

Can Statewide Emergency Department, Hospital Discharge, and Violent Death Reporting System Data Be Used to Monitor Burden of Firearm-Related Injury and Death in Rhode Island?

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ABSTRACT

Context: National data on the epidemiology of firearm injuries and circumstances of firearm deaths are difficult to obtain and often are nonreliable. Since firearm injury and death rates and causes can vary substantially between states, it is critical to consider state-specific data sources.

Objective: In this study, we illustrate how states can systematically examine demographic characteristics, firearm information, type of wound, toxicology tests, precipitating circumstances, and costs to provide a comprehensive picture of firearm injuries and deaths using data sets from a single state with relatively low rates of firearm injury and death.

Design: Cross-sectional study.

Setting: Firearm-related injury data for the period 2005-2014 were obtained from the Rhode Island emergency department and hospital discharge data sets; death data for the same period were obtained from the Rhode Island Violent Death Reporting System.

Main Outcome Measure: Descriptive statistics were used. Healthcare Cost and Utilization Project cost-to-charge ratios were used to convert total hospital charges to costs.

Results: Most firearm-related emergency department visits (55.8%) and hospital discharges (79.2%) in Rhode Island were from assaults; however, most firearm-related deaths were suicides (60.1%). The annual cost of firearm-related hospitalizations was more than \$830 000. Most decedents who died because of firearms tested positive for illicit substances. Nearly a quarter (23.5%) of firearm-related homicides were due to a conflict between the decedent and suspect. More than half (59%) of firearm suicide decedents were reported to have had current mental or physical problems prior to death.

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Conclusions: Understanding the state-specific magnitude and patterns (who, where, factors, etc) of firearm injury and death may help inform local injury prevention efforts. States with similar data sets may want to adopt our analyses. Surveillance of firearm-related injury and death is essential. Dissemination of surveillance findings to key stakeholders is critical in improving firearm injury prevention. States that are not part of the National Violent Death Reporting System (NVDRS) could work with their other data sources to obtain a better picture of violent injuries and deaths to make the best use of resources.

KEY WORDS: accident, assault, death, emergency department visit, firearm, homicide, hospital discharge, injury, Rhode Island Violent Death Reporting System, suicide

Firearm-related injuries are a public health epidemic in the United States¹⁻³ and cost more than \$48 billion in medical and work loss costs in the United States, annually.² In 2015 alone, 36 252 Americans were killed,^{4,5} almost 85 000 persons visited the emergency department,⁶ and more than 46 000 were hospitalized or transferred because of firearm injuries.⁶ The firearm death rate varies by gender (with the male death rate 6 times higher than that of females)⁷ and by geography. The national firearm-related injury death rate is 10.3/100 000 population.^{3,8} Alaska had the highest firearm death rate (19.7/100 000 population), followed by Louisiana, Mississippi, Alabama, and Montana.^{3,9} Hawaii had the lowest firearm death rate (2.8/100 000), followed by Rhode Island (3.3/100 000), Massachusetts, New York, and Connecticut.^{3,8,9}

In Healthy People 2020, established by the US Department of Health & Human Services, the objective IVP-30 is to reduce firearm-related deaths by 10%, and the objective IVP-31 is to reduce nonfatal firearm-related injuries by 10%.¹⁰ Many factors correlate with firearm injury and death, such as age, gender, veteran status, alcohol and substance use, firearm availability, mental health problems, physical health problems, and more; however, some of these factors may be state-specific.^{11,12} It is critical to understand the patterns (who, where, factors, etc), characteristics, magnitude, and costs of firearm injuries and deaths to develop strategies to prevent them.

Despite the magnitude of firearm injury, there are relatively few peer-reviewed publications on this topic.^{13,14} Scarcity of research on firearm injuries stems partly from disproportionately low federal funding for firearm injury prevention, including an explicit lack of appropriations to the Centers for Disease Control and Prevention (CDC) to research this topic.^{15,16} National data on firearm injury patterns are further limited because of inconsistent coding of cause of death, limited data on injury characteristics of firearm injury or death, and limited attention to the variations in epidemiology for the various types of firearm death.^{2,11,12,17-20} In addition, few studies of correlates of death in states with lower rates of firearm

death have been completed; theoretically, correlates and causes of firearm injury in low-mortality states may differ from national analyses.

In this analysis, we conducted a state-specific analysis in a state with one of the lowest firearm injury and death rates in the country. We combined 3 validated, reproducible data sets: (1) 2005-2014 statewide emergency department (ED) visit, (2) hospital discharge (HD), and (3) the Rhode Island Violent Death Reporting System. The objective of this study was to systematically examine demographic characteristics, firearm information, wound to body parts, toxicology tests, precipitating circumstances, and costs to inform firearm injury and death prevention.

Methods

Data sources

Emergency department data and HD data were captured from reporting data from the state's 11 acute care general hospitals, which are required by licensure regulations to report data on every ED visit and inpatient discharge to the Rhode Island Department of Health. These statewide ED and HD databases are primarily administrative data systems, designed to capture billing, licensing, and diagnostic information. Data points include patient demographics and clinical information coded to the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*.²¹ Hospital discharge data have been available since October 1, 1989, and ED data were first reported in 2005. As most payers require a single bill for patients seen in the same hospital for a single visit or stay, ED visits that included subsequent admissions to the same hospital were included as "HD," not "ED" data.

Cases were selected from the ED and HD billing databases using *ICD-9-CM* external cause of injury codes (E-codes): firearm accident (E922.0-.3, E922.8-.9), firearm suicide or self-inflicted injury (E955.0-.4), firearm assault (E965.0-.4), firearm injury from legal intervention (E970), and firearm injury with undetermined intent (E985.0-.4).^{7,22} Since there were only a few legal intervention cases, we

grouped them with assault/homicide.^{23,24} We excluded firearm injuries because of war ($n = 1$ for ED visits) and firearm injuries of undetermined intent ($n = 17$ for hospitalizations) because of small numbers. Therefore, the 4 categories of manner of death for this analysis were unintentional (“accident”), suicide, homicide/legal intervention, and undetermined intent (only for ED visits) (see Supplemental Digital Content Appendix Table A, available at <http://links.lww.com/JPHMP/A430>, and Table 1).

Rhode Island Violent Death Reporting System is a component of the National Violent Death Reporting System (NVDRS), which is a population- and state-based surveillance system established by the CDC to collect data on all violent deaths and associated risk factors in the United States.^{23,24} The NVDRS links data from coroner/medical examiner reports, death certificates, law enforcement reports, and secondary sources (eg, State Crime Laboratory, National Incident Based Reporting System, Child Death Review Team data) to provide detailed information on decedents’ demographics, toxicology, and the circumstances precipitating violent deaths. Rhode Island has participated in NVDRS since 2004.

Types of deaths in Rhode Island Violent Death Reporting System, assigned by abstractors, include suicides (intentional self-harm); homicides (assault); deaths of undetermined intent; unintentional firearm-related deaths; deaths due to legal intervention excluding legal executions; and deaths due to terrorism.^{23,24} For this analysis, deaths of undetermined intent ($n = 5$) and unintentional firearm deaths ($n = 2$) were excluded because of small numbers. Therefore, the 2 categories of manner of death for this analysis were homicide/legal intervention and suicide.

Characteristics, toxicology tests, and circumstances

Characteristics of firearm injuries and deaths and their respective categories are shown in Supplemental Digital Content Appendix Table A, available at <http://links.lww.com/JPHMP/A430>. Other characteristics, toxicology tests, and circumstances of firearm deaths and their categories are shown in Tables 2 to 4. Blood alcohol concentration, based on toxicological data, was dichotomized into less than 0.08% versus 0.08% or more. In correspondence with CDC standard methods of analysis,²³ the 11 distinct homicide circumstances were classified into 4 broad conceptual groups: (1) crime and criminal activity; (2) interpersonal; (3) life stressor; and (4) homicide event circumstances. The 22 distinct suicide circumstances were similarly classified into 4 broad conceptual groups: (1) mental health/substance abuse; (2) interpersonal; (3) life stressor; and (4) suicide event circumstances. Data about the existence of prior restraining orders were missing for more than 90% of firearm suicide and homicide victims; this data point was therefore not included in our analysis.

Data analyses

Raw counts of firearm injuries and deaths rather than rates were analyzed. It would be far more useful to give rates of injuries or deaths rather than percentages by characteristics. However, the numbers in Rhode Island were very small even when we combined 10 years of data. The CDC requires that states do not report rates for cells with a frequency of less than 20 due to instability. In addition, rates could not be calculated for many characteristics (eg, marital status, toxicology tests, and precipitating circumstances) because the

TABLE 1
Average Annual Charge, Cost, and Length of Stay by Manner of Firearm-Related Injury, 2005-2014^a

Manner of Firearm-Related Injury	n	Total Charge	Average Charge	Total Cost	LOS, d
ED visit ^b					
Unintentional	28	\$89 052	\$3180	\$28 330	
Assault/Legal intervention	49	\$199 828	\$4078	\$65 376	
Suicide attempt	4	\$19 823	\$4956	\$6644	
Undetermined intent	6	\$21 119	\$3520	\$6596	
Total	87	\$329 822	\$3791	\$106 945	
Hospitalization					
Unintentional	8	\$319 909	\$39 989	\$106 085	51
Assault/Legal intervention	41	\$2 080 275	\$50 738	\$669 772	302
Suicide attempt	3	\$167 234	\$55 745	\$54 954	26
Total	52	\$2 567 418	\$49 373	\$830 812	380

Abbreviations: ED, emergency department; LOS, length of stay.

^aFrom Rhode Island emergency department visit and hospital discharge data.

^bEmergency department visits in this analysis do not include those subsequent admissions to the same hospital.

TABLE 2
Characteristics of Firearm Homicide/Legal Intervention and Suicide Death, Rhode Island, 2005-2014^a

Characteristics of Firearm Death	Homicide/Legal Intervention (n = 173)		Suicide (n = 261)	
	n	%	n	%
Marital status				
Never married/single, not otherwise specified	131	75.7	96	36.9
Married/civil union/domestic partnership	31	17.9	91	35.0
Divorced/married, but separated	11	6.4	52	20.0
Widowed	0	0.0	21	8.1
Injury location				
House, apartment	77	45.0	196	75.4
Street/road, sidewalk, alley	53	31.0	7	2.7
Parking lot/public parking garage	11	6.4	9	3.5
Motor vehicle	8	4.7	13	5.0
Natural area (eg, field, river, beaches, woods)	4	2.3	16	6.2
Other	18	10.5	19	7.3
Injury at victim home				
Yes	48	28.2	187	71.6
No	122	71.8	74	28.4
Firearm caliber or gauge				
9 mm	32	29.9	23	10.0
.22 in	13	12.1	42	18.3
.40 in	17	15.9	17	7.4
.38 in	10	9.3	41	17.9
.45 in	9	8.4	14	6.1
.357 in	7	6.5	25	10.9
.32 in	<5 ^b		16	7.0
12-gauge	<5 ^b		24	10.5
Other	14	13.1	27	11.8
Firearm make				
Smith & Wesson	7	7.9	47	19.0
Ruger, Sturm Ruger	6	6.7	19	7.7
Taurus	5	5.6	16	6.5
Mossberg/Lakefield Arms	3	3.4	20	8.1
Glock	12	13.5	9	3.6
Other	56	63.0	136	55.0
Number of bullets				
1	85	50.0	247	96.5
2	27	15.9	8	3.1
3	17	10.0	0	0.0
≥4	41	24.1	<5 ^b	

(continues)

TABLE 2
Characteristics of Firearm Homicide/Legal Intervention and Suicide Death, Rhode Island, 2005-2014^a
(Continued)

Characteristics of Firearm Death	Intervention (n = 173)		Suicide (n = 261)	
	n	%	n	%
Number of wounds				
1	65	38.7	150	59.1
2	30	17.9	100	39.4
3	19	11.3	<5 ^b	
≥4	54	32.1	<5 ^b	
Wound to body part^c				
Wound to head	64	38.1	215	84.0
Wound to abdomen	37	22.6	4	1.7
Wound to face	20	12.3	28	11.7
Wound to thorax	70	43.2	15	6.2
Wound to upper extremity	69	42.1	10	4.1
Wound to lower extremity	28	17.1	<5 ^b	
Wound to neck	21	12.8	6	2.5
Wound to spine	10	6.1	<5 ^b	

^aFrom Rhode Island Violent Death Reporting System. Percentages might not total 100% because of rounding.

^bThe number of deaths are 5 or fewer; the number has been suppressed to retain confidentiality.

^cPercentages might exceed 100% because multiple wounds might have been coded.

TABLE 3
Toxicology Tests of Firearm Homicide/Legal Intervention and Suicide Deaths, Rhode Island 2005-2014^{a,b}

Toxicology Test of Firearm Death	Homicide/Legal Intervention (n = 173)		Suicide (n = 261)	
	n	%	n	%
Tested	169	97.7	257	98.5
Toxicology test positive				
Any toxicology	119	70.4	143	55.6
Any illicit substance	118	69.8	126	49.0
Alcohol	49	29.0	85	33.1
BAC <0.08 g/dL	16	...	17	...
BAC ≥0.08 g/dL	33	...	68	...
Marijuana	76	45.5	21	8.2
Opiates	22	13.0	34	13.3
Cocaine	21	12.4	12	4.7
Antidepressants	6	3.6	36	14.1

Abbreviation: BAC, blood alcohol concentration.

^aFrom Rhode Island Violent Death Reporting System.

^bSubcategories do not sum to 100% because test results of victims can be positive for alcohol or multidrugs.

TABLE 4
Circumstances of Firearm Homicide/Legal Intervention and Suicide Deaths, Rhode Island 2005-2014^{a,b}

Circumstance of Firearm Death	Homicide/Legal Intervention (n = 173)		Circumstance of Firearm Death	Suicide (n = 261)	
	N	%		n	%
Reported	108	65.1	Reported	249	95.4
Crime and criminal activity			Mental health/substance abuse		
Precipitated by another crime	25	15.1	Current depressed mood	129	49.4
Drug trade	15	...	Current diagnosed mental health problem	105	40.2
Robbery	7	...	Depression/dysthymia	87	...
Assault	5	...	Anxiety disorder	19	...
Other	5	...	Bipolar disorder	10	...
Crime in progress ^c	18	10.8	Other	25	...
Drug involvement	16	9.6	History of ever being treated for a mental health problem	104	39.9
Gang related	5	3.2	Current mental health treatment	88	33.7
			Alcohol problem	35	13.4
			Other substance abuse problem	23	8.8
Interpersonal			Interpersonal		
Intimate partner violence	16	9.6	Intimate partner problem	61	23.4
Jealousy (lovers' triangle)	11	6.6	Other relationship problem (nonintimate)	19	7.3
			Family relationship problem	17	6.5
			Other death of family member/friend within past 5 years	17	6.5
Life stressor			Life stressor		
Argument or conflict	39	23.5	Argument or conflict	13	5.0
			Physical health problem	80	30.7
			Crisis within previous or upcoming 2 wk	54	20.7
			Job problem	50	19.2
			Financial problem	45	17.2
			Noncriminal legal problem	15	5.8
			Recent criminal legal problem	14	5.4
			Eviction or loss of home	13	5.0
Homicide event			Suicide event		
Drive-by shooting	13	7.8	Left a suicide note	88	33.7
Victim used a weapon	12	7.2	Suicide disclosure	60	23.0
Justifiable self-defense	11	6.6	History of suicide attempt	26	10.0
Victim was bystander	5	3.0	History of suicidal thoughts or plan	16	6.1

^aFrom Rhode Island Violent Death Reporting System.

^bPercentages might exceed 100% because multiple circumstances might have been coded.

^cDenominator includes only those decedents involved in an incident that was precipitated by another crime.

denominators were unknown.²³ Therefore, if we reported rates, the majority would be blank. As the population in Rhode Island has been stable for more than 10 years (1.056 million in 2015 and 2016),²⁵ trends are unlikely to be affected by age population changes during the study period. Ten years of data were pooled to increase numbers. We used the Healthcare Cost and Utilization Project cost-to-charge ratios to convert total hospital charges to costs.²⁶ The number and percentage were not reported when the number of

decedents was less than 5 to maintain confidentiality. The analysis was performed using SAS (v9.4; SAS Institute Inc, Cary, North Carolina).

Results

The characteristics of Rhode Island firearm-related injury patients and decedents are summarized in Supplemental Digital Content Appendix Table A, available at <http://links.lww.com/JPHMP/A430>.

During 2005–2014, a total of 869 Rhode Island ED visits (not admitted to the hospital) were due to firearm-related injuries. More than half (55.8%) of firearm-related ED visits were due to assaults/legal intervention and 32.7% were unintentional. There were 519 firearm-related hospital admissions in Rhode Island during this decade, of which 79.2% represented assaults/legal intervention. We do not have data on alcohol/substance use among those with firearm-related injuries in Rhode Island. Most firearm assault injury victims were 15 to 24 years of age, black and Hispanic, living in 4 core cities (Central Falls, Pawtucket, Providence, and Woonsocket), self-pay, and discharged to home.

During the same time period, there were 434 firearm-related deaths, of which suicide accounted for 60.1% ($n = 261$) and homicide, 39.9% ($n = 173$). Most firearm homicide victims were young (aged 15–24 years), male (86%), black and Hispanic, resided in core cities, and used handguns. In contrast, most firearm suicide victims were middle aged (aged 45–64 years), male (91%), non-Hispanic white, resided in suburban regions, and used handguns (see Supplemental Digital Content Appendix Table A, available at <http://links.lww.com/JPHMP/A430>).

The average charge for each firearm-related ED visit ($n = 87$) (not leading to hospital admission) was approximately \$3800, representing hospital charges of approximately \$330 000 and approximately \$107 000 paid by insurance companies each year (Table 1). The average charge per firearm-related hospital admission ($n = 52$) (including ED visits that led to admission) was approximately \$50 000, resulting in more than \$2.5 million in hospital charges per year. Among these hospital admissions, the average annual length of stay was 380 days, and the total costs paid by insurance companies were more than \$830 000.

Clear patterns of firearm homicides and suicides were identified (Table 2). During 2005–2014, of the 173 firearm homicides, 71.8% of the victims were injured outside of their home (with 31% injured on street/road, sidewalk, or alley). In comparison, of the 261 firearm suicides, 71.6% were injured in their home. Most decedents, regardless of cause of death, were injured with a handgun. Nearly 46% of the homicide decedents were killed by 9 mm or .40 caliber guns, and Glock was the most common maker. In contrast, 36% of the suicide victims used .22 or .38 caliber guns to kill themselves, and Smith & Wesson was the most common maker. Almost 97% of suicide decedents died of 1 bullet, and 96% of them had wounds to the head or the face. Toxicology tests were conducted for nearly all decedents and results showed that almost 70% of the firearm homicide decedents

and 49% of the firearm suicide decedents tested positive for illicit substances on postmortem analysis (Table 3). Alcohol (29%), marijuana (45.5%), opiates (13%), and cocaine (12.4%) were most commonly identified in postmortem toxicological analysis of homicide decedents. Alcohol (33.1%), antidepressants (14.1%), and opiates (13.3%) were most commonly identified in postmortem toxicological analysis of suicide decedents.

Nearly a quarter (23.5%) of firearm homicides were due to a conflict between the decedent and suspect over money, property, or drugs (Table 4); only 15.1% of firearm homicides were precipitated by another crime, and 9.6% were directly attributed to intimate partner violence. In contrast, the most common circumstance preceding firearm suicides was having current mental health problems (40.2%). Almost half (49.4%) of the suicide decedents were perceived by self or others to be depressed at the time of death, although only 33.7% were currently receiving mental health treatment. Intimate partner problems were reported as a related circumstance in 23.4% of suicides. Many Rhode Island firearm suicide decedents also experienced life stressors such as a crisis in the past 2 weeks (20.7%), physical health problems (30.7%), job problems (19.2%), or financial problems (17.2%) preceding their death. In one-third of the suicide cases (33.7%), the decedent left a suicide note.

Discussion

In this state-specific study, we combined easily available data sources to describe the epidemiology of firearm injury and death in a state with low firearm injury and death rates. Our analysis also provides novel state-specific data on cost, means of death, and presence of substances in decedents' toxicological analysis, which may inform state-specific prevention efforts. These findings are critically important in light of increasing national discussion of the need for geographically specific firearm injury prevention strategies²⁷ and in light of the lack of high-quality state-specific data.^{2,11,17,18,20} To the authors' knowledge, this is the first attempt to combine statewide ED, HD, and Violent Death Reporting System data to monitor the burden of firearm injury and death in a single state.

In the United States, the societal costs for all types of gun-related injuries and deaths were estimated at more than \$174 billion (direct costs: \$8.4 billion such as for emergency and medical care) and the government costs for firearm injuries were more than \$12 billion in 2010.^{5,28} In Rhode Island, a state with relatively low rates of firearm injury, this type of injury is still very costly: the mean cost (paid by

insurance companies) for gun-related ED visits was nearly \$110 000 per year and more than \$830 000 per year for firearm-related hospitalizations. More than half of the acute medical costs identified by this study were covered by Medicaid or Medicare, which are public insurance programs. Nationally, firearm injuries and deaths cost Medicare and Medicaid \$1.4 billion (acute care only, not including long-term care, physical therapy, etc) in 2010.²⁸ Gunshot wounds can leave survivors with long-term physical disabilities and chronic mental health problems, which are associated with high long-term as well as acute care costs.^{2,29} These consequences and high costs, largely born by government-funded health care systems, highlight the importance of prevention from a financial perspective.

Studies suggest that states with strong gun laws and lower gun ownership see lower firearm death rates.^{1,9} Rhode Island General laws require a person to have a license or permit to carry a pistol (§11-47-8) (<http://webserver.rilin.state.ri.us/Statutes/>). Rhode Islanders may obtain a permit in 1 of 2 ways: (1) by applying to the Rhode Island Attorney General's office (§11-47-18) and (2) by applying to the licensing authorities of any city or town (§11-47-11). A wait time and background check apply to most people who purchase a pistol or revolver (§11-47-35). Those persons who have a carry license under §11-47-11 are exempt from the wait time and background check requirement. State law prohibits the possession of firearms on school grounds (§11-47-60) or at the workplace, unless a concealed carry permit from a licensing authority is obtained. Company policies about firearm carriage at a place of business are allowed to be stricter than state law.

In addition, there is very low household gun ownership (15.9%) in Rhode Island.⁹ These factors likely contributed to Rhode Island's ranking as having the second lowest gun death rate in the nation during 2014 (3.22/100 000).^{3,9} Yet, the epidemiology of firearm injury and death in our state mirrors that in national data. Most firearm-related ED visits and hospitalizations in Rhode Island in the last decade were due to assaults among young, minority men.^{2,13,17-20} Most firearm deaths were due to suicides among middle-aged, white men.^{2,11-13,17,18} These findings suggest that firearm injury prevention efforts may be generalizable across state lines, regardless of state-specific policies on firearm carriage.

Our analysis identifies a few areas of focus for future prevention work. First, our state-specific data support national work showing that alcohol is a major, immediately preceding risk factor for firearm death.¹³ Alcohol abuse is very common in Rhode Island; and data from the 2015 Rhode Island

Behavioral Risk Factor Surveillance System identify that 16% of Rhode Islanders were binge drinkers (≥ 5 drinks on 1 occasion for males, ≥ 4 for females) and 6.1% were heavy drinkers (> 2 drinks per day for males, > 1 for females). Nationally, firearm owners are significantly more likely than the general population to report binge drinking (odds ratio: 1.32, 95% confidence interval: 1.16-1.50) and heavy drinking (odds ratio: 1.45, 95% confidence interval: 1.14-1.83), and suicide is more likely to be due to firearms when alcohol is consumed prior to attempt.^{1,30} Alcohol intoxication may facilitate firearm use by fostering impulsive behavior and emotional impairment among suicide decedents.¹¹ To reduce firearm injuries and deaths, it is critically important to both treat alcohol misuse and reduce firearm access to patients in crisis who are using alcohol.^{1,13} Of note, the Rhode Island law §11-47-6 (mental incompetents and drug addicts prohibited from possession of firearms) was recently amended such that a person who has been adjudicated or is under treatment or confinement as a habitual drunkard has been removed from the language. It is difficult to know whether this or other legislation would influence injury patterns.¹ Chen and Wu's³¹ meta-analysis study found that substance use is statistically significant related to firearm violence. Future large-scale and rigorous substance use research is needed to understand the relationship between substance use and firearm violence, and how best to change this relationship.³¹

Second, our data highlight the importance of improved access to mental health care in general and temporary reduction of access to firearms for acutely suicidal patients in particular.^{11,32} In our state, only one-third of suicide decedents were reported to be receiving mental health treatment at the time of death. Other studies show that the decision to attempt suicide is made within a short period and without a plan.³³ Appropriate preventive interventions may need to be delivered not just by mental health professionals but also by internal medicine, pediatric, and emergency medicine physicians who care for these patients.¹¹ Protection of physicians' ability to have thoughtful conversations about firearm injury with at-risk patients is critically important.³⁴ In addition, programs such as the Harvard's Means Matters Program show that gun store owners and gun safety professionals can play an important role in preventing suicide among gun owners and their family members.^{33,35} Active partnerships between suicide prevention groups, gun retailers, firearm safety instructors, firing range owners, and guns rights advocates may help create an opportunity for lifesaving conversations at the time of firearm purchase or firearm safety training. Future studies should examine whether proactive discussions

about firearms between medical or gun safety experts and at-risk community members would reduce the risk of fatal suicide attempts.^{12,32,36}

Third, our data show a high prevalence of recent intimate partner problems and crises among firearm. Our analysis is limited by the large amount of missing data on whether intimate partner homicide victims had prior restraining orders. The presence of a firearm in a domestic violence situation heightens the risk of homicide for the victims, their children, and bystanders; statistics show that the risk of homicide for women is 5 times greater when a firearm is present in a domestic violence situation.^{37,38} The perpetrator may also use the firearm as an implicit or explicit threat against the victims or their children as the perpetrator seeks to maintain power and control over the victim.³⁸ With the passage of the new state law, perpetrators are now restricted from possessing/purchasing firearms when a temporary restraining order is in place and after conviction of misdemeanor domestic violence crimes.³⁹

Fourth, our data show that handguns were involved in most of the firearm-related homicides and suicides. Specifically, handguns were used in more than 60% of the firearm-related homicides and almost three-quarters of the firearm-related suicides. We found that 36% of the suicide victims killed themselves using .22 or .38 caliber guns, which can be small, lightweight, and inexpensive. State-specific awareness of the means of injury and death may improve law enforcement and policy efforts to reduce injury. Finally, although our findings cannot comment on whether the firearms used for homicide and suicide were legally obtained, gun theft is an important source of firearms used by criminals.⁴⁰ Future work could examine ways to reduce the accessibility of illegally obtained firearms and the influence of illegal firearms on homicide and suicide prevalence.

Limitations

This study is subject to some limitations: (1) ED visits, hospitalizations, and deaths that occurred in other states were not captured. (2) Our data do not include patients who sought care from urgent care facilities or in private physicians' offices, so our findings may overrepresent those with more serious firearm-related injuries, public health insurance, or self-pay.⁴¹ (3) Homicide and suicide circumstances are classified separately to adjust for homicide data generally being more difficult to obtain. Abstractors are limited to the information included in the investigative reports they receive, which may be unavailable until after prosecutions are complete.⁴² (4) Based on the

Implications for Policy & Practice

- Surveillance of firearm-related injury and death is essential. Surveillance data can provide the “who, when, where, and how” and eventually can lead to the “why.”
- Dissemination of surveillance findings to key stakeholders is critical in improving firearm injury prevention. Examples of Rhode Island stakeholders include the Rhode Island Department of Health Violence and Injury Prevention Program, Rhode Island State Crime Laboratory, Rhode Island Coalition Against Domestic Violence, Institute for the Study and Practice of Nonviolence, Rhode Island Police Chief Association, police departments, Rhode Island Hospital Injury Prevention Center, Division of Elderly Affairs, Department of Corrections, and Behavioral Health, Developmental Disabilities and Hospitals.
- These groups participate on the Rhode Island Violent Death Reporting System Advisory Committee. Similar advisory groups of stakeholders can and should be developed in other states. Additional relevant stakeholders may include gun shop owners, firearm safety instructors, and other concerned community members.
- These decision makers and program planners can use the data to understand the magnitude, trends, and characteristics of firearm-related violence, discover patterns, identify risk factors, and target high-risk subgroups to reduce firearm injuries and fatalities.
- State health departments, police departments, social services, local agencies and organizations, and the media need to work together to improve access to mental health care in general (including substance abuse) and to identify and intervene with at-risk members of the community.
- States with statewide ED, HD, and violent death reporting system can adopt our analyses to inform their own data-driven prevention programs. States that are not part of the NVDRS could work with their other data sources (ED, HD, Vital Statistics System, National Incident-Based Reporting System) to understand general patterns and trends in firearm injuries and deaths and obtain a better picture of violent injuries and deaths to make the best use of resources.

low numbers, legal intervention cases are combined with assault/homicide cases. The CDC coding manual states that deaths from legal intervention is a subtype of homicide where the victim is killed by or died because of law enforcement acting in the line of duty.²⁴ However, legal intervention circumstances may be very different than regular homicide/assaults. Future studies could combine legal intervention homicides from multiple states. (5) The literature is mixed about the reliability of E-coding of hospital and ED billing records.^{41,43} Billing database coders are not

specifically trained in violence categorization and charts are rarely completed to inform injury prevention.⁴⁴

Conclusions

This study presents a novel statewide methodology to examine the epidemiology of firearm-related ED visits, HDs, and deaths. Understanding patterns (who, where, factors, etc) and the magnitude of the issue may help the state develop geographically specific firearm injury prevention strategies. Despite that this study was conducted in a state with very low overall rates of firearm injury and death, injury patterns and precedents were similar to those reported on a national level. The Rhode Island study can be shared with other states.

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