Chapter 1
Scope of Firearm Injuries in the United States

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Firearm Injury Deaths

Firearm injury is one of the leading causes of death in the United States (US) [5]. In an average week, 645 people die due to firearm violence and 1565 more are treated in an emergency department (ED) for a firearm-related injury [18]. According to the Centers for Disease Control and Prevention (CDC), there were 38,658 recorded deaths from firearm-related injury in 2016 [13]. Even more shocking, this figure translates to an increase of 10,000 in comparison to the 28,874 recorded in 1999. To better eludicate this problem, this sobering statistic accounted for 16.7% of all injury deaths that year alone. Gun violence in the US is a public health problem that is both understudied and underfunded [1–4]. It is often described as an epidemic due to its alarmingly high levels in certain populations in the United States. The two major component causes of firearm injury deaths in 2016 were suicide (59.3%) and homicide (37.3%) [13]. The nature and frequency of firearm violence, combined with its substantial impact on the health and safety of Americans, make it an especially significant and important public health concern. It is crucial to note that it is not just the finite loss of life which needs to be acknowledged as not all firearm-related injuries are fatal. The nonfatal injuries in survivors can have a detrimental impact on the quality of life of the individual, leaving victims unable to recover in a substantial and meaningful manner, as they often suffer lasting physical and psychological distress years after the triggering event.

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Nonfatal Firearm Injuries

Many Americans are nonfatally injured in firearm-related violent acts each year. These include interpersonal violence, self-directed violence, legal intervention, unintentional injuries involving a firearm (such as hunting accidents or inadvertent injury while cleaning a gun or putting it away), and acts where the intent cannot be accurately determined [15]. The CDC has a web-based Injury Statistics Query and Reporting System (WISQARS) which is an online database that provides fatal and nonfatal injury, violent death, and cost of injury data from a variety of trusted sources [17]. It is used to help calculate accurate statistics and demographics of the individuals affected. According to WISQARS, there were 133,895 nonfatal firearm-related injuries recorded in 2016. These nonfatal gunshot wounds can have severe lasting consequences with negative impacts on the quality of life of the victims, not just due to the physical ramifications of the injury itself but the mental anguish that follows the victim as well.

For both firearm assaults and unintentional firearm injuries, rates for males were about nine times higher than those for females (27.9 vs. 3.2, for firearm assaults, and 6.6 vs. 0.7 for unintentional firearm injuries) [15]. Young people (which were classified as those individuals under the age of 35) accounted for roughly 72% of all nonfatal firearm injuries treated in US ED's each year from 2010 to 2012 [15]. Most of these injuries resulted from a firearm-related assault and disproportionately impacted young people aged 15–34 years. The overall average annual rate of nonfatal firearm injuries was 65.6 per 100,000 among persons 15–24 years of age, and 44.2 among young adults 25–34 years of age [15]. These age groups also had the highest rates of nonfatal unintentional firearm injury [15]. Gun violence is a substantial public health problem accounting for significant physical, psychological, and financial costs.

Medical Burden of Firearm Injuries

According to Fowler et al. (2015), patients arriving for medical treatment for a firearm injury due to unintentional circumstances frequently had leg and foot injuries (43%), followed by injuries to their arm or hand (34%) [15]. Individuals arriving for emergency department treatment following a firearm assault also frequently had leg and foot injuries (35%) [15]. Additionally, previous studies have shown that nonfatal firearm injury is a leading cause of spinal cord injuries in the United States [19] and that these injuries are more likely to result in paraplegia than other types of spinal cord injuries [20]. Moreover, even if the victim is fortunate enough to bypass death or SCI, there is also the possibility of such severe vascular or soft tissue injury to warrant amputation, this resulting in diminished quality of life and need for disability. Gunshot victims can also suffer from injuries to the abdomen resulting in hypovolemia warranting an operation, alimentary tract injuries resulting in stoma

placement, or the need for surgical removal of certain organs (such as the spleen) thus warranting lifetime precautions and vaccinations. The alimentary tract injuries that result in need for ostomy placement could result in decreased quality of life as well as depression and diminished self-image.

Gunshot wounds to the upper and lower trunk, however, remain the more common among assault cases than they were from unintentional firearm injury cases (20% vs. 6% for upper trunk injuries; 19% vs. 7% for lower trunk injuries) [15]. The percentage of assault or unintentional cases with GSWs to the head or neck were roughly 11% and 10%, respectively [15]. Penetrating spine injury (PSI) due to GSWs accounts for approximately 13–17% of injuries [22–25]. According to the National Spinal Cord Injury Statistical Center (NSCSC), acts of violence (primary GSWs) accounting for approximately 13.8% are a leading cause of injury as of 2015 [26]. The percentage of assault or unintentional cases with gunshot wounds to the head or neck was very similar as well (11% and 10%, respectively) [15]. Not surprisingly, due to the important anatomical structures residing within the head and neck, GSWs to these areas are often fatal, and only about one-third of patients with these injuries survive long enough to arrive at the hospital for treatment [16]. If victims experience a GSW to the head and are fortunate enough to survive, they may still suffer the consequences of a traumatic brain injury (TBI). A proportion of severe TBI survivors, after prolonged hospital care, require long rehabilitation and may have long-term physical, cognitive, and psychological disorders. Such disorders may disrupt previous relationships and preclude return to work, with severe economic and social impacts. The global burden is such that TBI survivors have a lower life expectancy than the general population [31]. Similar to fatal firearm injuries, males represent the majority of nonfatal firearm injuries accounting for a staggering 90% of all nonfatal firearm injuries medically treated each year [15]. From 2010 to 2012, the average annual rate of nonfatal firearm injuries for males was 38.4 per 100,000—or about 8.3 times the rate for females [15]. Most of these injuries were from a firearm-related assault or were unintentional. This is largely due to the high case fatality rate for self-harm injuries involving a firearm [15].

Firearm Injuries in Children

Similar to firearm deaths, children under the age of 15 had the lowest rate of unintentional firearm injury across all age groups [15]. Firearm-related injuries and fatalities among children are an important public health problem and remain to be the second leading cause of pediatric death in the US [9]. Nearly 1300 children die and 5790 are treated for gunshot wounds each year [9]. Males, older children, and minorities are disproportionately affected. Although unintentional firearm deaths among children declined from 2002 to 2014 and firearm homicides declined from 2007 to 2014, firearm suicides decreased between 2002 and 2007 and then showed a significant upward trend from 2007 to 2014 [9]. A study by DiScala et al. (2004) compared the outcomes by intent of nonfatal firearm injuries in ages 0–19. They

found that the unintentionally injured had a higher rate of surgical intervention (66.8% vs. 50.8%) and stayed in the hospital longer than the assaulted ones (median: 5 days vs. 3 days). Almost half of the children in both groups were discharged with disability, and approximately 87% returned to their home. Thus, they concluded that approximately 3200 children nationwide develop disability from firearms-related injuries annually [21]. Rates of firearm homicide among children are higher in many Southern states and parts of the Midwest relative to other parts of the country. Whether this is due to a cultural or economic component remains to be determined. Firearm suicides are more dispersed across the US with some of the highest rates occurring in Western states [10]. Firearm homicides of younger children often occurred in multi-victim events and involved intimate partner or family conflict; and unfortunately, older children more often died in the context of crime and violence [10]. Not surprisingly, firearm suicides were often precipitated by situational and relationship problems. The shooter "playing with a gun" was the most commonly cited circumstance surrounding unintentional firearm deaths of both younger and older children [10]. Not surprisingly, and further substantiated by numerous case-control studies, the presence of firearms in the home substantially increases the risk of adolescent suicide [27–29]. The ease of access to firearms in these situations needs to be addressed on a more personal level and it remains obvious that something needs to be done about this sooner than later, as we are losing our own children at an alarming rate for completely preventable reasons.

A study by Grossman et al. (2005) involving a separate case-control study showed that that safe gun storage practices are associated with a decreased risk of teen suicide and unintentional firearm injuries [30]. A study by Madhaven et al. (2019) found that many socioeconomic variables, including unemployment rates, percent urbanization, poverty rates, and teen tobacco use, were associated with firearm homicide rates in unadjusted analysis [9]. Children exposed to violence, crime, and abuse are more likely to abuse drugs and alcohol; suffer from depression, anxiety, and post-traumatic stress disorder; fail or have difficulties in school; and engage in criminal activity [32, 33].Firearm-related homicide in children remains a complex, multifaceted problem. Given the recent trends, more research is needed to identify meaningful ways to reduce firearm-related homicides among children.

Racial and Socioeconomic Disparities

Most gun-related violence occurs within socially and economically disadvantaged minority urban communities, where the rates of gun violence far exceed the national average [7]. The race with the highest gun-related violence remains African Americans. The age-adjusted death rate for non-Hispanic white males was 55.7% lower than for non-Hispanic black males and 67.0% higher than for Hispanic males [13]. Additionally, among the major race, ethnicity, and gender groups, the age-adjusted death rates for firearm-related injuries increased significantly in 2016 for non-Hispanic white males (3.9%), non-Hispanic white females (5.6%),

non-Hispanic black males (9.3%), non-Hispanic black females (26.3%), and Hispanic males (10.9%) compared to 2015 [13]. Homicide deaths by firearm affected black males the most, with an age-adjusted rate at 33 deaths per 100,000 people in 2017. Unfortunately, with the plethora of mass shooting events such as infamous Las Vegas Concert Shooting, church shootings, and school shootings, the emerging data from the CDC continues to see an upward trend in both firearm-related injury and death for the 2018 data. Gun violence has disturbingly high levels in certain populations in the United States. The state with the highest firearm-related death in was Texas, with an astonishing 3513 in 2017 [14]. The state with the lowest rate was Hawaii with just 39 mortalities linked to gun violence in that same year [14]. Counties classified as extremly violent were mostly rural, poor, predominantly minority, with high unemployment and homicide rates. According to Kalesam et al., overall, homicide rate was significantly associated with gun deaths (incidence rate ratios = 1.08, 95% CI = 1.06–1.09). In relatively safe counties, this risk was 1.09 (95% CI = 1.05–1.13), and in extremely violent gun counties this risk was 1.03 (95% CI = 1.03–1.04) [11]. Most states had at least one violent or extremely violent county and no state is free of gun violence all together. The US's proclivity towards guns has affected more than just our own generation, but our youth as well.

Cost of Firearm Injuries in America

In 1999, Cook et al. published a revealing study estimating the substantial medical expense of the consequences of firearm injury in the United States. At a mean medical cost per injury of about $17,000 per individual, the 134,445 (95% confidence interval [CI], 109,465–159,425) gunshot injuries in the United States in 1994 produced a staggering $2.3 billion (95% CI, $2.1 billion-$2.5 billion) in lifetime medical costs [12]. Of that $2.3 billion, almost half, or $1.1 billion (49%), was paid by US taxpayers [12]. Gunshot injuries due to assaults accounted for the majority (roughly 74%) of these total costs [12]. Firearm injury expenses represent a substantial burden to the medical care system and nearly half this cost is absorbed by US taxpayers in some form [12]. Recent data have shown an increase in firearm-related injuries accounting for $229 billion spent on costs associated with health care, criminal justice, loss of income, pain, suffering, and loss of quality of life for these patients in 2013 [6]. As the number of firearm-related injuries continues to grow, so will the exorbitant financial burden, not just to the victims, but to the economy as well.

The financial burden from the loss work wages associated with firearm injuries is substantial. Using average annual frequencies between 2010 and 2012, firearm deaths and injuries resulted in over $48 billion in combined lifetime medical and work loss costs (estimate: $48,292,384,000) [15]. An astonishing 91% of these costs were attributed to fatal firearm injuries ($44,041,023,000) [15]. The majority of costs for each of the three dispositions (deceased, hospitalized, treated, and released from the hospital) were from the loss of work; however, the percentages

differed for each. Ninety-nine percent of fatal firearm injury costs were attributed to work loss, while 79% (hospitalized) and 61% (treated and released) were attributed to work loss for the nonfatal firearm injury groups [15]. The composition of costs varied by intent within each disposition as well, with self-harm/suicide resulting in the greatest costs for fatal firearm injuries and assault/homicide resulting in the greatest costs for nonfatal firearm injuries [15]. These statistics emphasize the importance of addressing gun violence injury in the United States as well as its ramifications. It cannot be overemphasized that this is truly a public health concern as certain locations within the United States receive the majority of the violence.

Summary

Gun violence in the United States remains one of the leading causes of preventable death in both our older and younger populations. Every week in the United States, an average of 645 people lose their lives to firearm violence and 1565 more are treated in an emergency department for a firearm-related injury. This sobering statistic accounts for about 7% of the premature deaths before age 65 in the United States [8]. With the overwhelming number of mass shootings in public areas, schools, and churches, it is almost as if we have become jaded to the news of anther public "mass shooting" or "another man/woman or child killed" because of preventable gun violence. As emphasized here, the consequences of gun violence extend far beyond death for those victims lucky enough to survive. Surgical or medical treatments (amputation, stoma formation, and their long-lasting sequelae) are just a few of the ailments that leave the victim unable to feel "normal" again. Beyond this, there is the concern for substance abuse (alcohol, narcotics), PTSD, and overwhelming depression that also contributes to the overall decrease in the quality of life to those individuals affected. And, as the individuals make up the whole, the substantial economic burden to the United States cannot go unnoticed.

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