

COMMENTARY

Adequate Funding for Injury Prevention Research Is the Next Critical Step to Reduce Morbidity and Mortality From Firearm Injuries

Firearms are responsible for more than 33,000 deaths and 84,000 injuries every year.¹ The U.S. firearm fatality rate is the highest among all industrialized nations, with recent research demonstrating that Americans are 10 times more likely to die from a firearm-related cause than residents of 22 other similar high-income countries.² In fact, over 80% of all firearm-related deaths due to homicides, suicides, and unintentional firearm injuries that occur in industrialized nations happen in the United States.² These injuries disproportionately impact our most vulnerable citizens, particularly children, young adults, and the elderly. Firearms are the second leading cause of death among children overall and have been the leading cause of death and injury for urban African American youth for well over the past decade.¹ Among elderly citizens (65 +), firearms are responsible for 70% of successful suicide attempts.¹ The direct and indirect costs associated with firearm injuries are staggering, amounting to as much as \$230 billion annually^{3,4}—equivalent to the annual revenue of Apple Computers⁵ and nearly as much money as is spent annually for all Medicaid expenditures nationwide.⁴

Emergency physicians have long been on the frontlines of dealing with the public health tragedy of firearm violence. On a daily basis, we observe the devastating impact of firearm violence as patients are wheeled through our front doors and into our trauma bays: the 4-year-old child accidentally shot by his older brother while playing with a loaded firearm,^{6,7} the depressed and impulsive teen who is able gain access to an unlocked and loaded firearm at home,⁸ and the urban youth who is shot during an attempted robbery while

walking home from school.⁹ We are also too often a witness to the long-term physical impairments, substance use disorders, and mental health sequelae that follow such an injury, complications that repeatedly bring these patients back to our EDs for additional medical care.¹⁰ Such factors not only impact the survivors, but also fracture the fragile bonds holding together the families and communities that surround these patients. As emergency physicians, we know that a single firearm injury can be the key factor in keeping our patients from leading healthy and productive lives and we are also keenly aware that the most successful strategy for treating such patients is to have prevented them from being in our trauma bays in the first place.¹¹

Prevention science and public health research have increasingly become a key part of our national strategy to address injury-related deaths and represent a vital component of improving the long-term health and lives of people throughout the United States.¹² Injury prevention scientists do not view injuries as “accidents,” but rather as events associated with a disease that can be studied, understood, and mitigated or prevented. By asking a series of key questions—What is the scope of the overall problem? What are the contributing factors that increase or decrease the likelihood of such injuries? Are their effective interventions to decrease the incidence of disease or prevent adverse events from occurring? Can we implement effective interventions throughout our communities?—we can develop effective medical treatments and public policies that reduce the likelihood of such injuries. Such an approach has long been the standard way physicians and scientists in other disciplines have managed medical diseases (e.g., treating hypertension and developing smoking cessation programs to prevent heart attacks and strokes among at-risk patients). This approach is by its nature multidisciplinary, combining researchers in the fields of public health, engineering, urban planning, psychology, medicine, criminology, and economics.¹³ And this approach does not advocate a specific political viewpoint or promote laws that encroach on the legal rights of citizens, but rather reflects the principle that high-quality data can inform medical and policy decision-making that collectively contributes to improving health outcomes among our patients and the population at large.

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Emergency medicine has been a partner in conducting such research since the origins of our specialty,^{14,15} and this research has achieved a measurable impact on the mortality of the patients we care for on a daily basis. Deaths due to motor vehicle crashes have declined 31% in the past 35 years following substantial research to develop evidence-based interventions and policies, including improved laws addressing impaired drivers (e.g., minimum drinking age laws, 0.08 per se laws), unbelted drivers (e.g., primary seat belt laws), and young drivers/child passengers (e.g., graduated drivers licensing laws, child safety restraint legislation), as well as interventions and policies that improve roadway (e.g., guardrails, crash cushions) and vehicle (e.g., airbag, energy absorbing steering columns) design.^{1,12} In the 1970s, deaths due to aspirin poisoning among children declined more than 70% following the introduction of child-resistant packaging, with subsequent interventions for high-risk products (e.g., antifreeze, drain cleaner) continuing to have a significant impact on deaths due to childhood poisoning.¹² Needlestick injuries among phlebotomists and nurses fell 61% after a comprehensive effort among hospitals to improve the safety standards for routine blood draws. Such successes are not the result of limiting access to automobiles, critically necessary medications, or needles for phlebotomy, but rather are largely the result of high-quality research funded by federal health agencies and the translation of that research into evidence-based medical practice and public policies.^{12,16}

Unfortunately, we are not able to claim similar success in the area of firearm injury prevention. Firearm injuries first became recognized as a public health issue in the 1980s following a series of epidemiologic and policy-oriented studies identifying the promise of applying such an approach.^{17–21} This led several national organizations, including the American Medical Association and the American Academy of Emergency Physicians, to call for firearm injuries to be addressed as a public health issue worthy of both significant attention by the research community and federal funding agencies.^{22–27} However, as firearm injuries began to reach a peak in the early 1990s, a series of case-control and cohort studies were published demonstrating the increased risk for homicide, suicide, and accidental death in homes where a firearm is present.^{28–31} This research sparked an outcry from pro-firearm members of Congress who responded in 1996 by attempting to eliminate funding for the Centers for Disease Control and Prevention's (CDC's) National Centers for Injury Prevention and Control. While failing to defund the national injury center as a whole, these lawmakers were successful reallocating the \$2.6 million dollars earmarked in the CDC's budget for firearm prevention research to the field of traumatic brain injury and added language (termed the Dickey Amendment) to the CDC appropriations bill stipulating that funding could not "be used to advocate or promote gun control."³² Similar restrictions were subsequently implemented at the National Institutes for Health in 2011.^{33,34}

While these actions did not ban firearm research outright, the cumulative impact of these measures was unsettling, effectively shutting down research in the field of firearm injury prevention for a generation. Federal sources of funding rapidly disappeared with no

new National Institutes of Health (NIH) or CDC funding for firearm injury prevention research. Federal sources of funding rapidly disappeared with no new National Institutes of Health (NIH) or CDC funding for firearm injury prevention research. In fact, between 1973 and 2012, only three major NIH awards have focused principally on the prevention of firearm injuries. In comparison, cholera, polio, diphtheria, and rabies have received a combined total of over 320 research awards during the same time period despite the fact that firearm injuries are responsible for more fatalities annually than all of these diseases combined.^{35,36} The lack of federal research dollars led to a significant decline in research output. Between 1991 and 2010, despite accounting for 12.6% of all fatalities among U.S. youth, peer-reviewed manuscripts focused on firearm-related injuries accounted for less than 0.3% of all scientific publications in the literature.³⁷ The trend in publications on firearm injury prevention over this time period is 25% lower than it may have otherwise been when compared with publications in non-firearm-related disciplines studying diseases of equal impact on the U.S. population.³⁷ These restrictions also stalled the pipeline of new research investigators necessary to move this field forward. Senior-level research mentorship and the possibility of sustained career funding are crucial components of attracting, training, and retaining junior research investigators in any discipline. In 2013, there were fewer than 12 active experienced senior research investigators with careers focused in this area that could provide such mentorship, with only two of these researchers in the field of medicine.³⁸ The paucity of available data, the funding to study such data, and senior researchers within this field have limited our ability as a scientific community to develop the type of prevention science that has been so effective addressing other types of injury.

Newgard et al.³⁹ demonstrates the type of research that could be conducted if federal funding was made more available. Using a geospatial analysis, the authors examine a cohort of severely injured trauma patients transported to emergency departments by ambulance and compare event-level factors surrounding such firearm-related injuries in comparison to other violent and nonviolent injuries. Within this sample, the authors identified that severe firearm injuries had the highest rates of both serious anatomic injury and critical medical resource use when compared with other injury mechanisms. They also identified that in contrast to nonpenetrating assault injuries and motor vehicle crashes, firearm and knife injuries were more likely to occur within a patient's own neighborhood and often were occurring within the victim's home. Finally, the authors demonstrated that firearm injuries are more geographically and economically diverse than has previously been characterized in the literature, finding that while violent injuries do cluster within communities with higher rates of poverty and unemployment, these clusters account for only 5% of the total number of firearm events in their sample. Understanding such contextual features aids our understanding of when, where, and why such events happen and can be used to guide the design of place-based public health and criminal justice interventions. Such results may also

provide guidance to physicians who are attempting to intervene with high-risk patients who might benefit from further assessment and intervention (e.g., those at risk for self-inflicted injury).

Additional studies like the article by Newgard et al.³⁹ are urgently needed, but such research will only occur if federal lawmakers begin to appropriate funding for firearm prevention research. Following several highly publicized mass shootings and the tragedy at Sandy Hook Elementary School that resulted in the death of 20 first-grade children and six of their teachers and support staff, the nation and its lawmakers seemed motivated to act. Administration officials and several current and former members of Congress, including former Representative Jay Dickey—the author of the original legislation restricting funding in 1996—strongly advocated for the reinstatement of federal firearm research funding.⁴⁰ President Obama signed an executive order directing the CDC to resume its work in the field and pledged \$10 million for CDC firearm injury prevention in each of his last two budgets. However, to date, Congress has failed follow through on their part, stripping the earmarked money from the final CDC budget and continuing to fuel the policy debate with emotion and myth, rather than actual scientific data. And while the National Institutes of Justice (NIJ) and the NIH have started to respond to the President's call to action through the release of grant programs that for the first time are specifically focused on funding firearm injury prevention research, the initial funding is relatively small and has been reallocated from other existing violence research. If more substantial resources were applied to the science of firearm safety and injury prevention, our nation would likely see decrease in morbidity and mortality that parallels the success we have seen in the field of unintentional motor vehicle crash injury prevention simply as a result of the application of basic injury science and data driven prevention strategies. As emergency physicians, we have a direct link to the patients impacted by firearm injuries that fill our trauma bays and we need to do our part to advocate for reversing the current lack of federal funding for the second leading cause of death among our nation's children and young adults. Our patients and our communities suffering from the devastating toll of firearm injuries deserve no less.

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References

1. WISQARS (Web-based injury Statistics Query and Reporting System). Query W. 2010; Available at: <http://www.cdc.gov/injury/wisqars/index.html>. Accessed February 28, 2016.
2. Grinshteyn E, Hemenway D. Violent death rates: the US compared to other high-income OECD countries, 2010. *Am J Med* 2016;129:266–73.
3. Miller TR. *The Cost of Firearm Violence*. Calverton, MD: Children's Safety Network, 2012.
4. Follman MR, Lurie J, Lee J, West J. *What Does Gun Violence Really Cost? By the Numbers*. San Francisco, CA: Mother Jones, 2015.
5. Apple Press Info. *Apple Reports Record Fourth Quarter Results, iPhone, Apple Watch & App Store Drive Revenue Growth of 22%*. 2015. Available at: <http://www.apple.com/pr/library/2015/10/27Apple-Reports-Record-Fourth-Quarter-Results.html>. Accessed Mar 16, 2016.
6. Wintemute GJ, Teret SP, Kraus JF, Wright MA, Bradfield G. When children shoot children: 88 unintended deaths in California. *JAMA* 1987;257:3107–9.
7. Miller M, Azrael D, Hemenway D. Firearm availability and unintentional firearm deaths, suicide, and homicide among 5-14 year olds. *J Trauma Acute Care Surg* 2002;52:267–75.
8. Grossman DC, Reay DT, Baker SA. Self-inflicted and unintentional firearm injuries among children and adolescents: the source of the firearm. *Arch Pediatr Adolesc Med* 1999;153:875–8.
9. Cunningham RM, Ranney M, Newton M, Woodhull W, Zimmerman M, Walton MA. Characteristics of youth seeking emergency care for assault injuries. *Pediatrics* 2014;133:e96–e105.
10. DiScala C, Sege R. Outcomes in children and young adults who are hospitalized for firearms-related injuries. *Pediatrics* 2004;113:1306–12.
11. Cunningham R, Knox L, Fein J, et al. Before and after the trauma bay: the prevention of violent injury among youth. *Ann Emerg Med* 2009;53:490–500.
12. Hemenway D. *While We Were Sleeping: Success Stories in Injury and Violence Prevention*. Berkeley, CA: University of California Press, 2009.
13. Hemenway D, Miller M. Public health approach to the prevention of gun violence. *N Engl J Med* 2013;368:2033–5.
14. Kellermann AL. Emergency medicine and public health: stopping emergencies before the 9-1-1 call. *Acad Emerg Med* 2009;16:1060–4.
15. Rhodes KV, Gordon JA, Lowe RA. Preventive care in the emergency department, Part I: Clinical preventive services—are they relevant to emergency medicine? Society for Academic Emergency Medicine Public Health and Education Task Force Preventive Services Work Group. *Acad Emerg Med* 2000;7:1036–41.
16. Kellermann AL, Rivara FP. Silencing the science on gun research. *JAMA* 2013;309:549–550.
17. Baker SP, Teret SP, Dietz PE. Firearms and the public health. *J Public Health Policy* 1980;1:224–9.
18. Alexander GR, Massey RM, Gibbs T, Altekurse JM. Firearm-related fatalities: an epidemiologic assessment of violent death. *Am J Public Health* 1985;75:165–8.
19. Kellermann AL, Reay DT. Protection or peril? *N Engl J Med* 1986;314:1557–60.

20. Teret SP, Wintemute GJ. Handgun injuries: the epidemiologic evidence for assessing legal responsibility. *Hamline Law Rev* 1983;6:341.
21. Wintemute GJ. Firearms as a cause of death in the United States, 1920-1982. *J Trauma Acute Care Surg* 1987;27:532-6.
22. Firearms injuries and deaths: a critical public health issue. American Medical Association Council on Scientific Affairs. *Public Health Rep* 1989;104:111-20.
23. American College of Emergency Physicians. Practice resources - Violence. 2007. Available at: <http://www.acep.org/practres.aspx?id=29848>. Accessed Apr 8, 2008.
24. Muelleman RL, Reuwer J, Sanson TG, et al. An emergency medicine approach to violence throughout the life cycle. SAEM Public Health and Education Committee. *Acad Emerg Med* 1996;3:708-15.
25. Dowd M, Sege R; Council on Injury, Violence, and Poison Prevention Executive Committee; American Academy of Pediatrics. Firearm-related injuries affecting the pediatric population. *Pediatrics* 2012;130:e1416-23.
26. Leshner AI, Altevogt BM, Lee AF, McCoy MA, Kelley PW. *Priorities for Research to Reduce the Threat of Firearm-related Violence*. Washington, DC: National Academies Press, 2013.
27. Frattaroli S, Webster DW, Wintemute GJ. Implementing a public health approach to gun violence prevention: the importance of physician engagement. *Ann Intern Med* 2013;158:697-8.
28. Kellermann AL, Rivara FP, Rushforth NB, et al. Gun ownership as a risk factor for homicide in the home. *N Engl J Med* 1993;329:1084-91.
29. Kellermann AL, Rivara FP, Somes G, et al. Suicide in the home in relation to gun ownership. *N Engl J Med* 1992;327:467-72.
30. Kellermann AL, Somes G, Rivara FP, Lee RK, Banton JG. Injuries and deaths due to firearms in the home. *J Trauma Acute Care Surg* 1998;45:263-7.
31. Bailey JE, Kellermann AL, Somes GW, Banton JG, Rivara FP, Rushforth NP. Risk factors for violent death of women in the home. *Arch Intern Med* 1997;157:777-82.
32. U.S. Department of Justice. Omnibus Consolidated Appropriations Bill, HR 3610, Pub L No. 104-208. 1996.
33. Branas CC, Richmond TS, Culhane DP, Ten Have TR, Wiebe DJ. Investigating the link between gun possession and gun assault. *Am J Public Health* 2009;99:2034-40.
34. U.S. Department of Justice. Consolidated Appropriations Act, 2012, PL 112-74. 2011.
35. Branas CC, Wiebe DJ, Schwab C, Richmond T. Getting past the "f" word in federally funded public health research. *Inj Prev* 2005;11:191.
36. World Health Organization. Disease and Injury Country Estimates. 2015. Available at: http://www.who.int/healthinfo/global_burden_disease/estimates_country/en/. Accessed May 13, 2015.
37. Ladapo JA, Rodwin BA, Ryan AM, Trasande L, Blustein J. Scientific publications on firearms in youth before and after Congressional action prohibiting federal research funding. *JAMA* 2013;310:532-4.
38. Wintemute GJ. Responding to the crisis of firearm violence in the United States: comment on "Firearm legislation and firearm-related fatalities in the United States". *JAMA Intern Med* 2013;173:740.
39. Newgard CD, Sanchez BJ, Bulger EM, et al. A geospatial analysis of severe firearm injuries compared to other injury mechanisms: event characteristics, location, timing and outcomes. *Acad Emerg Med* 2016;23:554-565.
40. Dickey J, Rosenberg M. We won't know the cause of gun violence until we look into it. *Washington Post*. 2012 July 27.