

Estimated Lifetime Medical and Work-Loss Costs of Fatal Injuries — United States, 2013

Curtis Florence, PhD¹; Thomas Simon, PhD²; Tamara Haegerich, PhD³; Feijun Luo, PhD,¹; Chao Zhou, PhD¹

Injury-associated deaths have substantial economic consequences. In 2013, unintentional injury was the fourth leading cause of death, suicide was the tenth, and homicide was the sixteenth; these three causes accounted for approximately 187,000 deaths in the United States (1). To assess the economic impact of fatal injuries, CDC analyzed death data from the National Vital Statistics System (1) for 2013, along with cost of injury data using the Web-Based Injury Statistics Query and Reporting System (1). This report updates a previous study that analyzed death data from the year 2000 (2), and employs recently revised methodology for determining the costs of injury outcomes, which uses the most current economic data and incorporates improvements for estimating medical costs associated with injury (3). Number of deaths, crude and age-specific death rates, and total lifetime work-loss costs and medical costs were calculated for fatal injuries by sex, age group, intent (intentional versus unintentional), and mechanism of injury. During 2013, the rate of fatal injury was 61.0 per 100,000 population, with combined medical and work-loss costs exceeding \$214 billion. Costs from fatal injuries represent approximately one third of the total \$671 billion medical and work-loss costs associated with all injuries in 2013 (3). The magnitude of the economic burden associated with injury-associated deaths underscores the need for effective prevention.

The number of injury-associated deaths in the United States during 2013 was obtained from National Vital Statistics System, and lifetime costs were obtained from the Web-based Injury Statistics Query and Reporting System database (1). Injury death rates were calculated using the U.S. Census Bureau's bridged race population estimates for 2013. Lifetime cost estimates, which include lifetime work-loss and medical costs, were computed from average costs of earnings and treating injuries in 2010, adjusted to 2013 prices. For each death record, lifetime work-loss cost was assigned according to the sex and age of the decedent. The sex- and age-specific probability of surviving to a given age was multiplied by the mean earnings of persons of that sex and age using U.S. Census Bureau earnings data, assuming that no one would live beyond age 102 years. Lifetime medical costs were assigned by injury diagnosis and mechanism, place of death, and decedent's age (3). Medical costs were derived from various sources that measure the cost of transport, examination by a coroner or medical examiner, and health care in multiple settings, including emergency

departments, hospitals, and nursing homes. Work-loss costs were developed using earnings data from the U.S. Census Bureau's Current Population Survey and life expectancy data from CDC's National Center for Health Statistics. Number of deaths, rates and total lifetime medical and work-loss costs were examined for 2013, stratified by sex, age, and intent of injury. The distribution of costs by mechanism and intent of injury was also examined for the five highest-cost mechanisms, stratified by intent.

The total estimated lifetime medical and work-loss costs associated with fatal injuries in 2013 was \$214 billion (Table). Males accounted for approximately 78% of these costs and for 67% of injury deaths. Approximately two thirds of injury deaths were unintentional, and these deaths also represented a majority of the cost (\$129.7 billion [61%]). Approximately one fifth of injury-related deaths were suicides, and the cost of these deaths (\$50.8 billion) accounted for about 24% of all injury death costs. Approximately 8% of injury-related deaths were homicides, and the associated costs (\$26.4 billion) accounted for about 12% of the medical and work-loss costs for all injury deaths. Male victims represented 82% of the costs for suicide (\$41.7 billion) and 86% of the costs for homicide (\$22.5 billion).

Overall, rates of fatal injury increased with age; however, this pattern differed by injury intent, with higher homicide rates among young persons and higher suicide rates among middle-aged adults. The costs associated with fatal injury were concentrated among adolescents and young adults aged 15–24 years and adults aged 25–64 years. The lowest costs and the lowest proportion of costs were associated with injury deaths in persons aged ≥ 65 years. These differences are also reflected in the mean cost of injury death by intent (Figure 1). The mean medical and work-loss cost of any injury death in 2013 was slightly more than \$1.1 million, ranging from just below \$1 million for unintentional injuries, to in excess of \$1.6 million for homicides; the cost per suicide was \$1.2 million.

Among all injury deaths, drug poisonings accounted for 26% of the costs associated with fatal injuries, followed by transportation-related deaths (23%), firearm-related deaths (22%), deaths from suffocation (9%), and deaths resulting from falls (5%) (Figure 2). Considerable differences were observed in the proportional distribution of costs accounted for by each mechanism among unintentional deaths, homicides,

TABLE. Injury deaths, rates per 100,000 population, and estimated lifetime medical and work-loss costs, by sex, age group, and intent — United States, 2013

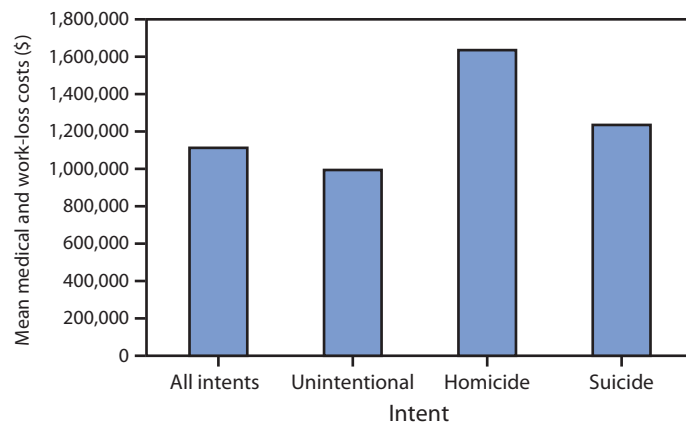
Intent	Total	Sex		Age group (yrs)				
		Male	Female	0–14	15–24	25–44	45–64	≥65
All intents*								
No. of deaths	192,945	129,912	63,033	5,501	21,320	53,205	58,350	54,524
Rate†	61.03	83.46	39.28	9.00	48.50	63.87	70.23	121.97
Costs‡	214,394	166,717	47,355	7,786	41,527	95,540	55,250	9,164
Unintentional								
No. of deaths	130,557	81,916	48,641	3,993	11,619	31,563	37,414	45,942
Rate†	41.30	52.63	30.31	6.54	26.43	37.89	45.03	102.77
Costs‡	129,726	97,091	32,585	5,628	22,371	56,079	35,112	7,439
Homicide								
No. of deaths	16,121	12,726	3,395	896	4,329	6,817	3,164	905
Rate†	5.10	8.18	2.12	1.47	9.85	8.18	3.81	2.02
Costs‡	26,350	22,572	3,817	1,235	8,622	12,858	3,159	202
Suicide								
No. of deaths	41,149	32,055	9,094	395	4,878	12,899	15,756	7,215
Rate†	13.02	20.59	5.67	0.65	11.10	15.49	18.96	16.14
Costs‡	50,795	41,747	8,913	664	9,578	23,242	15,038	1,443

Sources: CDC's National Center for Health Statistics National Vital Statistics System for numbers of deaths. Pacific Institute for Research and Evaluation for unit cost estimates. U.S. Census Bureau for population estimates. Numbers and rates computed using the Web-Based Injury Statistics Query and Reporting System (WISQARS) (<http://www.cdc.gov/injury/wisqars>).

* All intents include legal intervention and undetermined intent of injury.

† Deaths per 100,000 population.

‡ In millions of 2013 U.S. dollars. Cost estimates were computed from average lifetime work-loss and medical costs by mechanism and intent of injury. The base year for average costs was 2010. Base year costs were indexed to 2013 prices and applied to 2013 death counts. Lifetime medical costs refer to the medical costs associated with the fatal injury event.

FIGURE 1. Mean medical and work-loss costs per injury death, by intent* — United States, 2013

* All intents category includes legal intervention and undetermined intent of injury, in addition to unintentional, homicide, and suicide.

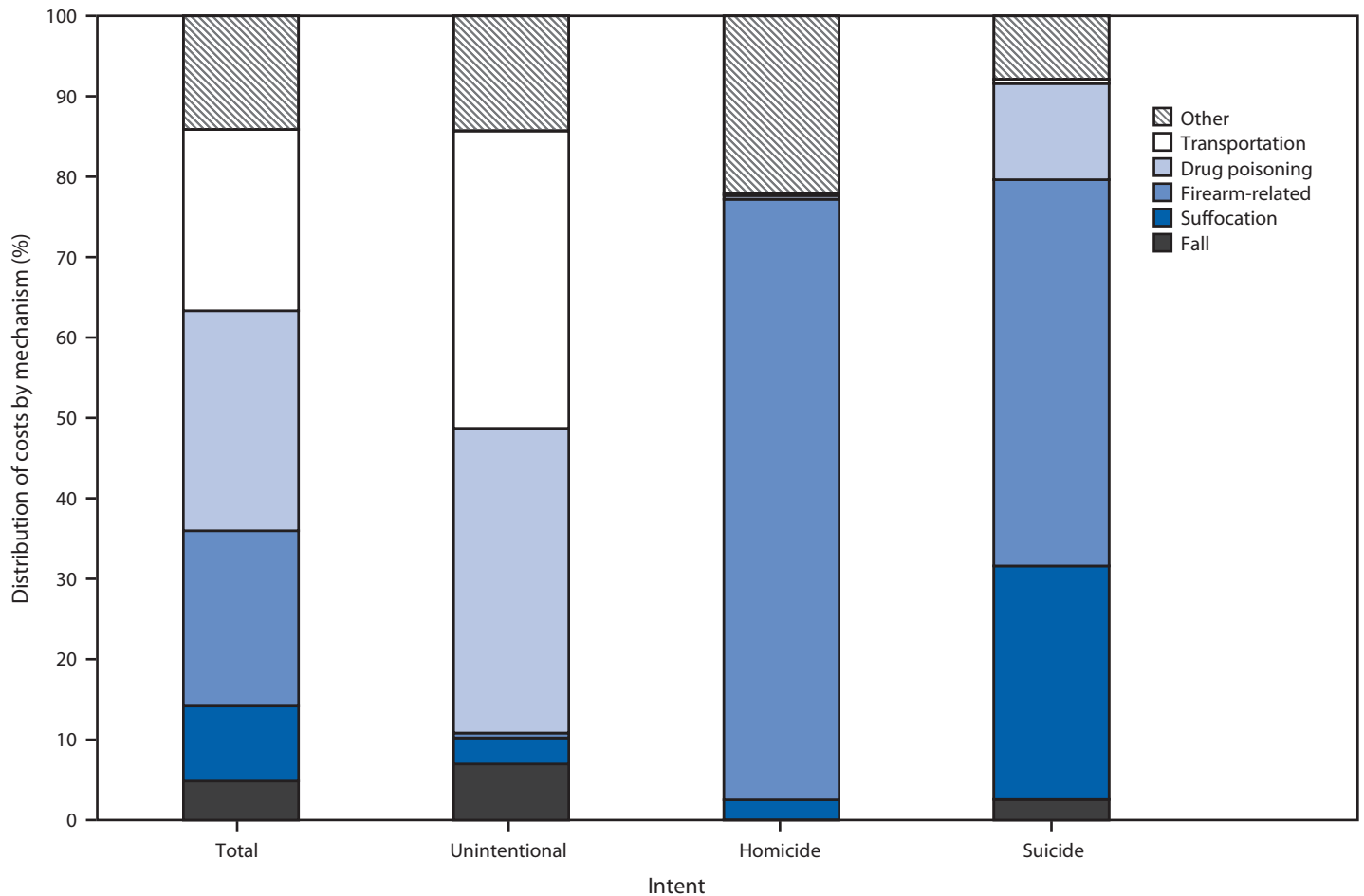
and suicides. Firearm-related fatal injuries accounted for 75% of the homicide-associated costs and 48% of the suicide-associated costs. Other leading mechanisms contributing to suicide costs were suffocation (including hanging) (29%) and drug poisoning (12%). Costs associated with unintentional injury deaths were primarily related to transportation-related deaths (37%) and drug poisonings (38%).

Discussion

Fatal injuries have a profound effect on victim's families and society in general. These deaths also have substantial medical and work-loss costs. Implementing effective prevention strategies can help to reduce these costs. The most recent study examining the medical and work-loss costs related to all types of injury analyzed data from the year 2000 (2). Since publication of that report, substantial changes have occurred in the causes and mechanisms of fatal injuries. For example, the rate of drug poisoning deaths doubled during 1999–2013 (4), and the suicide rate increased by 16% during 2000–2010 (5), whereas the death rate from motor vehicle crashes declined during 2000–2013 (6). These changes in the cause and mechanism of injury deaths suggest that previous estimates of cost associated with fatal injuries are not representative of current costs. This report uses the most recently available data on fatal injuries, as well as an updated costing methodology that incorporates up-to-date medical cost and earnings data.

Although the majority of total costs related to injury deaths were associated with unintentional injuries, substantial costs were also associated with suicide and homicide. The overall medical and work-loss costs associated with fatal injury differ considerably across demographic groups, intents, and mechanisms of injury. For example, males accounted for 75% of the costs of unintentional injury deaths, 86% of homicide-associated costs, and 82% of suicide-associated costs. Persons

FIGURE 2. Distribution of lifetime medical and work-loss cost estimates for fatal injury, by mechanism and intent — United States, 2013



aged 15–44 years accounted for 82% of homicide-associated costs, compared with 65% and 64% of suicide- and unintentional injury-associated costs, respectively. The higher burden of homicide at younger ages compared with other causes of injury death is reflected in the higher combined medical and work-loss cost per case for homicide.

The costs of injury deaths are not proportional to the rates of injury deaths because of the higher lifetime work-loss costs for persons who die at younger ages. These disparities largely result from differences in lost productivity, which are proportional to years of potential life lost. For example, persons aged <65 years accounted for \$199.8 billion (96%) of the overall \$208.3 billion associated with fatal injuries. Although persons aged ≥65 years accounted for 28% of all injury-associated deaths (and 35% of all suicides), deaths in this age group accounted for only 1% (homicide) to 6% (unintentional injury) of costs related to injury deaths. Additionally, although the unintentional injury death rate for persons aged ≥65 years was more than twice as high as for any other age group, only 6% of the unintentional costs were incurred by this age group,

highlighting the relation between the cost of an injury death and years of potential life lost. Similarly, 18% of all suicides were among those aged ≥65 years, yet <3% of the suicide-related costs were accounted for by this age group.

Although drug poisonings, transportation- and firearm-related injuries, suffocation, and falls accounted for the greatest proportion of costs for all injury deaths, these proportions differed by intent. Firearm-related injuries accounted for most of the homicide-associated costs, and a large share of the cost of suicide, but <1% of the costs of unintentional injuries. Drug poisonings, the leading mechanism of overall injury deaths, accounted for approximately 38% of the cost of unintentional deaths and 12% of the suicide-associated costs. More than 99% of transportation-related fatal injuries, which accounted for the second largest share of all costs, were associated with unintentional injury deaths.

The findings in this report are subject to at least four limitations. First, the costs measured account for medical costs and lost productivity associated with decedents. Other societal costs, including those associated with law enforcement,

Summary**What is already known on this topic?**

Injuries are a leading cause of death in the United States, particularly among adolescents and young adults. Intentional and unintentional injury-associated deaths result in a substantial economic burden. Injury and violence prevention strategies can save lives and reduce costs.

What is added by this report?

Cost of injury estimates were updated using improved methodology and the most recently available injury data. The total estimated lifetime medical and work-loss costs associated with fatal injuries in 2013 was \$214 billion. Males accounted for 78% of economic costs (\$166.7 billion). Approximately 61% of the total costs were attributable to unintentional injuries (\$129.7 billion), followed by suicide (\$50.8 billion [24%]) and homicide (\$26.4 billion [12%]). Drug poisonings as a mechanism accounted for the largest share of injury costs (27%), followed by transportation (23%) and firearm-related injuries (22%).

What are the implications for public health practice?

Injury deaths created a substantial economic burden in the United States during 2013. Understanding the causes and mechanisms of injury death that created the largest share of this burden, such as drug overdoses, and understanding disparities among affected groups can inform public health prevention efforts.

prosecution, and corrections, as well as the pain and suffering of family members, were not considered. Second, intent of fatal injury, as determined from the manner of death assigned on death certificates by coroners or medical examiners, can differ across jurisdictions (7). Finally, work-loss costs were assigned using the mean earnings of the general population by sex and specific age groups. If the mean earnings of persons who die from injuries differ from those of the general population, the estimates might be higher or lower than the actual lost earnings.

Injury prevention programs, strategies, and practices can reduce risks for deaths, enhance protection at the individual, relationship, neighborhood, and societal levels, and substantially reduce the costs identified in this report. Numerous strategies have demonstrated the potential for

preventing different causes and mechanisms of injury. For example, street outreach programs that effectively mediate conflicts in high-crime communities have shown promise in reducing firearm-related violence (8). Information about the cost-effectiveness of injury prevention strategies is also expanding. Child safety seat laws and sobriety checkpoints offer net cost savings, with medical and other resource costs saved that exceed implementation and maintenance costs (9). These current estimates of the economic burden of fatal injuries can be used by decision makers to compare the costs of implementing prevention strategies with the cost that might be avoided by preventing injuries.

¹Division of Analysis, Research and Practice Integration, National Center for Injury Prevention and Control, CDC; ²Division of Violence Prevention, National Center for Injury Prevention and Control, CDC; ³Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control, CDC.

Corresponding author: Curtis Florence, cflorence@cdc.gov, 770-488-1398.

References

1. CDC. Web-Based Injury Statistics Query and Reporting System (WISQARS). Available at <http://www.cdc.gov/injury/wisqars>.
2. Finkelstein EA, Corso PS, Miller TR, et al. The incidence and economic burden of injury in the United States. New York, NY: Oxford University Press; 2006.
3. Florence C, Haegerich T, Simon T, et al. Estimated lifetime medical and work-loss costs of emergency department-treated nonfatal injuries—United States, 2013. *MMWR Morb Mortal Wkly Rep* 2015;64:1078–82.
4. Lawrence BA, Miller TA. Medical and work loss cost estimation methods for the WISQARS cost of injury module. Available at <http://www.pire.org/documents/WisqarsCostMethods.pdf>.
5. Baker SP, Hu G, Wilcox HC, Baker TD. Increase in suicide by hanging/suffocation in the U.S., 2000–2010. *Am J Prev Med* 2013;44:146–9.
6. National Center for Statistics and Analysis. 2013 motor vehicle crashes: overview. Available at <http://www-nrd.nhtsa.dot.gov/Pubs/812101.pdf>.
7. Breiding MJ, Wiersma B. Variability of undetermined manner of death classification in the US. *Inj Prev* 2006;12(Suppl 2):ii49–54.
8. Webster DW, Whitehill JM, Vernick JS, Curriero FC. Effects of Baltimore's Safe Streets Program on gun violence: a replication of Chicago's CeaseFire Program. *J Urban Health* 2013;90:27–40.
9. Miller T, Finkelstein E, Zaloshnja E, Hendrie D. The cost of child and adolescent injuries and the savings from prevention, in Injury prevention for children and adolescents: research, practice, and advocacy. Liller K, ed. Washington, DC: American Public Health Association; 2012:15–64.

Estimated Lifetime Medical and Work-Loss Costs of Emergency Department–Treated Nonfatal Injuries — United States, 2013

Curtis Florence, PhD¹; Tamara Haegerich, PhD²; Thomas Simon, PhD³; Chao Zhou, PhD¹; Feijun Luo, PhD¹

A large number of nonfatal injuries are treated in U.S. emergency departments (EDs) every year. CDC's National Center for Health Statistics estimates that approximately 29% of all ED visits in 2010 were for injuries (1). To assess the economic impact of ED-treated injuries, CDC examined injury data from the National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP) (2) for 2013, as well as injury-related lifetime medical and work-loss costs from the Web-Based Injury Statistics Query and Reporting System (WISQARS). NEISS-AIP collects data from a nationally representative sample of EDs, using specific guidelines for recording the primary diagnosis and mechanism of injury. Number of injuries, crude- and age-specific injury rates, and total lifetime work-loss costs and medical costs were calculated for ED-treated injuries, stratified by sex, age groups, and intent and mechanism of injury. ED-treated injuries were further classified as those that were subsequently hospitalized or treated and released. The rate of hospitalized injuries was 950.8 per 100,000, and the rate of treated and released injuries was 8,549.8 per 100,000. Combined medical and work-loss costs for all ED-treated injuries (both hospitalized and treated and released) were \$456.9 billion, or approximately 68% of the total costs of \$671 billion associated with all fatal and ED-treated injuries. The substantial economic burden associated with nonfatal injuries underscores the need for effective prevention strategies.

Numbers of ED-treated injuries, rates, and lifetime cost estimates by age and sex of the patient and by mechanism and intent of injury were analyzed using WISQARS (3). Rates were calculated using the U.S. Census Bureau's bridged race population estimates for 2013. Lifetime medical and work-loss costs were calculated from average costs of treating nonfatal injuries and earnings in 2010, adjusted to 2013 prices. Lifetime work-loss is the estimated wages lost because of time away from work while recovering from the injury, and the loss of income incurred for injuries that lead to permanent disability. For each ED-treated injury record, lifetime work-loss costs and medical costs were assigned using the age and sex of the injured person, along with the injury diagnosis and mechanism (4). Work-loss and medical costs for nonfatal injuries were developed from various sources, including days of work missed because of injury, from the Agency for Healthcare Research and Quality's (AHRQ) Medical Expenditure Panel Survey;

hospital costs, from the Health Care Cost and Utilization Project; earnings data, from the U.S. Census Bureau's Current Population Survey; and life expectancy data, from CDC's National Center for Health Statistics. Number of injuries, rates, and total lifetime medical and work-loss costs were estimated for 2013, stratified by sex, age and intent of injury. Differences by race and ethnicity were not examined because those data are not available in the WISQARS nonfatal injury reports. The distribution of costs by mechanism of injury and ED discharge disposition of treatment (i.e., hospitalized or treated and released) was also assessed for seven selected mechanisms. Finally, the costs of ED-treated nonfatal injuries were compared with those of fatal injuries presented in another *MMWR* report (5).

For all ED-treated nonfatal injuries, the total costs were \$456.9 billion; 63% of these costs were for hospitalized injuries, for which the total estimated lifetime medical and work-loss costs were \$289.7 billion (Table 1). Approximately 65% of these costs were accounted for by males; these costs were also concentrated in the adult population, with more than three quarters of the cost being for persons aged ≥ 25 years. Unintentional injuries accounted for \$253.5 billion in lifetime costs, or about 87% of costs for hospitalized injuries. Assault injuries and self-harm injuries (defined as an injury or poisoning resulting from a deliberate violent act inflicted on oneself) accounted for \$26.4 billion and \$11.3 billion of lifetime costs, respectively. Approximately 85% of costs for hospitalized assault injuries were borne by males (\$22.5 billion), whereas costs for hospitalized self-harm injuries were more similar among males (\$6.5 billion) and females (\$4.7 billion). Costs for hospitalized violent injuries were concentrated among adults aged 15–44 years, with 72% of costs for assaults and 67% of self-harm costs accounted for by these age groups. In contrast, adults aged ≥ 45 years accounted for 59% of costs associated with hospitalized injuries that were unintentional.

Total estimated costs for injuries for which patients were treated and released were \$167.1 billion (Table 2). Approximately 58% of these costs were accounted for by males (\$96.2 billion), and 71% for persons aged < 45 years. A very large share of these costs (\$156.1 billion [93%]) was for unintentional injuries. Assault injuries and self-harm injuries accounted for \$9.8 billion and \$627 million in costs, respectively. Males accounted for about two thirds of assault

TABLE 1. Hospitalized* nonfatal injuries, rates per 100,000 population, and estimated lifetime medical and work-loss costs, by sex, age group, and intent — United States, 2013

Intent	Total	Sex		Age group (yrs)				
		Male	Female	0–14	15–24	25–44	45–64	≥65
All intents*†								
No. of injuries	3,005,772	1,639,305	1,366,326	189,400	337,789	678,465	829,903	967,066
Rate [§]	950.81	1,053.19	851.41	310.04	768.50	814.51	998.87	2,163.26
Costs [¶]	289,730	191,283	101,022	22,352	38,106	75,308	87,932	69,783
Unintentional								
No. of injuries	2,486,337	1,351,321	1,134,950	164,271	196,256	471,906	699,926	952,138
Rate [§]	786.49	868.17	707.23	268.90	446.50	566.53	842.43	2,129.87
Costs [¶]	253,549	162,965	93,001	20,125	27,636	61,344	80,462	69,199
Assault								
No. of injuries	169,076	134,952	34,115	6,659	47,458	73,258	36,120	4,388
Rate [§]	53.48	86.70	21.26	10.90	107.97	87.95	43.47	9.81
Costs [¶]	26,366	22,529	3,681	906	7,113	11,962	5,728	462
Self-harm								
No. of injuries	344,914	147,871	196,977	18,461	92,959	129,876	93,121	10,404
Rate [§]	109.11	95.00	122.74	30.22	211.49	155.92	112.08	23.27
Costs [¶]	11,320	6,522	4,728	595	3,212	4,373	2,800	317

* Includes nonfatal injuries initially treated in a hospital emergency department that resulted in hospitalization or transfer for specialized medical care.

† All intents include legal intervention. Assault, self-harm, and legal intervention include cases that are confirmed or suspected. All other cases are considered unintentional.

§ Injuries per 100,000 population.

¶ In millions of 2013 U.S. dollars. Cost estimates were computed from average lifetime work-loss and medical costs by mechanism and intent of injury. The base year for average costs was 2010. Base year costs were indexed to 2013 prices and applied to 2013 emergency department–treated injury counts. Lifetime medical costs refer to the medical costs associated with the injury event.

TABLE 2. Treated and released* nonfatal injuries, rates per 100,000 population, and estimated lifetime medical and work-loss costs (in millions of dollars), by sex, age group, and intent — United States, 2013

Intent	Total	Sex		Age group (yrs)				
		Male	Female	0–14	15–24	25–44	45–64	≥65
All intents*†								
No. of injuries	27,028,247	14,358,379	12,669,537	5,819,455	5,014,247	7,580,392	5,665,770	2,947,418
Rate [§]	8,549.76	9,224.69	7,894.91	9,526.17	11,407.84	9,100.41	6,819.33	6,593.18
Costs [¶]	167,135	96,233	70,701	36,750	30,348	50,749	35,699	13,281
Unintentional								
No. of injuries	25,407,794	13,418,964	11,988,499	5,681,198	4,504,264	6,909,368	5,386,913	2,925,179
Rate [§]	8,037.16	8,621.15	7,470.53	9,299.85	10,247.58	8,294.83	6,483.70	6,543.43
Costs [¶]	156,087	89,042	66,883	35,903	26,850	45,995	33,869	13,178
Assault								
No. of injuries	1,398,931	816,536	582,394	120,616	434,671	584,023	239,462	20,091
Rate [§]	442.52	524.59	362.91	197.44	988.91	701.13	288.22	44.94
Costs [¶]	9,753	6,358	3,371	770	3,051	4,235	1,601	93
Self-harm								
No. of injuries	130,650	46,992	83,658	15,766	48,818	41,825	22,819	1,422
Rate [§]	41.33	30.19	52.13	25.81	111.07	50.21	27.47	3.18
Costs [¶]	627	245	377	61	218	214	121	7

Sources: National Electronic Injury Surveillance System–All Injury Program (NEISS–AIP) for injury rates, disposition, and mechanism. Pacific Institute for Research and Evaluation for unit cost estimates. U.S. Census Bureau for population estimates. Numbers and rates computed using WISQARS (<http://www.cdc.gov/injury/wisqars>).

* Includes nonfatal injuries for persons initially treated in a hospital emergency department and then released.

† All intents include legal intervention. Assault, self-harm, and legal intervention include cases that are confirmed or suspected. All other cases are considered unintentional.

§ Injuries per 100,000 population.

¶ In millions of 2013 U.S. dollars. Cost estimates were computed from average lifetime work-loss and medical costs by mechanism and intent of injury. The base year for average costs was 2010. Base year costs were indexed to 2013 prices and applied to 2013 emergency department–treated injury counts. Lifetime medical costs refer to the medical costs associated with the injury event.

Summary**What is already known on this topic?**

Each year, approximately 3 million persons are hospitalized and 27 million are treated and released in emergency departments (EDs) in the United States because of violence and unintentional injuries. Medical and work-loss costs associated with these injuries create a substantial economic burden for the health care system and the general public.

What is added by this report?

During 2013, the rate of nonfatal injuries treated in U.S. hospital EDs that resulted in hospitalization was 951 per 100,000, and the rate of nonfatal injuries that were treated and released was 8,549 per 100,000. Nonfatal injuries accounted for approximately \$456 billion in medical and work-loss costs. The vast majority of ED-treated nonfatal injuries were unintentional. The majority of medical and work-loss costs associated with ED-treated nonfatal injuries were from falls (37% of costs) and transportation-related injuries (21% of costs).

What are the implications for public health practice?

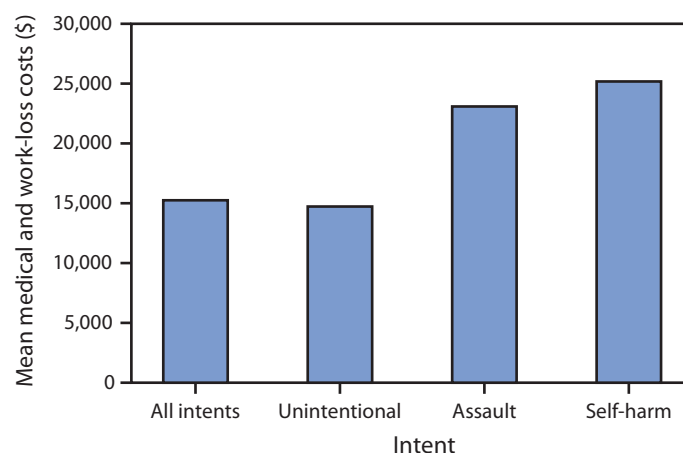
Injury and violence prevention strategies can reduce a substantial source of morbidity and financial burden in the United States. Understanding how the cost burden is distributed across different mechanisms and segments of the population can allow prevention interventions to be targeted where they will have the greatest impact. The concentration of costs from falls (primarily among older adults) and transportation-related injuries suggests that a substantial proportion of costs can be avoided by implementation of prevention strategies that address these mechanisms and age groups.

costs (\$6.4 billion), whereas females accounted for 60% of the self-harm costs (\$377 million). Rates for nonfatal treated and released injuries from assaults and self-harm were highest among those aged 15–24 years, followed by those aged 25–44 years. Persons aged 15–44 years accounted for a large share of assault (83%) and self-harm costs (79%), whereas costs for unintentional treated and released injuries were more evenly distributed among age groups.

Although unintentional injuries account for a large majority of nonfatal injuries and their associated costs, intentional injuries are more costly on a per case basis (Figure 1). Overall, the mean medical and work-loss cost for an ED-treated nonfatal injury (including both hospitalized patients and patients treated and released) was \$15,211; among unintentional injuries, the mean cost was \$14,685, whereas the mean cost of an assault injury was \$23,034. Self-harm injuries were the most costly on a per case basis (\$25,121). Assaults and self-harm have considerably higher lifetime medical care costs, and assaults have higher work-loss costs than unintentional injuries.

Lifetime costs for ED-treated injuries were associated with a range of injury mechanisms (Figure 2), and in many cases,

FIGURE 1. Mean medical and work-loss costs per case of emergency department–treated nonfatal injury, by intent* — United States, 2013



* All intents category includes legal intervention. Assault, self-harm, and legal intervention are cases that are confirmed or suspected. All other cases are considered unintentional.

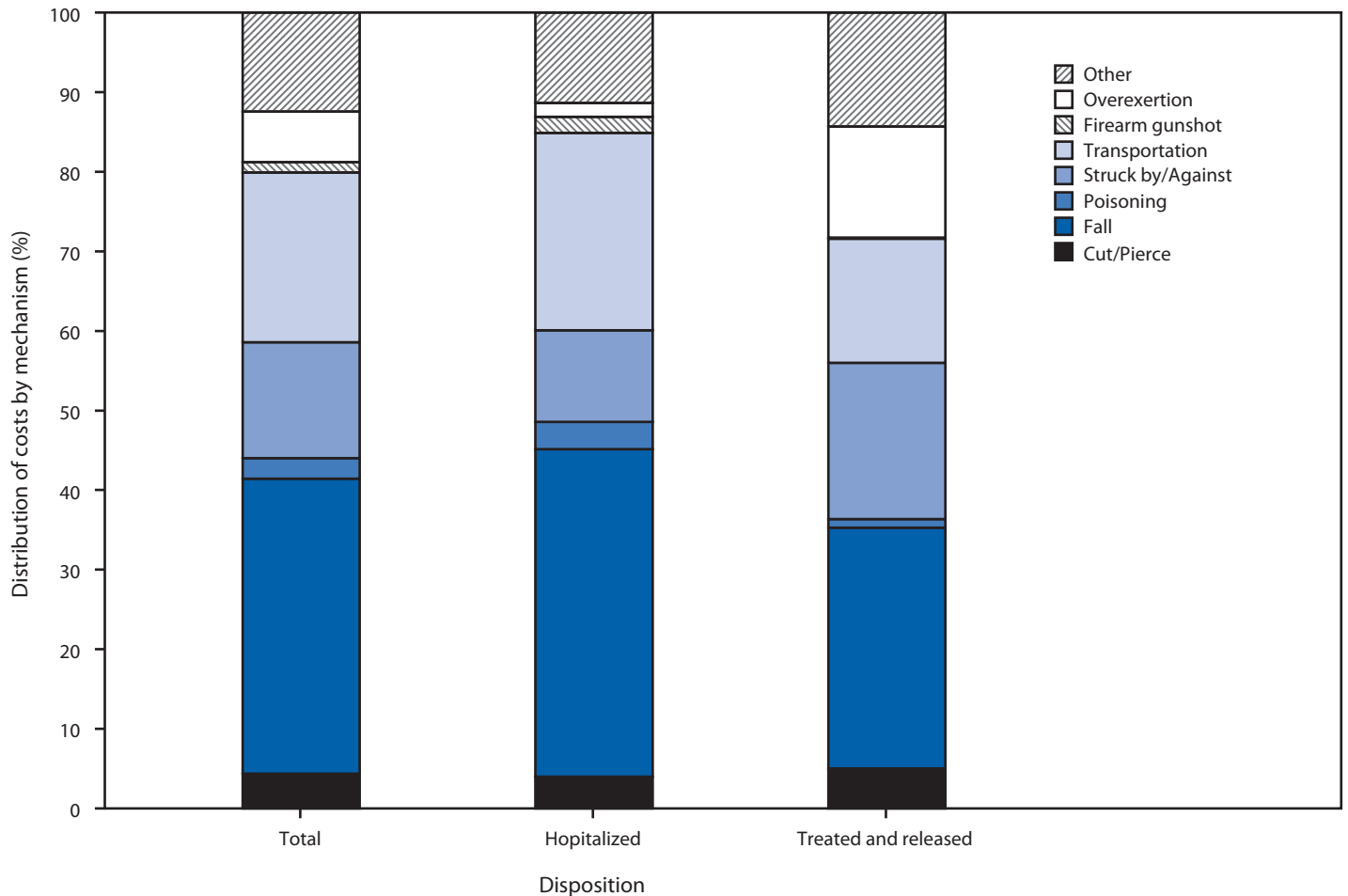
these mechanisms differed from those that accounted for fatal injury costs (5). For all ED-treated nonfatal injuries, 37% of costs were associated with injuries from falls, and 21% from transportation-related injuries. All poisonings accounted for only 2.6% of nonfatal injury costs; however, among fatal injuries (5), drug poisonings, a subset of all poisonings, accounted for the highest percentage of costs (27.4%) (5). Although firearm-related injuries accounted for approximately one fifth of costs associated with fatal injuries (5), they represent slightly more than 1% of costs from nonfatal injuries. Hospitalized injury costs were primarily associated with falls (41%) and transportation (25%). A large share of costs related to injuries that were treated and released were also associated with falls (30%), whereas other mechanisms, such as overexertion, accounted for a higher percentage of costs than for hospitalized injuries (14%).

Discussion

In addition to the recognized health, psychological, emotional, and social consequences of injury, ED-treated nonfatal injuries resulted in substantial costs for the U.S. health care system, as well as substantial work-loss costs in 2013; these costs provide a strong incentive to prevent injury. Although almost 90% of all ED-treated injury costs were associated with unintentional injuries, the costs per case were 57% higher for injuries resulting from assaults and 71% higher for injuries resulting from self-harm than for unintentional injuries.

Various mechanisms account for nonfatal injury costs; some, such as falls and transportation-related injuries (primarily motor vehicle crashes), account for large shares of nonfatal and fatal injury costs; whereas others are differentially distributed.

FIGURE 2. Distribution of lifetime medical and work-loss cost estimates for nonfatal injury, by mechanism and disposition — United States, 2013



Falls account for approximately one third of all (treated and released and hospitalized) nonfatal medical and work-loss costs. Falls were also the fifth leading mechanism for fatal injury costs, so effective prevention of fall injuries, such as strength and balancing exercises for older adults, could result in a substantial reduction in lifetime medical and work-loss costs (5). Transportation-related injury (primarily motor vehicle crashes), a leading contributor to fatal injury costs, also accounts for the second largest share of nonfatal injury costs (5). Some mechanisms that account for a large share of fatal injury costs, such as firearms and drug poisonings, account for a relatively small share of nonfatal injury costs (5), likely a consequence of their higher lethality.

The findings in this report are subject to at least three limitations. First, the costs measured account for medical costs for physical injury only and lost productivity associated with nonfatal injuries initially treated in hospital EDs. Costs of injuries treated in other health care settings, or injuries that were not medically treated, were not ascertained. Second, additional costs (e.g., for mental health or psychological treatment

and costs for the criminal justice and emergency response systems) were not considered, nor were costs that might be incurred years after the initial injury, as in the case of child maltreatment (6). Therefore, these estimates likely represent an underestimate of the complete cost of injury. Finally, intent of injury and mechanism were assigned by trained coders based on brief narratives abstracted from patients' medical records for which the level of detail on circumstances varied. Inaccuracies in the abstraction and coding process might have affected the distribution of cost by intent and mechanism.

Although nonfatal injuries treated in EDs are common and costly, appropriate implementation of evidence-based strategies can reduce nonfatal injuries from the mechanisms that lead to the greatest cost burden. For example, primary seat belt laws, motorcycle helmet laws, sobriety checkpoints, and alcohol interlocks are effective in preventing motor vehicle-related injuries and can produce substantial economic benefits that greatly exceed the implementation costs (7). The relatively high rate of injuries from assaults and self-harm among adolescents and young adults underscores the need for early prevention

strategies that take advantage of the best available evidence to enhance youths' skills, family relationships, and social environments to reduce risk for violence-related injuries. One example is Life Skills Training, a middle school classroom-based program to reduce substance use, which is a risk factor for violent behavior (8,9). Finally, the ED might also be a useful setting for implementing prevention. Studies of some screening and brief intervention programs for reducing excessive alcohol use, which is a risk factor for both unintentional and violent injuries, have shown that this intervention can reduce the likelihood of a subsequent visit to the ED for injury or violence-related causes (10). Expanded implementation of evidence-based programs and policies to prevent injuries and violence can reduce not only the pain and suffering of victims but also the considerable societal costs.

¹Division of Analysis, Research and Practice Integration, National Center for Injury Prevention and Control, CDC; ²Division of Violence Prevention, National Center for Injury Prevention and Control, CDC; ³Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control, CDC.

Corresponding author: Curtis Florence, cflorence@cdc.gov, 770-488-1398.

References

1. CDC. National Hospital Ambulatory Medical Care Survey: 2010 emergency department summary tables. Available at http://www.cdc.gov/nchs/data/ahcd/nhamcs_emergency/2010_ed_web_tables.pdf.
2. US Consumer Product Safety Commission National Electronic Injury Surveillance System. Available at <http://www.cpsc.gov/en/Research-Statistics/NEISS-Injury-Data>.
3. CDC. Nonfatal injury data. Available at <http://www.cdc.gov/injury/wisqars/nonfatal.html>.
4. Lawrence BA, Miller TA. Medical and work-loss cost estimation methods for the WISQARS Cost of Injury module. Available at <http://www.pire.org/documents/WisqarsCostMethods.pdf>.
5. Florence C, Simon T, Haegerich T, et al. Lifetime medical and work-loss costs of fatal injuries—United States, 2013. *MMWR Morb Mortal Wkly Rep* 2015;64:1074–7.
6. Fang X, Brown DS, Florence CS, Mercy JA. The economic burden of child maltreatment in the United States and implications for prevention. *Child Abuse Negl* 2012;36:156–65.
7. Preusser DF, Williams AF, Nichols JL, Tison J, Chaudhary NK. Effectiveness of behavioral highway safety countermeasures. Available at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_622.pdf.
8. Center for the Study and Prevention of Violence. Blueprints for healthy youth development. Available at <http://www.blueprintsprograms.com>.
9. Substance Abuse and Mental Health Services Administration. National Registry of Evidence-Based Programs and Practices. Available at <http://www.nrepp.samhsa.gov>.
10. Mello MJ, Nirenberg TD, Longabaugh R, et al. Emergency department brief motivational interventions for alcohol with motor vehicle crash patients. *Ann Emerg Med* 2005;45:620–5.