eg, through personal sales, auctions, gun shows), may not sell or transfer handguns to youth younger than 18 years. However, no age restrictions exist for the sale or transfer of long guns in these unlicensed transactions.⁸⁰ Federal law prohibits the possession of a handgun by any person younger than 18 years but does not place a minimum age for possession of long guns.⁸¹ State laws vary around age of purchase and possession of handguns and long guns.

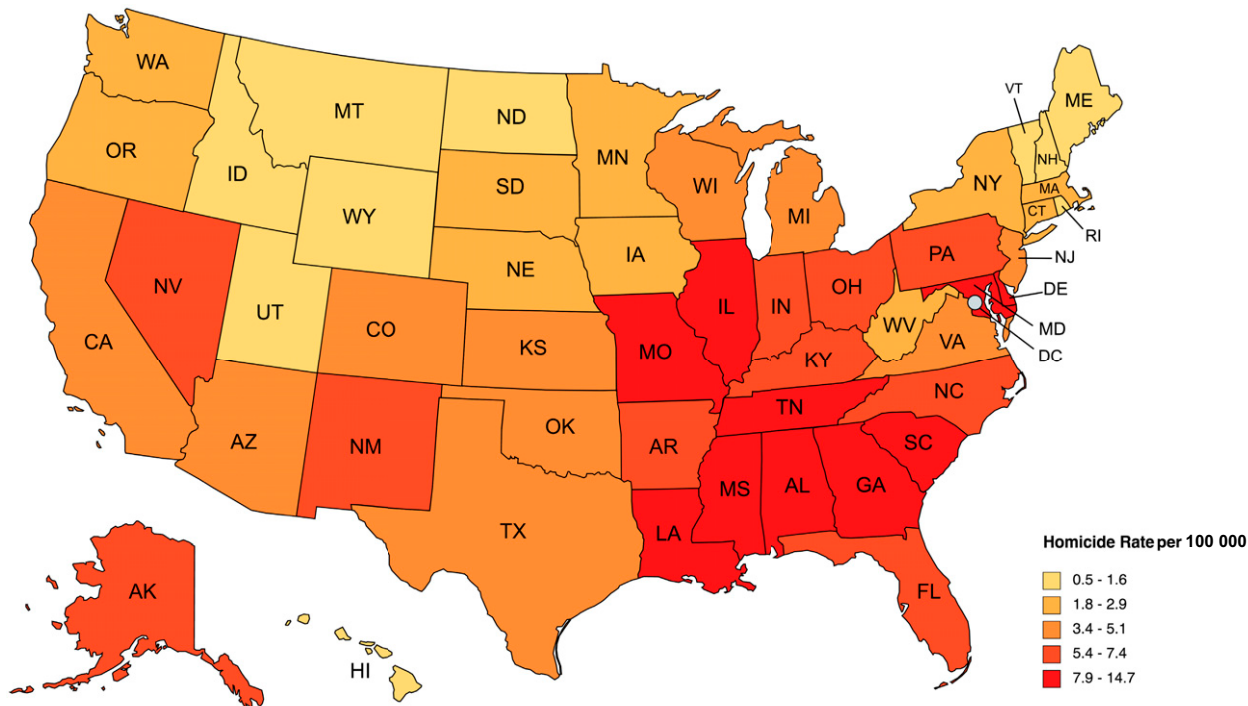


FIGURE 6
Homicide firearm fatality rates in youth 5 to 24 years, average 2016 to 2020. Data obtained from: <https://www.cdc.gov/injury/wisqars>.

Risks Associated With Firearm Access

State-level household firearm ownership is positively associated with state-level overall youth suicide rates.^{22,82} With each 10-percentage point increase in states' firearm ownership rates, the youth suicide rate increases by greater than 30%.⁸² The presence of a firearm in the home is also an independent risk factor for unintentional firearm death and injury among children.⁸³ Studies have also linked the ease of access and relative presence of firearms in a community to firearm homicide rates.^{46,84,85} Thus, adolescent access to firearms implicates unsanctioned use and/or access.

It is also important to consider the environment of carrying firearms or having access to them in response to perceived danger and peer influence. These include gang involvement, drug dealing, drug use, violence, exposure to violence,

neighborhood disorder, and peer victimization.^{31,86-90} The 2019 High School Youth Risk Behavior Survey found that nationwide, 6.7% of males report carrying a firearm (not for hunting or sport) in the past 12 months, with a high of 14.5% in Alabama.⁸⁰ However, 1 cross-sectional study reported no relationship between fear of victimization or victimization on subsequent carrying of a firearm.⁹¹

Depression, Suicide, Firearms, and Means Restriction

Depression is a major risk factor for suicide, the second leading cause of death for those 10 to 24 years of age.² However, it must also be recognized that only 50% of adolescent suicide victims had a diagnosis of depression at the time of their death.⁹² Compared with those with known mental health problems, adolescents with no apparent psychiatric disorder have increased suicide rates when loaded firearms are stored in the home.⁹³

This is because suicidal behavior is often impulsive,⁹⁴ acute, and crisis-oriented in nature; thus, the decision to attempt suicide occurs quickly—usually within 10 minutes of the actual attempt.⁹⁵ Adolescents with suicidal intentions typically use the method most conveniently available, and what matters at that moment of the attempt is whether an adolescent has the opportunity for regret and the lethality of the action. Unfortunately with firearms, once the trigger is pulled, there is no opportunity for regret, as >90% of firearm suicide attempts will result in death.⁹⁶ In contrast, only 2% of poisonings and <1% of self-inflicted injuries with sharp instruments result in death.⁹⁷ Given the impulsivity of suicide and the high fatality rate associated with firearms,^{17,97} it is imperative to identify opportunities for intervention to prevent firearm suicides among youth through screening for both firearm access and individual risk for suicide,

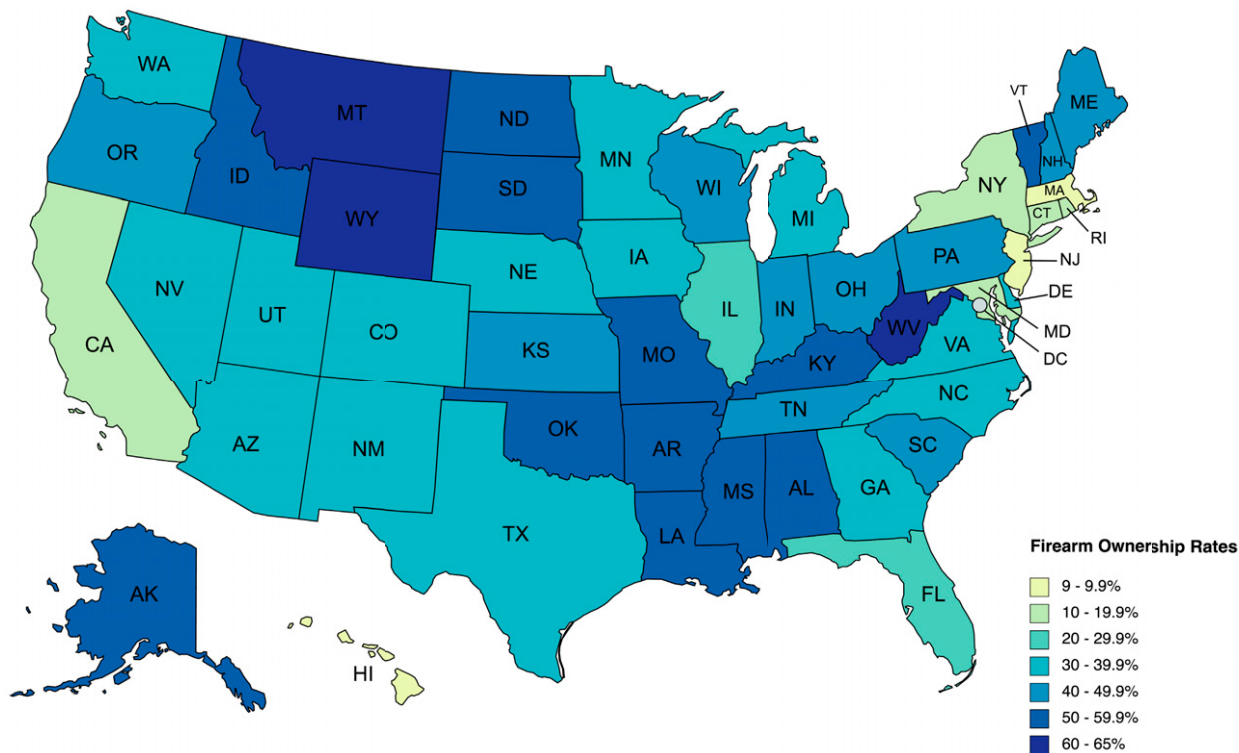


FIGURE 7 Household firearm ownership, United States 2016. Data obtained from: <https://www.rand.org/pubs/tools/TL35.html>.

which are approaches endorsed by psychiatry professional organizations.^{98,99}

In pediatric firearm suicide, over three quarters of these suicides occurred when there was easy access to a loaded and unlocked firearm with ammunition. The firearm was stored unlocked and loaded in the circumstances of firearm suicide for 42% of children 10 to 14 years of age and 35% of youth 15 to 19 years of age. The firearm was stored unlocked and unloaded among 38% of children 10 to 14 years of age and among 39% of youth 15 to 19 years of age (National Violent Death Reporting System, 2020). When a firearm is used in a pediatric suicide among youth 10 to 14 years of age and youth 15 to 19 years of age, parents owned the firearm 66% and 51% of the time, respectively. Importantly, in these same age groups, the victims themselves possessed the firearm

10% and 25% of the time, respectively (National Violent Death Reporting System, 2020).

An important element of suicide prevention is lethal means screening and restriction, aimed at preventing access to the most lethal agents of harm.¹⁰⁰ Although there are multiple agents that can be used for lethal means, for this technical report we will focus on firearms. By inquiring about and understanding the at-risk patient's access to firearms, clinicians can then counsel the family about the increased risk of suicide when firearms are present in the home.^{22,82} Ease of access to firearms matters and restriction of lethal means of firearms for suicide can be accomplished through 3 mechanisms:

1. Eliminating physical access (eg, not owning a firearm, making the decision to remove firearms from

the home, locking up firearms in appropriate lockboxes, use of personalized smart gun safety technology that limits access to the firearm only by the authorized user[s]).

2. Reducing “cognitive access”—how accessible the concept of suicide is in an individual's mind (eg, consider limiting access and/or have open dialog of content—online or in other forms—that may be focused on self-harm behaviors).¹⁰¹
3. Preventing acquisition of highly lethal methods (eg, age restrictions on firearm purchases, implementation of extreme risk protection order legislation).¹⁰⁰

A common argument against firearm means substitution is that people who want to die by suicide will have another attempt if they survive an initial attempt. In fact, fewer than 10% of people who survive a suicide

attempt will ultimately die by suicide.¹⁰²

The role of the pediatric clinician in lethal means counseling is essential to educate families about how lives can be saved from suicide by preventing access to firearms.¹² Even though the danger firearms pose with depressed adolescents may appear evident, this is not necessarily true for a family who is unaware of the risk of suicide in general, nor for the family who has not considered the risks of the intentional use of firearms for self-harm. Especially in the homes of at-risk youth with mental health and substance use disorders, it is important to inform families that depending on the locality, firearms can be temporarily transferred to other people, including family, friends, firearm dealers, gun clubs or shooting ranges, as well as the local police in many localities.^{103–106} In some states, clinicians can directly petition or can advise families to petition for extreme risk protection orders to prevent at-risk individuals from purchasing or owning a firearm.¹⁰⁷

INTERVENTIONS

Safe Storage and Personalized Smart Gun Technology

The full spectrum of public health approaches for firearm injury prevention include primary (universal) prevention, secondary (targeted), and tertiary prevention strategies (Table 1). The previously

published American Academy of Pediatrics (AAP) policy statement included that the safest way to store a firearm is outside of the home.^{6,108} However, it must be recognized that safer firearm storage advice must take place in the context of firearm ownership in the United States. Over one-third of households, representing 22.6 million children, own and store firearms in the home.^{109,110} In this environment, pediatric clinicians can still have important conversations on firearms and provide thoughtful and pragmatic recommendations about safer storage of firearms with families. It is essential to consider the parents' beliefs and values, including reasons for firearm ownership (ie, involvement in the military, police, or security fields, household protection, recreational shooting, hunting) when having discussions addressing the safety of children when firearms are in the home. Knowledge of the reason(s) for firearm ownership may facilitate discussion of risks and support for prevention measures in the home. Storage of a firearm outside of the home, and off the property, is a possibility not all families may have considered (Table 2).¹⁴ Although parents who keep firearms for home protection may not view this as a favorable choice, hunters and collectors may consider this option.

When a firearm is kept in the home, there are multiple methods for safer

storage to prevent children and adolescents from accessing and using it (Fig 8, Table 2).¹⁴ The safety principals remain the same for all developmental ages and stages. There are 4 key elements to safer firearm storage in the home (Fig 9)¹¹¹:

1. Store the firearm unloaded.
2. Store the firearm locked.
3. Store the ammunition separated from the firearm.
4. Store the ammunition locked separately from the firearm.

Each element of safe storage decreases the likelihood of youth inappropriately accessing firearms and decreases the risk of injury and death.^{111,112} One study using a statistical simulation model concluded that if 20% of parents who currently store their firearms unlocked changed their storage practices and stored them unloaded with the firearm and ammunition locked away separately, there would be an estimated decrease of up to 122 pediatric firearm-related fatalities and 201 injuries annually.¹³ It should be noted that the operative word is “safer”—although the likelihood of a firearm injury or fatality is lower in a household where a firearm is stored locked, unloaded and separate from the locked ammunition, children and youth still gain access to these firearms every year with deadly consequences.

TABLE 1 Spectrum of Public Health Approaches to Firearm Violence Prevention

Primary (universal) prevention	Secondary (targeted) prevention	Tertiary prevention
<ul style="list-style-type: none"> ● Effective firearm legislation ● Universal background checks ● Child access prevention laws ● Extreme risk protection order laws ● Ban on assault weapons ● Development of personalized “smart” gun technology ● Regulations related to firearms as a consumer product 	<ul style="list-style-type: none"> ● Lethal means restriction for youth at risk for self-harm ● Community- and hospital-based violence prevention programs ● Anticipatory guidance with patients and families regarding safer storage of firearms in the home ● Recommend including provision of firearm lock or safe 	<ul style="list-style-type: none"> ● Violence intervention advocacy programs

TABLE 2 Firearm Storage Options Inside and Outside the Home

Product	Description
Storage options inside the home	
Cable lock	Blocks either the barrel of the firearm and/or the ammunition by preventing a detachable magazine, which holds the bullets, from attachment to the firearm.
Trigger lock	Prevents a firearm from being fired by covering the trigger and trigger guard. They are available in versions with keys or combinations.
Lockbox or gun safe	Lock boxes and gun safes provide a place to store a firearm in a locked, ideally unloaded, location. One can access a lock box or safe in multiple ways including keys, combinations, keypad, biometrics, and RFIDs. Keypads and biometric boxes or safes can be opened in 1 to 2 seconds.
Storage options outside of the home	
Safe deposit box and storage units away from the home	These are other personally owned options for storage.
Other family members or friends	Temporary legal transfer of firearms to families and friends is available in all states (with differing restrictions). ^{104,105,194}
Firearm storage locations outside of the home	Readily available off-premise storage possibilities include shooting ranges or gun clubs, police stations, ¹⁹⁵ and many licensed firearm dealers. ¹⁰⁵

RFID, radio frequency identification.

In addition to these options, there is currently existing technology with personalized “smart guns,” which provide gun owners the ability to secure their handguns by preventing unauthorized users from firing a firearm (ie, curious children, youth at risk for harming themselves or others). These firearms are designed to recognize authorized users, either using proximity devices, such as paired radio frequency identification (RFID) watches or rings, or via built-in biometrics recognizing fingerprints or palmprints.¹¹³ In addition, similar personalized “smart” firearm safety technology is currently available on the consumer market for handgun safes and firearm trigger locks, which use biometric fingerprint technology to allow the authorized user access to the handgun or trigger. It is estimated that 37% of unintentional pediatric deaths could be avoided through the use of personalized firearm technology¹¹⁴ and would likely greatly reduce pediatric firearm suicides. Although personalized firearm technology has been in development by leading firearm manufacturers for over 20 years, they are not readily available for sale in the United States. This lack of availability is in part attributable to a 1976 change in

consumer safety regulations stating, “The Consumer Product Safety Commission shall make no ruling or order that restricts the manufacture or sale of firearms, firearms ammunition ...”.^{115,116} Firearms are the only consumer product in the United States not regulated for safety.¹¹⁷ The lack of personalized firearm technology availability is also, in part, a response to threatened boycotts of manufacturers and firearm stores willing to sell them.¹¹⁷ Despite these barriers, 59% of people are willing to purchase “childproof guns,” and 86% of firearms owners support the sale of personalized firearm technology.^{118,119}

Primary Care Interventions

Primary care interventions to prevent firearm injury, similarly to motor vehicle injury prevention, to children and youth center on (1) talking to patients and families about firearms in their home and places they may visit; (2) anticipatory guidance for at-risk individuals; and (3) programs to directly prevent injury.¹²⁰ In general, parents and caregivers are often interested in discussing firearm injury prevention,^{121–123} yet this topic is sometimes viewed as a lower priority compared with other issues in anticipatory

guidance.^{121–123} One survey of parents in a primary care clinic reported 66% believed pediatricians should ask about firearms, but only 13% reported having this type of discussion during a visit. Further, firearm-owning parents were less likely to welcome the discussion, with approximately 14% reporting they would be offended, although 63% stated that they would “think it over” or “follow the advice.”¹²⁴ In another study, qualitative interviews of 16 pediatric clinicians and 20 parents reported firearm screening is undesirable by some families and that culturally appropriate messaging is important.¹²⁵

Anticipatory guidance for firearm safety injury risk¹² is included in the *AAP Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescent*, fourth Edition, beginning with the prenatal visit.^{126,127} Unfortunately, although providers generally believe in the importance of discussions on firearm safety in the home, rates for counseling by pediatric clinicians are generally very low,^{121,128,129} including in pediatric resident clinics.^{130,131} Formal training in and



FIGURE 8 Gun storage options. Infographic from Project ChildSafe (<https://projectchilsafe.org>).

belief in the efficacy of counseling are important factors to increase self-efficacy and counseling for firearms in the primary care setting¹³²⁻¹³⁵ and influencing practice,^{132,135} as is the belief that youth suicide is preventable.¹³⁴ Although many clinicians employ selective counseling practices,¹³³ pediatricians do not predict firearm ownership among individual families accurately.¹²⁴

Primary care interventions focused on anticipatory guidance and

interventions to prevent firearm access can be divided into those focused on unintentional access and those focused on lethal means prevention for suicide prevention (<https://www.aap.org/en/patient-care/gun-safety-and-injury-prevention/safe-storage-of-firearms/>).¹²⁸ Several interventional studies have examined the effectiveness of firearm safety anticipatory guidance, with and without safety device provision, with mixed results.¹³⁶⁻¹³⁹ Most studies were conducted before 2010, limiting

applicability in our current environment. One multicenter randomized control trial of firearm safety anticipatory guidance demonstrated increased self-report of firearm safe storage.¹³² Another study involving family practitioners showed improved patient self-report of safe storage practices among adult patients after receipt of counseling, with or without an accompanying brochure.¹⁴⁰ Pediatric primary care interventions involving counseling plus distribution of a firearm locking

Practice **safer storage** in your household by storing your firearm:



FIGURE 9

Safer storage for household firearms. Graphic courtesy of the Trainees for Child Injury Prevention, a partnership between the AAP and the Center for Injury Research and Policy at Nationwide Children's Hospital.

device have demonstrated significant increases in self-report of safe firearm storage.^{132,141}

The role of primary care in prevention of youth suicide has become increasingly important. Screening for depression and direct suicide risk can be effective in identifying at-risk youth¹⁴² and is 1 part of a multipronged strategy for youth firearm suicide prevention. Although families and medical and behavioral health providers agree safe firearm storage is an important factor in protecting at-risk youth,¹⁴³ the effectiveness of primary care safe firearm storage interventions for youth suicide prevention is an area for further research.

ED and Hospital Interventions

Emergency Department

The ED is another opportunity for firearm injury prevention with screening for at-risk youth and presence of household firearms as well as anticipatory guidance,

including lethal means restriction (<https://www.hsph.harvard.edu/means-matter/recommendations/clinicians/>).¹⁴⁴ Although ED providers indicate comfort in assessing risk for suicidality, they have less confidence in counseling on lethal means restriction because of lack of training and experience.¹⁴⁵ Clinicians receiving lethal means restriction training are more likely to provide it.¹⁴⁶ Implementing a universal ED suicide screening process is associated with increased physician comfort, knowledge, attitudes, and beliefs toward screening.¹⁴⁷

In practice, research has demonstrated anticipatory guidance can be effective in the ED setting. Several studies examining lethal means counseling about firearms reported parents of youth at risk for suicide noted increased self-efficacy, with some studies reporting up to 100% success rate in parents restricting access to lethal means, compared with families not

counseled.^{58,148–150} One controlled trial examined a lethal means counseling intervention for firearms and medications by ED behavioral health specialists to caregivers of youth presenting with behavioral health concerns, and afterward, there was improved parental self-reported safe storage of firearms and medications.¹⁵¹ Another ED study combined clinician lethal means counseling with provision of a free medication lock box and reported 209 of 236 (89%) of all youth presenting for suicidal ideation received the counseling and product. Before counseling, 67% of caregivers self-reported safe storage of firearms compared with 100% of caregivers after counseling.¹⁴⁹ In addition to firearm suicide risks, the ED is a prime location to screen and intervene with adolescents for exposure to firearm violence. One clinical screening tool, the Serious fighting, Friend weapon carrying, community Environment, and firearm Threats (SaFETy) score, has

been shown to identify factors predictive of future firearm violence in a single-center study of substance-using youth.¹⁵²

Hospital-Based Prevention Programs

Hospital-based violence intervention programs identify youth injured from violence at their index ED visit and enroll them in programs to reduce recidivism, including for firearm violence.^{15,153} These programs employ multidisciplinary approaches and work with medical staff and community-based partners to provide safety planning, services, and trauma-informed care to victims of violence.^{15,153} Studies of hospital-based violence intervention programs have demonstrated decreases in behavior related to violence,¹⁵⁴ reductions in reinjury,^{77,155,156} and juvenile detention center costs.¹⁵⁷ One such program, including adult and pediatric patients, noted a 50% decrease in the number of pediatric injuries compared with adult patients over 12 years of the program.²¹

Community Intervention Programs

Community-based firearm injury intervention programs are generally focused on violence intervention advocacy programs, firearm safety product distribution programs, and gun buybacks. Violence intervention advocacy programs are interventions focused on addressing the risk and protective factors for firearms injuries and deaths, both at the individual and community level, to address violence within local context.^{15,158} One example of a pediatric-focused community partnership intervention is the Harlem Hospital Injury Prevention Program in New York City. The program, a coalition of community leaders; multidisciplinary academicians; city, state, and federal agencies; school health programs; and private foundations, demonstrated decreased injury rates

for adolescents, specifically for firearm-related injuries.^{159–161} This broad, multipronged intervention established youth programs, built playgrounds to provide safe venues for children, and provided access to the arts and green spaces.^{161,162}

This type of program, in conjunction with community-level improvements in public transportation, environmental safety conditions, and housing, can also be effective in reducing firearm injuries and deaths.^{163,164}

Another example of a community violence prevention program is Cure Violence, a program based on behavioral change and the adaptation of societal norms.^{158,165} This model uses violence interrupters (or credible messengers) who are individuals in the local community who can develop trusting relationships with “high-risk” youth. They also use outreach workers to connect youth to resources in housing, education, recreation, and employment as well as to other community and faith-based organizations, all in cooperation with local law enforcement.

Firearm Safety and Storage Programs

On a more individually focused level, community-based firearm safety storage programs have demonstrated efficacy in improving family-reported safe storage behaviors. These programs, which include distributing cable locks,¹⁶⁶ trigger locks,^{167,168} and lock boxes,^{169–171} have demonstrated increased safe storage practices. These programs typically include an educational component in addition to safety product distribution. One study involving installation of firearm safes into rural Alaska homes led to significant improvement in safe firearm storage that was durable over the 18-month study period.¹⁷¹

Firearm Buyback Programs

Firearm buyback programs are community-based programs in which the community is invited to return unused and/or unwanted guns to a secure location. The firearms are then taken into possession by the police for safe disposal, in exchange for a financial incentive (eg, cash or a store gift card). The effectiveness of firearms buyback programs in the United States in decreasing violent crime and reducing firearm mortality is unclear because of inconsistency in implementation strategies.¹⁷² However, results from the Australian Gun Buyback program suggested there were significantly reduced homicide rates in the decade following the intervention (1997–2007). The characteristics of this Australian program included abrupt implementation, narrow focus on a particular class of firearms, and broad application across the entire population.¹⁷³

EFFECTIVENESS OF LEGISLATION IN FIREARM INJURY PREVENTION

Suicide

Legislation is another means for decreasing injuries and deaths from firearms for individuals of all ages.^{174–177} Several studies have specifically examined the impact of legislation on firearm suicides among youth. Some studies have reported no association with minimum age restriction laws and firearm outcomes.^{178,179} In contrast, a 2020 study demonstrated that policies restricting the sale of handguns to individuals 21 years or older were associated with a 18.1% reduction in overall suicide rates and a 35.5% reduction in firearm suicides among adolescents.¹⁸⁰ Further, state laws requiring all licensed firearm dealers to provide locks for all sold handguns were associated with an almost 20% reduction in adolescent firearm

suicide.⁸¹ State laws establishing minimum purchase age for sales of unlicensed handguns are also associated with youth suicide rates. Although there is federal law prohibiting licensed sales of handguns from firearm dealers to individuals younger than 21 years, this law does not apply to unlicensed sales between individuals or at firearms shows. States limiting handgun sales to youth 21 years and older are associated with lower suicide rates in individuals 18 to 20 years of age, compared with states with an 18-year-old age limit for unlicensed sales. Furthermore, states demonstrated higher suicide rates after lowering the age for unlicensed handgun sales.¹⁸⁰

Most studies evaluating the association of legislation on firearm-related suicide in youth have focused on child access prevention (CAP) laws, with differing results. These laws, commonly known as safe storage laws, make it a civil or criminal offense for the firearm owner if a child is provided with, accesses, or could potentially access an improperly stored firearm.¹⁸¹ The specifics regarding firearm access, penalties, age cutoff, and stringency of the laws vary by state, which likely accounts for the differing results of the various studies.¹⁸² Although some studies have been unable to demonstrate an association between CAP laws and firearm-related deaths in youth,^{183,184} others have found CAP laws to be associated with approximately a 10% decrease in firearm suicides rates among youth.^{179,182,185} One study evaluated the impact of different types of CAP laws, namely recklessness laws (eg, laws related to providing firearms to a minor) and negligence laws (eg, laws related to unsafe firearm storage) on state-level firearm fatality rates among children 0 to 14 years of age. Firearm

suicides were reduced by 12% in states with negligence CAP laws (16 states); however, no association was found with recklessness CAP laws (9 states) and firearm suicides.¹⁸² Studies of CAP laws found that states with “stronger” laws, meaning those with criminal liability for negligent storage of firearms, were associated with a 54% reduction in self-inflicted firearm injuries among youth when compared with states with no CAP laws.¹⁸⁶ However, CAP laws should also be considered in the context of the possibilities of adverse policing among some communities as well as resulting in financial penalties or incarceration of grieving parents and family members. Other legislative options include laws incentivizing safer storage of firearms. One study found laws regarding safety locks and safe storage were noted to be associated with greater than a 10% reduction in firearm-related suicides for each additional law of this type.⁸¹

Homicide

There are limited studies specifically examining different types of firearm laws and their effects on homicide in children and youth. Reviews of the effectiveness of legislation on homicides have primarily focused on the adult population older than 18 years.^{174,175,177} In general, states with stronger firearm laws are associated with lower firearm homicide rates.¹⁷⁴ One 2017 systematic review focused on the effects of US firearm laws on firearm homicides from 1970 to 2016 and concluded in the aggregate, stronger firearm legislation was associated with decreased firearm homicide rates, but this included homicides of all ages. Specifically, laws strengthening background checks in conjunction with those requiring a permit to purchase firearms were associated with decreased firearm homicide rates.^{175,187} A 2019

scoping review specifically examined the association of firearm laws with pediatric firearm outcomes and also concluded CAP laws were not associated with decreased firearm homicide.¹⁸⁸ States with stronger firearm laws are also associated with a decreased likelihood of firearm carrying by youth, defined as youth having carried a firearm on at least 1 day in the prior 30 days.¹⁸⁹ This suggests stronger state firearm law environments could decrease firearm homicides perpetrated by youth by limiting youth firearm carrying.

In examining state laws raising the minimum age from 18 to 21 years for handgun purchase and/or possession, 1 study found these laws were not associated with a lower rate of firearm related homicides perpetrated by young adults.¹⁹⁰ When considering CAP laws, 1 study found states with negligence laws had an associated 15% decreased rate of firearm homicides.¹⁸²

Unintentional Injuries or Deaths

The most studied legislation and its potential impact on unintentional firearm injury are CAP laws and have demonstrated mixed results.^{183-185,188,191-193} These studies may have conflicting results because of their use of 19 years as the upper age limit of their study population, as the oldest age for which CAP laws impose criminal liability varies from 14 to 17 years, depending on the state.¹⁸⁸ One study analyzing negligence versus recklessness CAP laws found a 13% reduction in unintentional firearm injuries when compared with states with no CAP laws. Further, states with the most restrictive CAP laws imposing criminal liability on adults who negligently store firearms where minors could access them were associated with a 59% reduction in unintentional firearm deaths.¹⁸² Similarly, 2 other studies found unintentional firearm

deaths were lower for children in states in which violation of the law was a felony.^{191,193}

CONCLUSIONS

Firearms are a leading cause of injury and death to US children and youth from suicide, homicide, assault, and unintentional shootings. Primary care, ED, hospital-based, and community-level interventions focused on risk screening, safer storage counseling, lethal means counseling, and intervention programs can be effective in decreasing access to firearms. Additionally, legislation can be an effective means for decreasing firearm injuries and deaths among our youth. Ultimately, a multipronged approach will be essential to substantially decrease firearm injuries and deaths to US youth. Only with a firm and continuous commitment by all stakeholders, including individuals, families, communities, clinicians,

public health professionals and researchers, firearm owners and nonowners, firearm manufacturers and sellers, and legislators, to addressing this public health crisis will US youth begin to be protected from firearm injuries and deaths.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
CAP: child access prevention

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