The economic cost of firearm-related injuries in the United States from 2006 to 2010

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Background. *Estimates of the number of firearm-related injuries widely vary. Although focus has been primarily on deaths, the societal cost of caring for victims of these injuries is largely unknown. Our goal was to estimate the economic impact of nonfatal, firearm-related injuries in the United States based on recent, publically available data.*

Methods. *We queried several national registries for hospital and emergency department (ED) discharges from 2006 to 2010 to estimate the annual incidence of firearm-related injuries. The cost of direct medical services and lost productivity from firearm-related injuries were extrapolated from recently published estimates. To identify potentially important trends, we compared the economic impact and payor mix for firearm-related injuries in 2006 with those in 2010.*

Results. *During the 5-year analytic period, we identified 385,769 (SE = 29,328) firearm-related ED visits resulting in 141,914 (SE = 14,243) hospital admissions, costing more than $88 billion (SE = $8.0 billion). Between 2006 and 2010, there was a decrease in the rate of hospital visits from 6.65 per 10,000 visits in 2006 to 5.76 per 10,000 visits in 2010 ($P < .001$). Similarly, the rate of hospital admissions and ED visits without admission decreased from 2.58 per 10,000 to 1.96 per 10,000 ($P < .001$) and 4.08 per 10,000 to 3.79 per 10,000 ($P < .001$). Regression of the economic costs from 2006 to 2010, adjusted for Consumer Price Index, showed no change ($P = .15$). There was a decrease in the proportion of Uninsured between 2006 and 2010 from 51.6% to 46.78% ($P < .001$).*

Conclusion. *Firearm-related injuries are a major economic burden to not only the American health care system but also to American society. The incidence of these injuries has decreased slightly from 2006 to 2010, with no change in the economic burden. Research aimed at understanding the associated financial, social, health, and disability-related issues related to firearm injuries is necessary and would likely enhance our knowledge of the causes of these events, and may accelerate development of interventions and policies to decrease the staggering medical and societal cost of gun violence. (Surgery 2014;155:894-8.)*

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One year has passed since the 20 children and 6 teachers of the Sandy Hook Elementary School died from multiple gunshot wounds in one of the worst mass shootings in the United States. In the past 12 months, the Centers for Disease Control and Prevention (CDC) estimates that an additional 34,000 Americans died as a result of gun violence in the United States.[1] Approximately 750 of these victims were children, and these numbers only represent documented fatalities.[1] Between 2006 and 2010, there were also nearly 75,000 nonfatal gun-related injuries per year in the United States, 11% of which occurred in children younger than 17 years of age.[1] For 2013, the CDC predicts that approximately 100,000 nonfatal gun-related injuries will occur in the United States.[1]

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The cost of caring for victims of gun-related injuries is multifaceted. However, these figures have been reported infrequently and only as estimates, derived from different databases and for finite periods. The most recent cost analysis, performed by Pacific Institute for Research and Evaluation (PIRE) and the National Injury and Violence Prevention Resource Center in 2010, estimated the cost to provide care for both fatal and nonfatal victims of gun violence, accounting for both medical and socioeconomic domains, was approximately $174 billion.[2] Prior to this, estimates that were published in the 1980s and 1990s, suggested that the cost was approximately $20 billion per year, with an estimated $1.4 billion in direct costs for health care and related goods.[3,4] Despite these results, the trend in cost of firearm-related injuries has remained unknown. Our aim in this study was to determine the estimated economic and societal cost of gun-related injuries in the United States from 2006 to 2010 by using national hospital discharge data.

METHODS

Data source. We queried the Nationwide Inpatient Sample (NIS), the National Emergency Department Sample (NEDS), and the Kid Inpatient Database (KID) from 2006 to 2010 for all hospital and emergency department (ED) discharges for firearm-related injuries based on the *International Classification of Diseases* version 9 injury codes (E-codes). The following e-codes were used: E922.x, E955.0, E955.x, E965.x, E985.x, E991. The NIS, NEDS, and KID databases are publicly available, nationally representative databases collated by the federal government as part of the Healthcare Cost and Utilization Project in the Agency of Healthcare Research and Quality and include comprehensive, hospital-level discharge data from a 20% sample of US hospitals. Associated standard errors of the mean were extracted with the means.

Economic estimates. Estimates of the economic costs of hospital visits were performed using previously published estimates by PIRE.[2] These estimates were robust and included the full continuum of societal costs from medical to lost tax revenue. Specifically, this included: (1) work loss; (2) emergency transport; (3) police; (4) criminal justice; (5) insurance claims processing; (6) employer cost; (7) lost quality of life; (8) lost US government tax revenue; (9) medical care; and (10) mental health services. To estimate the economic cost during our study period, we used the PIRE estimates from 2010 for nonfatal firearm injuries—$423,813 was used for each patients that was admitted to the hospital and $122,372 for patients that were discharged from the ED without a hospital admission. We used the medical care domain of the Consumer Price Index to adjust for medical inflation and cost back to 2006.[5]

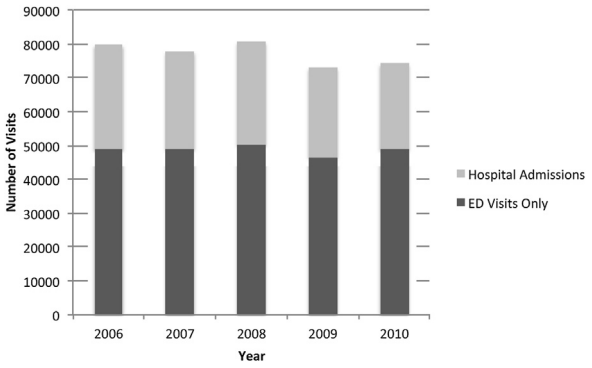

Fig 1. Number of hospital visits for victims of firearm injuries from 2006 to 2010.

Cost trend analysis. To examine whether there was a substantial change in the cost of medical care among victims of firearm injuries that presented to hospitals, we determined the total estimated costs for each year from 2006 to 2010. We then estimated the cost among patients admitted to the hospital and also the ones that were seen in the ED but did not require an admission.

Payor mix analysis. To evaluate whether there was a substantial change in the payor mix among victims of firearm injuries, we extracted the means including standard errors of services by payor from the NIS/NEDS/KID databases for 2006 and 2010. Specifically, we determined the proportions of uninsured, governmentally insured (Medicaid and Medicare) and private insurance for the period spanning the years 2006 and 2010, inclusively.

Statistical analysis. Using a χ^2 test, we compared proportions and frequencies. Similarly, using linear regression, we analyzed the economic trends. To check the robustness of the economic results, we also ran a Student t test comparing the costs in 2006 to 2010. We considered a two-tailed P value $<.05$ as statistically significant. All analyses were conducted using SPSS, v. 17.0.3 (SPSS, Inc, 2009, Chicago, IL).

RESULTS

Hospital visits for firearm injuries. From 2006 through 2010, there were 385,769 (SE = 29,328) firearm-related ED visits resulting in 141,914 (SE = 14,243) hospital admissions. During this period, 243,856 (SE = 16,677) were seen, evaluated, and were discharged from the ED without need for hospital admission. In 2006, there were

Table. Number of hospital visits for victims of firearm injuries from 2006 to 2010

Year	*2006*	*2006 rate*	*2010*	*2010 rate*	P *value*
Hospital visits					
Sample size	120,033,750		128,970,364		
All visits	79,834	6.65 per 10,000	74,259	5.76 per 10,000	<.001
Admitted to the hospital	30,921	2.58 per 10,000	25,342	1.96 per 10,000	<.001
Discharged from the ED	48,914	4.08 per 10,000	48,918	3.79 per 10,000	<.001
Economic costs					
Total	$18,622,721,416.32		$16,984,527,276.00		.48
Admitted to the hospital	$12,847,660,657.92		$10,968,347,046.00		.28
Discharged from ED	$5,775,060,758.40		$6,016,180,230.00		.68
Insurance status					
Uninsured	36,721	51.60%	31,417	46.78%	<.001
Medicare/Medicaid	18,307	25.71%	20,986	31.25%	<.001
Private	16,152	22.69%	14,755	21.97%	.001

ED, Emergency department.

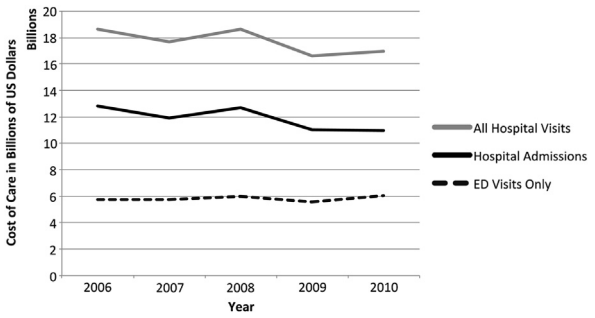

Fig 2. Economic cost of hospital visits for victims of firearm injuries from 2006 to 2010.

79,834 (SE = 7,189) hospital visits for victims seeking treatment for gunshot wounds. This number steadily decreased to 74,259 (SE = 4,727) by 2010 (Fig 1). This represented a small, but significant, decrease in the rate of hospital visits from 6.65 per 10,000 visits in 2006 to 5.76 per 10,000 visits in 2010 ($P < .001$). Similarly, the number of hospital admissions decreased from 2.58 per 10,000 visits to 1.96 per 10,000 visits ($P < .001$). ED visits also decreased from 2.58 per 10,000 in 2006 to 1.96 per 10,000 in 2010 ($P < .001$) (Table).

Economic analysis. Based on the PIRE estimates and adjusting for medical inflation from the Consumer Price Index, the total economic cost of firearm injuries in the United States from 2006 to 2010 was $88.6 billion (SE = 8.0 billion). Patients who required hospital admissions exacted $29.1 billion (SE = 2.0 billion) in direct acute care cost.

Patients who were not admitted to the hospital resulted in an estimated $59.5 (SE = 6.0 billion) in acute care expense. Between 2006 and 2010, these was no significant difference in total acute care cost by regression analysis; $18.6 billion to $17.0 billion ($P = .15$). Similarly, there was no difference in costs to care for patients who were admitted to the hospital in either 2006 or 2010, $12.8 billion to $11.0 billion ($P = .07$), respectively. For patients discharged directly home from the ED, there was no difference in the cost of care, from $5.8 billion in 2006 to $6.0 billion in 2010 ($P = .71$) (Fig 2). Sensitivity analysis examining only 2006 to 2010 showed the same results (Table).

Payor-mix analysis. Approximately 75% of patients who presented to the hospital for firearm injuries were either uninsured or covered by Medicaid/Medicare during the study period. There was a decrease in the proportion of patients with no insurance from 51.60% in 2006 to 46.78% in 2010 ($P < .001$), with a similar increase in the proportion of patients on governmental insurance (Medicare/Medicaid) from 25.71% in 2006 to 31.25% in 2010 ($P < .001$). The number of patients with private insurance decreased slightly from 22.69% to 21.97% ($P = .001$) (Table).

DISCUSSION

From 2006 to 2010, the cost to care for victims of gunshot violence who presented to the ED is estimated at $88.6 billion. During this period, the number of hospital visits, hospital admissions, and ED visits that did not require admission decreased substantially. The economic cost of victims presenting to the hospital for gunshot violence remained constant between 2006 to 2010. This was in the setting of a decrease in the proportion of victims with no insurance and private insurance, with a concomitant increase in the proportion of victims with governmental insurance. The overall proportion of patients with either no insurance or governmental insurance stayed constant at around 75%.

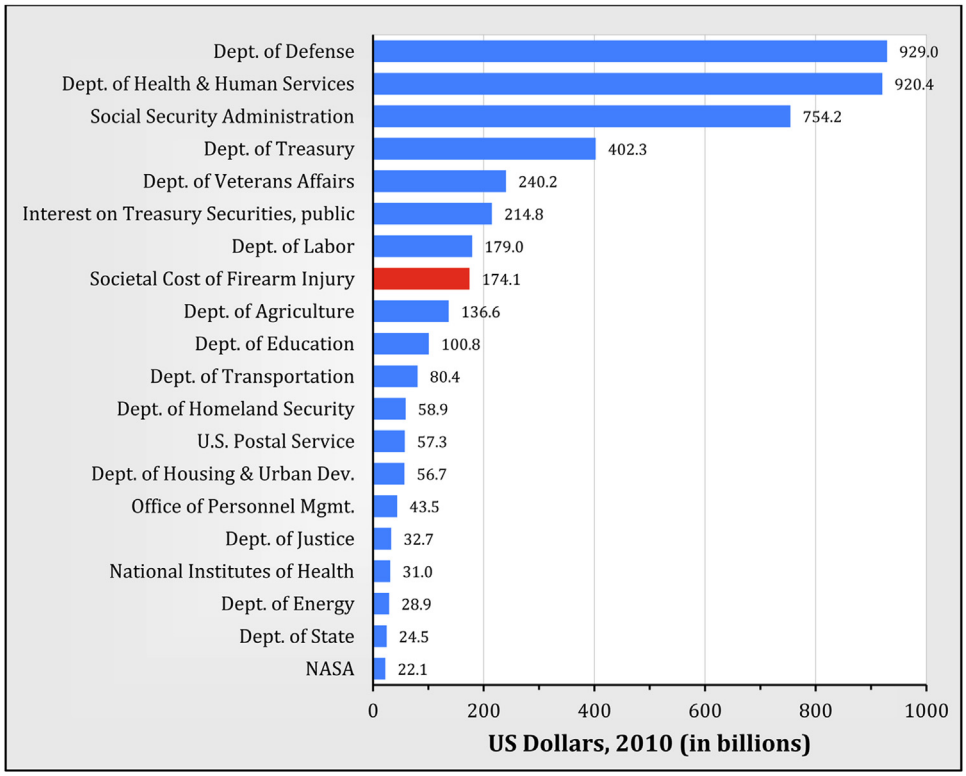

Fig 3. US total societal cost of firearm injuries in 2010 compared with US government expenditures in 2010.[6,7] Calculated societal cost is the unified costs of ED only, fatal, and hospital admitted care based upon 2010 incidence data from the CDC. US government spending represents the top 20 gross cost spending in 2010, divided by departments, as reported by the US Department of the Treasury and the National Institutes of Health Office of the Budget.

The cost to care for victims of gun-related injuries is substantial, especially if injuries result in permanent or chronic physical and/or cognitive impairments. According to PIRE, the cumulative cost in 2010, for both fatal and nonfatal victims of gun violence in the US was approximately $174 billion.[2] To put this into perspective, compared with US government expenditures in 2010, the expense of caring for victims of gun-related injuries was nearly three times that of the budget for the US Department of Homeland Security and was almost double the funds allocated to the US Department of Education (Fig 3).[6,7] Psychological comorbidities, dependent care, supervision needs, and loss of productivity by families of victims, although difficult to accurately calculate, undoubtedly add significantly to the overall cost of care as victims who survive often have chronic disabilities.

The medical treatment of trauma patients has traditionally posed reimbursement challenges for hospitals as well. The majority of the victims of this mechanism of injury are young (<25 years of age), uninsured or enrolled in government-based insurance programs and therefore add to the amortized cost of care. Although our data demonstrates that the uninsured and underinsured account for approximately 75% of all hospital visits for firearm injuries and that this statistic has remained unchanged between 2006 and 2010, it is likely that this number underestimates the true proportion of the underinsured since there are many patients with commercial insurance who are under-insured and are not captured in the databases that we evaluated. Faced with suboptimal or no reimbursement for this cohort of visits, hospitals are forced to absorb significant amounts of the costs for the care of these patients, which ultimately results in fewer resources for other patients and for quality improvement initiatives that typically require significant up-front expenditures.

Interestingly, we found a decrease in the proportion of uninsured during the study period. This was in the setting of an increase in Medicaid/Medicare insurance and a slight decrease in the proportion of patients with private insurance. This trend is the opposite of national trends, where there was an increase in the number of uninsured nationally from 43.4 million to 49.2 million.[8] Without specific data on governmental

programs and enrollment in individual states, it is difficult to determine the reason. The most likely reason is that the population that we studied were all individuals that ended up in a hospital setting and; as a result, they had access to case managers and enrollment programs that were not available to the typical "working-poor" uninsured. Similarly, because of the economic costs required to treat these victims, the hospital had an incentive to aggressively enroll these patients into any program available, whether it be Medicare, Medicaid, or state-funded catastrophic reimbursement programs.

One major limitation of this study is that our cost estimates were based on previously published research and as with any economic estimates, there are inherent problems. Additionally, the national databases used sampled only 20% of hospitals in the US. However, these are the best estimates that we can gather based on the data currently available for the entire Nation. Furthermore, a precise number to the dollar is not needed as the magnitude of the cost is accurate enough to define the problem.

Although the US remains mired in a contentious debate over the public health crisis of gun violence and what actions would be necessary and effective to address its impact on the US health care system, it is clear that many more Americans will sustain either a fatal or nonfatal gunshot wound in the years to come. It is important to consider the cost of caring for these avoidable injuries and to better understand the impact that gun violence has on our health care system when we propose remedies to control burgeoning cost. A thorough evaluation of this public health crisis is necessary. However, the moratorium placed on federal funding with the 1996 Omnibus Consolidated Appropriations Bill (Public Law 104-208) on the CDC and the Consolidated Appropriations Act of 2012 in 2011 (Public Law 112-74) on the National Institutes of Health for research on gun violence has impeded progress towards evidenced-based solutions to this issue and that data that can be mined is not current. Without adequate funding, the work of many well-intentioned public health professionals is lost in political rhetoric. It is clear that the societal cost of gun violence goes far beyond the statistics of the death toll. Failure to pass meaningful gun control legislation and to lift the restriction on research will only continue to add to the unsustainability of our health care system. Research aimed at understanding the associated financial, social, health, and disability-related issues would not only enhance our knowledge of gun violence but also accelerate development of interventions and policies to decrease the staggering medical and societal cost of gun violence.

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