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Challenges, Successes, and the Future of Firearm Injury Prevention

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Policy Points:

- Firearm injury is a leading cause of death in the United States, with fatality rates increasing 34.9% over the past decade (2010-2020).
- Firearm injury is preventable through multifaceted evidence-based approaches.
- Reviewing past challenges and successes in the field of firearm injury prevention can highlight the future directions needed in the field.
- Adequate funding, rigorous and comprehensive data availability and access, larger pools of diverse and scientifically trained researchers and practitioners, robust evidence-based programming and policy implementation, and a reduction in stigma, polarization, and politicization of the science are all needed to move the field forward.

Keywords: firearm, violence, suicide, injury.

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Scope of the Problem

Firearm injuries constitute a major US public health crisis that requires urgent attention. Fatality rates have increased 34.9% over the past decade (2010-2020), with firearms responsible for over 400,000 deaths and an estimated 1.2 million emergency department visits for nonfatal injuries during this time.[1–4] In 2017, firearm deaths surpassed motor vehicle crash deaths for the first time in a generation[3,4] and remain even higher today.[3] Firearms were responsible for 45,222 fatalities in 2020, the highest absolute number of annual deaths ever recorded by the Centers for Disease Control and Prevention (CDC) and second only to opioid overdoses as an injury-related cause of death,[1] and in 2020 firearms became the leading cause of death for children and teens.[5] Although such injuries result from many causes, the overwhelming majority (98%) result from intentional forms of firearm violence such as nonpartner/partner homicides and assaults, self-inflicted firearm suicides, police violence, and active shooter incidents (e.g., school shootings).[1,6] It should be noted that although active shooter incidents, such as mass shootings and school shootings, are devastating and receive the majority of national attention, they only make up a small fraction of the deaths and injuries occurring from firearms.[7] Most deaths from firearms are self-inflicted firearm suicides.[1] Additionally, long-term morbidity from firearm injuries is substantial, with 70% of adults reporting substantially worse physical health and function five years postinjury[8] and 50% of children requiring disability and/or rehabilitative care on inpatient hospital discharge[9] because of a firearm injury. Furthermore, individuals who survive an initial firearm injury are at elevated risk for repeat firearm injuries (some of which are fatal),[10–13] substance use disorders,[14] mental health issues (e.g., anxiety, PTSD),[15] and criminal justice system involvement.[12,16]

The effects of firearm violence extend beyond the victims of firearm injuries to include those who witness a shooting or experience the injury or death of family and friends, yet we know relatively little about this secondhand experience and its sequelae. Communities are also affected by firearm violence because events such as mass shootings and firearm homicides and assaults can affect the collective community-wide sense of safety and security,[17–19] and firearm-related suicides can

leave communities and family members dealing with long-term mental health sequalae.[20–24] The economic costs of firearm injuries are high, estimated at $229 billion annually[1,25–27] when including acute and long-term medical costs and disability care, lost work and productivity, and costs for criminal justice proceedings. Importantly, these estimated costs do not include the costs associated with the efforts of witnesses, friends, families, and communities to recover from this type of violence.

Disparities

Although firearm fatalities affect all US communities, disparities exist by age, race/ethnicity, sex, and rurality.[28] Firearm injuries are the leading cause of death for youth (ages 10–24; 63% firearm homicides), with high-school–aged teens (ages 14–17) more likely to die from a firearm injury than any other leading cause of death.[3,5,6] Suicide is the second leading cause of injury-related death among older adults (age 65+), with firearms responsible for >70% of completed suicides.[1,29] Firearm suicide is also particularly prevalent among veterans and active-duty military members,[29] with rates that are 1.5 times higher than the general population.[30] Racial differences in firearm injuries and death are stark. Black youth experience firearm homicide rates 17 times higher than White youth and are twice as likely to be hospitalized for nonfatal firearm injury.[31] However, White and Native American/Alaskan Native populations experience firearm suicide rates 2.6 and 1.8 times higher than other racial/ethnic groups, respectively.[1] Sex differences in firearm fatality are also notable. Although firearm fatality risk is six times higher for men, women are overrepresented among intimate partner homicides, with more than half resulting from firearms.[32–34] Finally, US cities are disproportionately affected by firearm homicide, whereas rural settings are disproportionately affected by firearm suicides.[35–37]

Researchers have identified that although multiple firearm violence risk factors exist across all ecological levels, disparities are largely associated with underlying structural factors at the community and/or societal level.[28,38,39] Firearm homicide is largely concentrated within urban communities with a legacy of severe racial segregation, redlining,[40–42] and economic disinvestment.[43] Disinvestment in urban communities of color is also associated with a lack of available evidence-based prevention services.[44–46] Parallel structural factors contribute to elevated rural and military firearm suicide rates,[47] including economic distress and lack of

economic opportunity, inadequate availability of and access to mental health and social services, and elevated rates of access at high-risk times. These disparities have only been widening in recent years, and although the reasons for the increase in firearm deaths and injuries and the widening disparities are still unknown and likely multifaceted and complex, there are some proposed explanations for this. These include increased stressors during the COVID-19 pandemic such as increased social isolation, economic hardships, mental stress, and changes and disruptions in services and education, in addition to increased firearm purchasing and access to firearms and increased strains in community–law enforcement relations that have been reflected in protests over lethal police force.[48] Current data do not show this trend in increased deaths and injuries dissipating (data are from the final Multiple Cause of Death Files, 2018–2020, and from provisional data for years 2021–2022, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program),[49] and there is little evidence that these numbers will revert back to prepandemic levels[5] without evidence-based solutions.

Injuries Are Preventable

Past successes in other fields of injury prevention can be used as a guide for reducing and preventing injuries and deaths from firearms. Injuries have been shown to be preventable using comprehensive, multifaceted approaches.[50–56] The most apt guide for firearm injury prevention is the success seen in reducing motor vehicle crash deaths.[6,50,52,53,55–58] Motor vehicle death rates per mile of driving have decreased by over 90%[58] over the past 50 years, all while the number of cars and miles driven has increased.[56] This success is due to multidisciplinary approaches to reducing motor vehicle crash injuries and deaths that included implementing a combination of behavioral (e.g., child car seats), engineering (e.g., collapsible safety columns, air bags), policy (e.g., primary seat belt laws, drunk driving legislation, licensing, speed limits, graduated drivers licenses), and cultural norm (e.g., Mothers Against Drunk Driving) interventions to reduce the burden of injuries and deaths.[50–58] The application of scientific methods from multiple disciplines helped to spur this reduction in motor vehicle death rates while the number of cars and miles driven increased. Similar approaches are now being applied to the science of firearm injury prevention.

US Cultural Context

At the outset, it is important to acknowledge the controversial nature of this topic area. However, it is also important to note that firearm injury prevention research is not focused on a debate about the constitutional right to private firearm ownership, which was affirmed in *District of Columbia v Heller* (554 US 570 [2008]). Rather, the field seeks to understand the key risk and protective factors associated with firearm injury, as well as the mechanisms across the spectrum of approaches (behavioral, policy, education) that can effectively reduce firearm injury and death. We recognize that firearm ownership is a part of the fabric of US culture,[59–62] that there are many complexities around its history and deeply problematic policies and practices around race, and that the vast majority of individuals and families that own firearms are law-abiding and responsible citizens. Although the burden of firearm injuries and deaths is substantial, these events are preventable, and the application of injury prevention science and methods to make progress in reducing injury outcomes is consistent with a respect for the rights of law-abiding citizens to own and maintain firearms responsibly and legally. This paper seeks to highlight solutions and approaches to firearm injury that can occur in this cultural context.

Purpose of This Paper

Researchers and practitioners generally agree that bringing multidisciplinary teams and methods together to address firearm injury prevention is vital to reduce the epidemic of firearm injury and death in the United States.[6,38,58,59,63] Yet, several major challenges hamper this field of research and its potential to staunch the firearm injury epidemic. We provide a brief overview of five challenges for firearm injury prevention that have had a significant detrimental effect on advances in the field. We also provide a brief review of the successes in the field of firearm injury prevention to date and suggest future directions for this field. The five challenges we focus on include inadequate funding; a lack of comprehensive data availability and access; limited evidence-based programming and policies that are scientifically designed and tested; limited diverse and scientifically trained researchers and practitioners; and the stigma, polarization, and politicization of this field of study.

Five Challenges and Successes in the Field of Firearm Injury Prevention

The challenges build on and are interconnected with one another, creating a perfect storm of barriers and further limiting successes in all areas of firearm injury prevention. However, although the challenges in the field are immense and interrelated, there are successes that also inform future directions for the field.

Funding

The Challenge of Inadequate Funding for Research. Despite firearm injury being a leading cause of death with widespread effects on societal well-being, past policies regarding research funding for firearm injury prevention have resulted in a severe lag in evidence-based solutions and policies to address firearm injury and death and have stalled the growth of the field.[63–70] Firearm injury prevention research receives only 1.6% of the predicted federal funding commensurate with other leading causes of mortality and morbidity for all age groups[65] and only 3.3% of the predicted federal funding spending for pediatric populations.[63] This deficit has led to not only a lack of research, publications, and evidence-based solutions to this health problem but also a limited field of trainees and researchers in this space.[63–69]

Firearm injuries were first recognized as a public health problem in the 1980s, after the release of several studies applying the public health approach to firearm injury.[71–75] This led many professional organizations to call for firearm injuries to receive both further research and federal funding for that research.[76–79] Yet, after multiple studies in the 1990s indicated that a firearm present in the home increased risk for suicide and homicide,[80–83] Congress passed legislation (called the Dickey Amendment) that reallocated the CDC's firearm research funding to other injury-related topics and prohibited the use of research money to "advocate or promote gun control."[84] Similar restrictions were applied to National Institutes of Health (NIH) funding in 2011.[85,86] The effect of these measures were far-reaching. Although firearm research was not banned (research is separate from advocacy), federal funding for the field of firearm injury prevention was extremely limited. Only three major NIH awards focused on the prevention of firearm injury were awarded

between 1973 and 2012,[68] compared with over 300 awards for diphtheria, polio, cholera, and rabies, which together account for less than 0.07% of the fatalities seen by firearms in the United States during the same period.[87,88] CDC funding for firearm-related research fell by 96% from 1997 to 2012.[65] The National Institute of Justice continued to fund firearm violence prevention research; however, the National Institute of Justice has a comparatively smaller research budget than the NIH and CDC have. These policies that caused a lack of federal funding for research have stifled our knowledge about the risk and promotive factors associated with firearm injury and evidence-based solutions for our communities most affected by firearm injury.[64–66,89,90]

Successes in the Firearm Injury Prevention Research Funding Landscape. Even though funding for firearm injury prevention research and programming has been inadequate to address the burden of firearm injury and death, there have been some successes, including funding from private sources and increased federal funding in recent years. Local and state governments, foundations, and academic institutions have filled some of the deficit left by the decades of limited federal funding.[65] Gurrey and colleagues found that over 50% of firearm research publications published between January 2000 and December 2019 were funded by philanthropic sources.[65] Although this funding has helped to advance the field of firearm injury prevention in the absence of federal efforts, it cannot fill the gap left by the absence of federal funding to address firearm injury on a societal level. Fortunately, this gap is closing, in part because of the 2018 update to the language in the CDC appropriations bill that allows for the CDC to conduct research on the causes of gun violence[91] and the $25 million spending bill for the CDC and NIH that supported studies of firearm injury prevention.[92] This is in addition to funding that has been available from the Department of Justice and has allowed for expanding the range of topics that are addressed and broadens the disciplines attracted to the field.

Data Access and Availability

Challenge: Lack of Comprehensive Data Access and Availability to Conduct Necessary Research and Evaluate Effective Policies. The lack of comprehensive data access and availability to conduct the necessary research and evaluate effective polices needed to address the burden of firearm injury

is another major challenge to the field of firearm injury prevention. One of the key approaches in the scientific method is having appropriate data to evaluate policies, outcomes of interest, causal factors, and potential points of intervention.[93] The field of firearm injury prevention has not had adequate access to relevant administrative data because of the data not being collected, existing data not being available to researchers,[38] or data being available to researchers that is not comprehensive or has many flaws. For example, we do not currently have a reliable source for rates of nonfatal firearm injuries; thus, evaluations of policies and interventions to prevent these injuries are limited through the lack of data available.[94,95] Those limitations hamper the understanding of the effects of policies and interventions, ultimately delaying their improvement. Additionally, the lack of comprehensive administrative data on firearms transactions means that some policies may be made impotent and ineffective or, at the least, less effective, when enacted. For example, when domestic violence restraining orders are issued with firearm-relinquishing orders accompanying them (i.e., the perpetrator of domestic violence must hand over all firearms to law enforcement until the order is lifted), without having a registry of firearms sales, law enforcement and survivors must rely on the perpetrator to honor the order and be truthful about the number of firearms they own.[96–98] Without accurate data, policies meant to prevent firearm injury may be ineffective not only because of the inability to evaluate their effect but also the inability to implement them fully.

Limited research in the field has also limited the number of data sets that researchers may share and make publicly available so that other researchers may apply their skills and knowledge in different ways than the original intent of a particular study. An expert panel convened by the National Opinion Research Center (NORC) suggested that the creation and curation of firearm data and databases is necessary and can be immensely helpful for the field to address the gaps in data and enhance creative solutions.[99]

This lack of data results in many unanswered research questions in the field of firearm injury prevention that are critical to understand so that we can begin to develop an evidence base to inform prevention and test solutions and policies. Some of these unanswered questions include (a) understanding how many people are injured by a firearm every year in the United States; (b) understanding the root causes of firearm injury and death[39]; (c) understanding the variability in outcome variables

(e.g., homicides, violent crime, suicide) that limits comparisons between distinct community strategies (e.g., land use/zoning, vacant lot remediation, safe storage) or similar strategies applied within different community settings (e.g., schools, neighborhoods, churches); (d) testing intervention efficacy for the most severe violence typologies[38,39,100–106]; (e) research questions regarding subpopulations, communities, or settings where interventions may be most effective (i.e., moderator analyses) and which intervention components explain why and how a particular community-based intervention works (i.e., mediator analysis)[38,101,107]; and (f) the effect of policy interventions such as licensure requirements, firearm restrictions, and gun trafficking laws.[108–114] Additionally, the lack of data has limited the range of questions that can be studied because they represent a small number of disciplines and paradigms, limited application of different perspectives (i.e., disciplines, paradigms) for analysis and interpretation of the data, and limited types of data collected (e.g., survey, case study, interview, experimental).[115–118]

Success in Firearm Injury Data Availability and Access. In addition to the successes seen in funding, there have been successes in firearm injury data access and availability. As rates of firearm injury deaths have increased and more attention has been paid to the prevention of this issue, several professional organizations have developed and released best-practice statements and consensus agendas around firearm injury[38,79,119–123] that highlight key areas for which more data are needed.[124] Additionally, as more federal funding has become available, more comprehensive reviews of scientific articles on this topic have arisen.[39,103–106,124,125] The NORC expert panel report also identified key relevant databases and the need to develop a data infrastructure that can be harmonized with local data to inform solutions and policies.[99] These reviews and consensus agendas have aided our knowledge in the field of firearm injury prevention and provide a roadmap for the kinds of data needed to build firearm science.

An additional success in this area has been the creation of academic research centers and institutes solely dedicated to the study of firearm injury prevention research, which expand the access and availability of data as research is conducted. These include the Johns Hopkins Center for Gun Violence Solutions founded in 1995, followed more recently by the Violence Prevention Research Program at the University of California at Davis, the Harborview Firearm Injury & Policy Research Program at the University of Washington, the Harvard Injury Control Research

Center, the Violence Prevention Institute at Tulane University, the New Jersey Gun Violence Research Center at Rutgers University, and the University of Michigan Institute for Firearm Injury Prevention. These academic centers and institutes have pushed the field forward despite the challenges that the field faces, and they have had many successes in expanding the access and availability of data as research has been conducted.

Lastly, the creation and curation of firearm data and databases has been immensely helpful for the field and addresses the gaps in data access and availability, although there are still limitations to these data such as representativeness and the ability to link data sets.[99,126] Everytown for Gun Safety and the National Institute of Justice mass shooting database are welcome signs that data are becoming more available. The Firearm Safety Among Children and Teens (FACTS) Consortium has created a public searchable repository of over 100 databases that include at least some firearm-related variables relevant for the 1- to 17-year-old population that are housed with the Intercollegiate Consortium of Political and Social Research. Taken together, although strides have been made in the addressing the challenge of firearm data access and availability, more work is needed to generate the data that will help researchers and policymakers understand the problem and potential solutions moving forward.

Evidence-Based Programming and Policies

Challenge: Limited Evidence-Based Programming and Policies that are Scientifically Designed and Tested. In addition to and because of the limited funding and inadequate data available to conduct the research and evaluation needed to advance the field of firearm injury prevention, there have been limited evidence-based programming and policies that have been scientifically designed and rigorously tested.[104–106] Rigorous evaluation of programs and policies is needed to determine whether they have the intended effects.[127–129] The need for rigorous study for effective firearm program design and evaluation has long been known.[38,79,104–106,119–122,130–132] The research-to-practice gap has been a challenge for the field of injury prevention regardless of the topic,[133,134] but it is especially challenging for the firearm injury prevention community, for which a lack of evidence-based programming exists in the

first place. Furthermore, the lack of economic data on existing programs limits the ability to drive the policy changes needed to advance implementation of efficacious programs on a scale that can affect firearm morbidity and mortality broadly across communities.[81]

In the face of rising rates of firearm injury and death and the lack of evidence-based funding, many organizations and communities have introduced untested programmatic work into their communities, and legislators have introduced policies that evaluations suggest increase harm (such as stand your ground laws),[135] to begin to address the needs of their community when evidence-based programming is not available.[38,79,119–122,130,131] Rigorous evaluation is needed to determine what programs and policies are effective at reducing firearm injury and death, what the essential components of these programs for those with limited resources are, and what the unanticipated consequences of the programs to alert practitioners about potential pitfalls are. Broad dissemination of these programs prior to further evidence testing risks credibility for the field at best and at worst could be introducing programs and policies that could actually cause harm. There are many examples in public health of untested programs that were found to be ineffective or harmful after broad implementation and resource allocation, despite best intentions.[136–139] The field of firearm injury prevention is likely no different.

Success in Promising Evidence-Based Programming and Policies that are Scientifically Designed and Tested. In addition to the successes seen in funding and data, there have been several successes in developing promising pathways to firearm injury prevention programs and policies. Evidence-based programs that were designed broadly for youth violence,[140] intimate partner violence,[141] and/or suicide prevention[142] have demonstrated efficacy in prior research in reducing the antecedents and related upstream violent behaviors but have not been specifically tested with regards to firearm-specific outcomes. More research is needed to test the efficacy of these programs on reducing firearm-specific outcomes. Additionally, evidence-based environmental interventions have been shown to reduce firearm outcomes. Experimental and descriptive studies have established an evidence base for demolitions of rundown buildings, vacant lot remediation, and greening intervention for both antecedents of firearm injury[143–146] and firearm injury prevention in particular.[147–149] Likewise, laws that strengthen permit-to-purchase and background checks have shown evidence of decreasing firearm

homicide rates,[150] as have domestic violence firearm restrictions on decreasing intimate partner homicides. Although there have been many successes in the field of firearm injury prevention in terms of promising programming to address violent behaviors, more work is needed to fully understand the effect of these programs on firearm-specific outcomes.

Trainees

Challenge: Limited Pools of Diverse and Scientifically Trained Researchers and Practitioners. Another critical challenge the field of firearm injury prevention faces is the limited pools of scientifically trained and diverse researchers and practitioners. Without adequate funding for research and without access to relevant data, the field has not been able to attract the number of new researchers and practitioners needed to move the needle on firearm injury prevention. Early-career faculty and students look for career paths that have stable funding streams and momentum and mentors available to help them navigate successful careers.[151–153] Firearm research has not developed the necessary infrastructure or disciplinary and methodological opportunities necessary to nurture and build a field of science on the topic, and, even worse, firearm research became a field that might have a negative effect on one's career trajectory because of the stigma associated with it. Additionally, the availability of senior mentorship is a critical aspect of attracting, training, and retaining junior investigators in any field of science.[154–156] Researchers have documented that fewer than 15 senior investigators had research careers in firearm injury prevention in 2015.[131] With few senior researchers, no mid-career scientists, and an absence of robust federal funding, the pipeline of investigators poised to address this leading cause of death was stalled. Relatedly, as the pipeline of investigators in general has stalled, so has the pipeline to attract investigators from diverse backgrounds, including culturally and ethnically/racially diverse, and from different disciplines and focus areas. Cultivating and supporting diverse viewpoints and experiences is paramount to the success of any field of science,[157–160] especially for firearm injury prevention, in which many disparities exist and have gone unaddressed for so long.[161] Lastly, comprehensive, evidence-based training is also lacking for trainees.[162,163] Without systematic, scientific training, the development of the field of firearm injury prevention remains limited and stifled.

Success in Increasing Scientifically Trained Researchers and Practitioners. Building on the successes in funding, data, and programming and policies, there have been successes in increasing the pool of scientifically trained researchers and practitioners in the field of firearm injury prevention. Namely, the creation of centers and institutes have resulted in an increase in scientific training and mentorship for students and early-career faculty. The Johns Hopkins Center for Gun Violence Solutions, for example, has trained doctoral students and junior researchers in firearm injury prevention research since the 1990s. More recently, recognizing the magnitude and scope of this problem, the Eunice Kennedy Shriver National Institute of Child Health and Human Development funded the FACTS Consortium in 2017 to develop research resources to address this deficit of knowledge, as well as to begin to cultivate training opportunities for young scholars to build research careers in pediatric firearm injury prevention.[124] The University of Michigan–led consortium included a nascent postdoctoral research training program to expand the scientific workforce, and the University of Michigan Institute for Firearm Injury Prevention recently received a T32 training grant from the NIH to train up to four postdoctoral scholars annually that will continue to feed the pipeline of researchers in the field. The FACTS Consortium has also established a collaborative multidisciplinary national network of more than 30 established and developing faculty experts conducting pediatric firearm injury research that have helped to mentor students and postdoctoral scholars, develop supportive environments for developing students in their home institutions, and ensure a multidisciplinary representation of new empirical research at the annual national conference.[38,39,103–106] Although this funding and work has created significant forward momentum, there is still an urgent need to build and sustain this early pipeline work.

The Stigma, Polarization, and Politicization of the Field

Challenge: The Stigma, Polarization, and Politicization of the Field. In addition to the gaps in funding, evidence-based programming and policies, trainees, and data, the stigma, polarization, and politicization of firearm research must also be acknowledged.[164] There are many documented cases of researchers reporting feeling significant pressure to present findings that would be acceptable to certain groups,[165–168] such

as gun activist groups, rather than presenting all findings that emerge from scientific study. This tension and pressure have been reported to be more prevalent in the field of firearm injury prevention compared with other fields of study,[169] and the field has been particularly challenged by this. Unbiased and uncompromised scientific findings and results, free and independent from the influence of funders or politics, are seen as a key tenet to research and academic endeavors.[170–172] More research is needed to understand how these experiences influence the field of firearm injury prevention and its growth, as well as methods to overcome these challenges.

Success in Addressing the Stigma, Polarization, and Politicization of the Field of Study. Lastly, building on the success of funding, data, programming, and training, there is beginning to be a shift in the stigma, polarization, and politicization of the field of firearm injury prevention research. This is seen through the attention the field is getting and the released best-practice statements and consensus agendas around firearm injury.[38,79,119–123] These consensus agendas have highlighted the push and change in social norms to mobilize the field of firearm injury prevention into one that is seen by all members of our community as a legitimate field of study that can address the urgent need of firearm injuries and death.

Future Directions for the Field of Firearm Injury Prevention

Past successes in injury prevention can be used as a guide for the future field of firearm injury prevention. Injuries have been shown to be preventable using comprehensive, multifaceted approaches,[50–56] and the field of firearm injury prevention is no different. The model of bringing multidisciplinary teams and approaches together to address the burden of firearm injury will be a key future direction for the field[6,38,58,59,63] and overcome the five challenges we have described that has hampered the field.

Funding: Future Directions

Scientific advances in the field of firearm injury prevention have lagged substantially behind those for other injury (e.g., motor vehicle crashes) and medical (e.g., human immunodeficiency virus [HIV]/acquired im-

munodeficiency syndrome [AIDS], cancer) diseases of similar size and scope because of the lack of federal research funding during the past 30 years.[63] Although the recent annual allocation of $25 million of federal funding[67] provides an opportunity to develop community prevention strategies and test policies that can address the underlying disparities that exist for firearm violence outcomes, we need to build on this success and the successes of other state and private funding sources by communicating our successes so that policymakers can see benefits of funding in this area in reducing injury. It is also vital to communicate that these successes were made without interfering with their constituents' rights to own firearms. The field needs to make clear that both firearm research and rights can coexist, as motor vehicle research and driving can thrive together. We also need to communicate to practitioners and policymakers when we have developed evidence-based programming to inform best practices and disseminate effective programming. Furthermore, developing evidence-based interventions and policies that are needed for the field typically involves a linear progression through efficacy, effectiveness, and eventually implementation trials that can take years and need community and stakeholder involvement (including law enforcement) to ensure long-term sustainability[173] and the federal funding investments needed over the next 10 years to appropriately address the burden of firearm injuries and deaths in the United States.

Data Access and Availability

Although published empirical research on firearm injury has more than tripled since 2000, the amount of research as measured by the number of articles reporting funding is 30% lower in 2019 than in 2000 and only represents about 0.0006% of total published research in PubMed.[65] One reason for the limited research is that we have limited data with strong study designs, samples, and data collected. It is also critical that future research includes theoretical foundations that guide the research questions, variables that are collected, and samples studied and that use the most rigorous designs necessary to develop or test hypotheses. Theoretically driven data are also needed to help identify modifiable risk and promotive factors needed to focus prevention strategies. These data need to be context and population specific so that they are relevant for the type of firearm violence addressed (e.g., suicide, interpersonal, un-

intentional) and so that we can begin to build a body of knowledge that is both specific and generalizable. We also need to develop more interdisciplinary collaborations to look beyond our own discipline's theories and better build the databases and data sets that can most adequately inform prevention strategies. These data need to cross socioecological levels to include information from behavior to policy, improve measurement of complicated constructs, and capitalize on advances in technology to provide novel data collection and data methods.[38] Additionally, facilitating access to existing and newly collected data in repositories can also eliminate barriers for researchers and expand the number and range of scholars working in this field.[174] We must all make a commitment to sharing data and contributing to data repositories to increase the access and availability of data for researchers.

Evidence-Based Programming and Policies: Future Directions

Evidence-based programming and policies have been lacking in the field of firearm injury prevention. We need to test existing violence prevention programs and policies for their effectiveness on firearm violence, with attention to the specific components of the programs and policies to inform the appropriate improvements to make to reduce firearm violence. We also need to conduct evaluations to ensure that current policies are implemented with fidelity. A limitation in evaluating firearm policies is the patchwork of differing ways they are written across states and implemented across jurisdictions. A lack of policy impact may be found when there is, in fact, a lack of policy implementation.

We also need to work with local partners and those affected by firearm violence to develop new locally relevant prevention programming. A useful strategy we have used is to work with local partners who have created and implemented local programs to codify their work and develop research designs to test their effectiveness. This approach honors local knowledge, ensures programs are culturally relevant, and helps to sustain programs found to be effective. An assessment of racial equity in firearm policies and programs must also be made in recognition of the burden of firearm homicide falling mainly on Black communities because of structural factors and to ensure that existing policies and programs reduce those disparities rather than enhance inequity.

Implementation science can also be applied to understand what components of an intervention are most effective, inform efficient strategies for overcoming challenges in program functioning, and reduce the gap between practice and research. Implementation science approaches also help with coordination across sites to develop best practices for program implementation,[65–67] documenting and analyzing key procedures for implementation, and establishing toolkits to guide dissemination in other communities.[65] Finally, another direction for evidence-based programming and policies is to build in cost effectiveness research from the beginning so we can both estimate costs accurately and ensure data collection for different possible benefits of prevention (e.g., health care and service utilization, type of injury and disability).

Training: Future Directions

To increase the pipeline of rigorously trained researchers and practitioners, more training awards that include both pre- and postdoctoral researchers are necessary. Courses and evidence-based training curricula that draw on many disciplines focused on firearm injury is another step the field can make to expand the pipeline of trainees and to expose others to the ideas from this field. These courses and training materials can also focus on different aspects of injury, including but not limited to primary, secondary, and tertiary prevention strategies. Training opportunities and courses are necessary at every level of education, including master's and undergraduate students, adult learners, and practitioners. It is especially important to increase the pool of diverse researchers in the field regarding ethnic and racial backgrounds, socioeconomic circumstances, different paradigms, educational backgrounds (i.e., disciplines), and firearm injury focus areas (e.g., suicide, intimate partner, safe storage).

Stigma, Polarization, and Politicization: Future Directions

Politicization of the field of firearm injury prevention has been a challenge. As the field grows and the science is more robust and rigorous, more funding is allocated to addressing the burden, and more evidence-based programming and policies are implemented, the stigma and polarization of the field may diminish. The creation of a

scientific professional society focused on firearm injury prevention is also an important step in destigmatizing the field as a legitimate and acceptable topic of study while also providing a supportive network of scientists available to share ideas, mentor young scholars, and model careers focused on the topic. Another strategy to reduce stigma and politicization is to develop partnerships with a wide range of stakeholders and those affected by firearm violence to give voice to and respect multiple perspectives on firearm injury prevention.

Conclusion

The challenges faced by the field of firearm injury prevention are not new. Almost 30 years ago, Dr. Kellermann wrote on the "Obstacles to firearm and violence research,"[175] and many of those obstacles—inadequate funding, inadequate pool of experienced researchers, critical gaps in available data, fatalistic attitudes about violence prevention, barriers to interdisciplinary research, and opposition from powerful interest groups— remain today; however, progress has been made. With a renewed scientific focus and the availability of federal research funding for firearm injury prevention research, fostering a collaborative multidisciplinary network of scholars focused on testing rigorous, innovative, data-driven solutions is critical to addressing existing barriers to high-quality research and achieving the transformative progress needed to address this public health problem.

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