

When bullets

Catherine W. Barber, MPA

Victoria V. Ozonoff, PhD

Maxine Schuster, PhD

Beth Hume, MPH

Heather McLaughlin, MPH

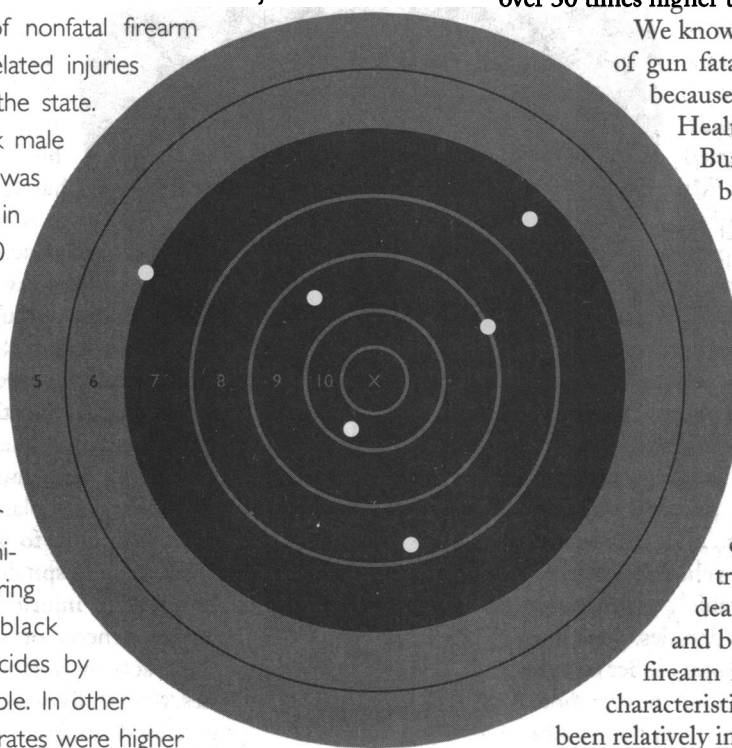
Laurie Jannelli

A New Surveillance System Targets Firearm Injuries

don't kill

SYNOPSIS

THE MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH has created the first statewide surveillance system in the nation that tracks both fatal and nonfatal weapon injuries. The authors summarize findings for 1994 and discuss their public health implications. Suicides were the leading cause of firearm fatality, while self-inflicted injuries accounted for only 3% of nonfatal firearm injuries. Risk of violence-related injuries varied dramatically across the state. In Boston, one in 38 black male teenagers ages 15 to 19 was shot or stabbed in 1994, in contrast to one in 56,000 for white females of any age living in suburban communities. In Boston, non-Hispanic black male teenagers were at 41 times higher risk than white male teenagers for gun injuries. Shooting homicides increased sixfold during the late 1980s among black Boston males, while homicides by other means remained stable. In other Massachusetts cities, injury rates were higher among 20 to 24-year-olds than among teenagers, and, in some areas, incidence rates were as high or higher among Hispanic males than among non-Hispanic black males. Between 1985 and 1994, the proportion of firearm injuries caused by semiautomatic pistols increased from 23% to 52%, according to police ballistics data.



A look at the toll of firearm violence internationally is instructive: in 1992, 38 people died in England from gun homicides,¹ about 100 in Australia,² 214 in Canada,³ and 17,790 in the United States.⁴ The contrast is daunting, even when the much larger population of the United States is taken into account. The U.S. total firearm death rate from suicide, homicide, or accident of 15 per 100,000 residents is over 30 times higher than that of England.

We know something about the scope of gun fatalities in the United States because the National Center for Health Statistics and the Federal Bureau of Investigation have been reporting on them since the 1930s. About 40,000 deaths yearly in this country are caused by firearms.⁵ Most are suicides or homicides, with suicides slightly in the lead; accidents run a far distant third at about 4% of the total. But as the front-line workers—police officers, emergency nurses, and trauma surgeons—well know, deaths are only the most visible and best reported consequence of firearm injuries. The incidence and characteristics of nonfatal injuries have been relatively invisible to the general public

and poorly described or understood even within the medical and criminal justice systems. This has been due to the lack of a reporting system for nonfatal injuries.^{6,7}

The Massachusetts Department of Public Health is one of a handful of state health departments that have been trying to develop such a system. Massachusetts's Weapon-Related Injury Surveillance System (WRISS) was created

with support from the Centers for Disease Control and Prevention (CDC) to track the epidemiology of nonfatal and fatal weapon injuries and to learn whether such a tracking system is both feasible and useful. This article describes the development of the nation's first statewide, emergency department-based surveillance for shootings and stabbings and reports key findings of this system and other new firearm data sources developed by WRISS. We begin with a brief overview of how weapon injuries have come to be addressed as a public health issue.

Weapon Injuries in the Public Health Context

Discussing weapon injuries as a health issue might raise eyebrows among public health professionals more accustomed to a traditional disease model. Why is public health addressing an issue previously considered the domain of police, courts, and criminologists? Throughout the 20th century, as infectious disease has declined in the United States, injury has taken its place as the leading cause of death for young people ages 1 to 44, leading to a reconfiguration of public health priorities.⁸ Injury prevention and chronic disease prevention have joined infectious disease control as key components of the public health commitment to preventing premature mortality and excess morbidity. Starting in 1980, the CDC began developing injury surveillance and control programs, activities that are now coordinated by the agency's National Center for Injury Prevention and Control (NCIPC). NCIPC addresses the full range of injuries, including drownings, bike collisions, suicides, domestic abuse, playground injuries, and the leading cause of injury death, motor vehicle crashes.

As the rate of motor vehicle fatalities has declined over the past three decades, guns have emerged as the number one injury killer in more and more states.⁹ The decline in the motor vehicle death rate has resulted from the application of the three *Es* of public health injury control: engineering (air bags, seat belts, safer highways), enforcement (speed limit reductions, child restraint mandates, drunk driving enforcement), and education (designated driver campaigns, seat belt use). Similar prevention tools are increasingly being applied to gun-related injuries. An important tool in this

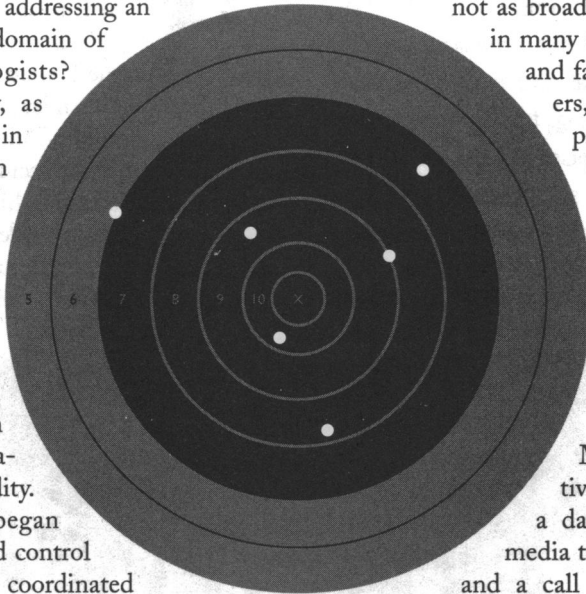
effort are surveillance systems that generate hard data on the dimension and characteristics of the problem. NCIPC currently funds seven such firearm surveillance projects. Massachusetts's was the earliest, with a pilot beginning in 1990.

A New Surveillance System

Massachusetts might seem an improbable birthplace for gunshot wound surveillance. It is anything but the gun capital of the nation. The state ranks next to lowest in firearm death rates (Hawaii is lowest).⁹ In 1991, Georgia, with a population only slightly larger than Massachusetts's six million, ranked seventh on the list, with 1377 lives lost to bullets, in contrast to 307 in Massachusetts. Tied for first were Louisiana and Nevada. Southern states made up most of the remaining top nine slots. The gun culture is not as broadly in evidence in Massachusetts as in many states. Signs for gun shops are few and far between; buttons, bumper stickers, even clothing accessories sporting pro-gun sentiments are rarely seen. Only 15% of Massachusetts residents report having a gun of any type at home, and half of those report having a handgun.¹⁰ National surveys, on the other hand, find about 41% of households reporting a gun, and 24% a handgun.¹¹

Although gun fatalities in Massachusetts may seem comparatively low, still, at close to one death a day, enough gunfire fills the news media to instill deep concerns in residents and a call for prevention. Throughout the 1980s and 1990s the Department of Public Health initiated a series of prevention activities addressing both family abuse and youth violence. Program planners were often frustrated by lack of data to guide their efforts. Indeed, neither the hospitals nor the police really knew how many injuries they saw, much less by whom, where, or under what circumstances these acts of violence were committed. Fatalities, thankfully, were too few in number to support epidemiologic analysis at the local level or to allow measurement of the impact of violence prevention programs with any precision. Police data on assaults, centralized by the FBI's Uniform Crime Reporting (UCR) system, were reported only in aggregate, could not be broken down by demographic characteristics of the victim or offender, and did not differentiate threats from injuries.¹² While the FBI

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Estimated firearm injuries by intent and demographic group, Massachusetts 1994

	Population	Total injuries			Violent injuries			Self-inflicted injuries			Unintentional injuries		
		Incidence	Rate per 100,000	(95% CI)	Incidence	Rate per 100,000	(95% CI)	Incidence	Rate per 100,000	(95% CI)	Incidence	Rate per 100,000	(95% CI)
Sex													
Female	3,127,680	94	3.0	(2.4,3.6)	66	2.1	(1.6,2.6)	16	0.5	(0.3,0.8)	8	0.3	(0.1,0.4)
Male	2,888,745	1118	38.7	(36.4,41.0)	788	27.3	(25.4,29.2)	156	5.4	(4.6,6.2)	84	2.9	(2.3,3.5)
Age (in years)													
0-14	1,144,984	25	2.2	(1.3,3.0)	18	1.5	(0.8,2.3)	2	0.2	(0.0,0.4)	5	0.4	(0.1,0.8)
15-24	933,224	644	69.0	(63.6,74.3)	525	56.2	(51.4,61.0)	30	3.2	(2.1,4.4)	28	3.0	(1.9,4.1)
25-44	2,013,198	404	20.1	(18.1,22.0)	273	13.6	(12.0,15.2)	66	3.3	(2.5,4.1)	42	2.1	(1.5,2.7)
45+	1,925,019	134	7.0	(5.8,8.2)	37	1.9	(1.3,2.6)	74	3.8	(3.0,4.7)	18	1.0	(0.5,1.4)
Ethnicity													
Black	279,156	508	182.1	(166.3,197.9)	445	159.3	(144.5,174.1)	12	4.3	(1.9,6.7)	14	5.1	(2.5,7.8)
Hispanic	287,561	232	80.7	(70.3,91.1)	211	73.5	(63.6,83.4)	5	1.7	(0.2,3.3)	2	0.8	(0.0,1.9)
White	5,297,982	388	7.3	(6.6,8.1)	154	2.9	(2.5,3.4)	149	2.8	(2.4,3.3)	70	1.3	(1.0,1.6)
Community													
Large	2,231,900	877	39.3	(36.7,41.9)	713	31.9	(29.6,34.3)	49	2.2	(1.6,2.8)	47	2.1	(1.5,2.7)
Small	3,784,525	294	7.8	(6.9,8.6)	107	2.8	(2.3,3.4)	122	3.2	(2.6,3.8)	47	1.3	(0.9,1.6)
TOTAL	6,016,425	1239	20.6	(19.4,21.7)	873	14.5	(13.5,15.5)	172	2.9	(2.4,3.3)	95	1.6	(1.3,1.9)

NOTES: Numbers, rates, and confidence intervals (CI) are adjusted for underreporting of nonfatal injuries by dividing reported nonfatal injuries by .75; totals include cases with unknown intent, sex, age, race, and community; populations are based on the 1990 US Census Modified Age Race Sex File; ethnic groups include white non-Hispanics, black non-Hispanics, and Hispanics; size of victim's community of residence was based on populations under 50,000 and 50,000 and larger; CIs were based on multiplying by 1.96 the standard error of the incidence rate for deaths and estimated nonfatal injuries.

has introduced a major improvement to the UCR system, the National Incident-Based Reporting System,¹³ which supplies rich detail on each serious crime event, most Massachusetts police departments, particularly those serving urban areas, have not adopted it.

The Department of Justice, however, regularly surveys victims of crime; these surveys have indicated that 90% of victims of aggravated assault who receive medical care are treated in a hospital setting rather than in a health clinic or private doctor's office.¹⁴ Therefore, WRISS investigators determined that the logical place to build a data infrastructure for weapon injuries was the hospital emergency department.

The common wisdom in 1990 was that emergency departments are a great setting for emergency care but an unreliable source of paperwork. A few factors, however, assisted WRISS, key among them the fact that shootings are compelling and hospital personnel seem to agree that they *should* be reported. Massachusetts law for decades has required physicians to report stabbings and shootings to police.¹⁵ While compliance under the old system was very poor, it was, at least, a starting point. Even when not in compliance, hospital personnel were aware of their obliga-

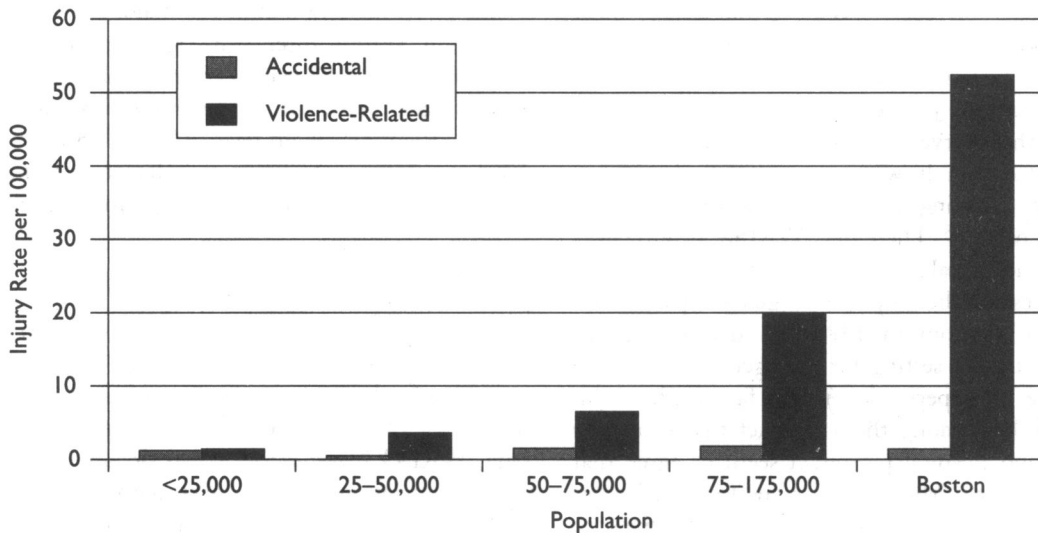
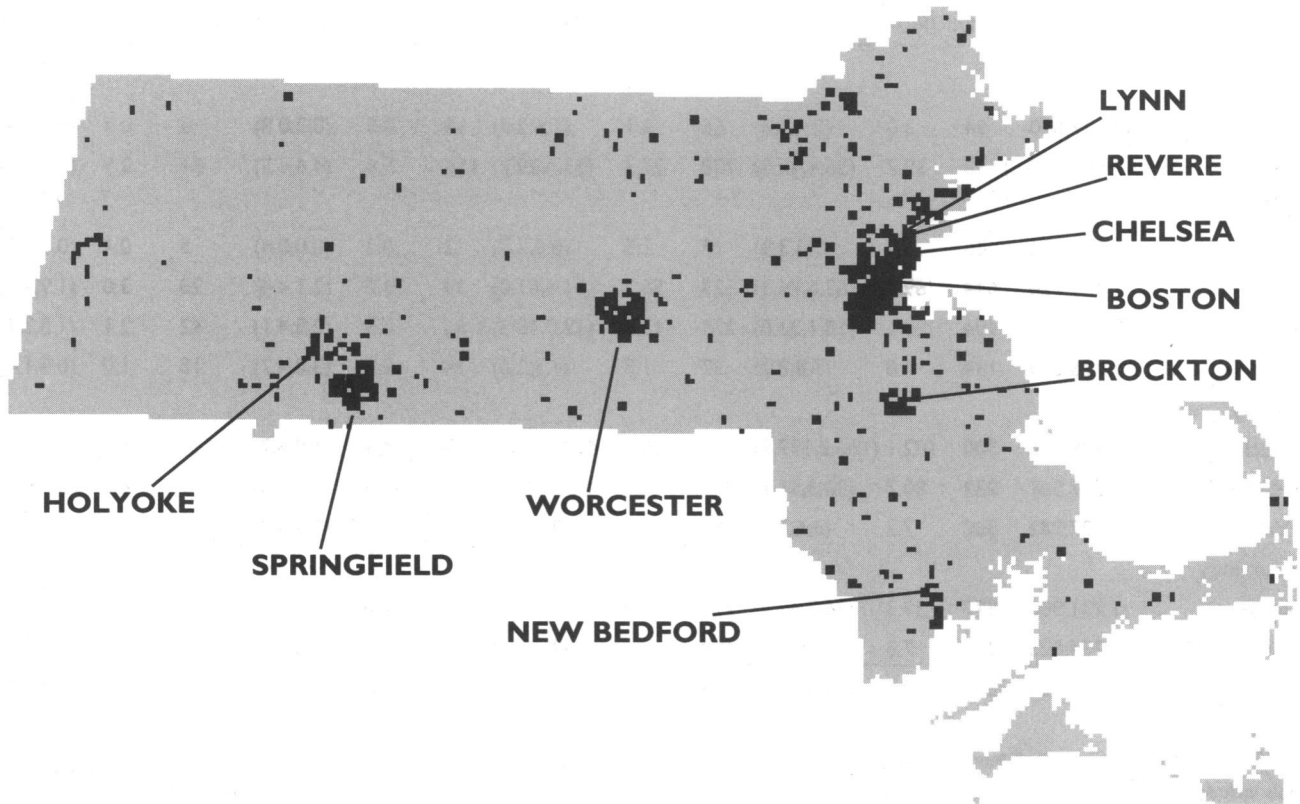
tion to report to state and local police.

In 1990, pilot reporting began in two emergency departments in Springfield and in the major city-owned hospital in Boston. Within three years, reporting was underway in each of the state's 85 acute care hospital emergency departments. (See "How the Reporting System Works" for details.) Rigorous record reviews by WRISS investigators in 1994 revealed a systemwide compliance rate of about 75%: not perfect, but far better than originally expected.

Surveillance Findings

With data available both from death certificates and WRISS's emergency department-based reports, Massachusetts became the first state in the nation capable of describing the toll of weapon injuries on its population. Using 1994 data, WRISS investigators could document levels of risk across population groups. Investigators first linked death certificates and emergency department reports to identify prehospital deaths not captured by emergency department reporting and to identify those patients who left the emergency department alive but later died as hospital inpatients.

Figure 1. Geographic distribution of firearm injuries by victim's community of residence, Massachusetts, 1994, not adjusted for underreporting



Firearm assaults clustered in urban areas. The firearm assault rate was 38 times higher in Boston than in communities with populations of less than 25,000. Gun accidents did not show similar clustering by size of victim's community.

The latter cases were excluded from the emergency department dataset to avoid double counting.

In 1994, a total of 1002 firearm injuries and fatalities were reported to WRISS. (Nonpowder gun injuries—from “BB guns”—are not included in this total. See “Toy Guns: Real Weapons, Real Injuries.”) After adjusting the number of nonfatal injuries to account for underreporting by hospitals, WRISS staff estimated that 1239 Massachusetts residents were injured or killed by firearms in 1994. (Age-adjusted estimates were calculated by dividing the reported number of cases by the average statewide compliance rate of 0.75). This translates into an incidence rate of 20.6 per 100,000 residents, less than half the national rate of 53.4, as estimated by the CDC in 1992. (The CDC estimate was based on record reviews of a national sample of emergency departments and on death certificate surveillance.) The lower rate in Massachusetts was not surprising given the state’s traditionally low incidence of suicides and homicides.

Case Fatality Rates: Who Dies? Who Survives?

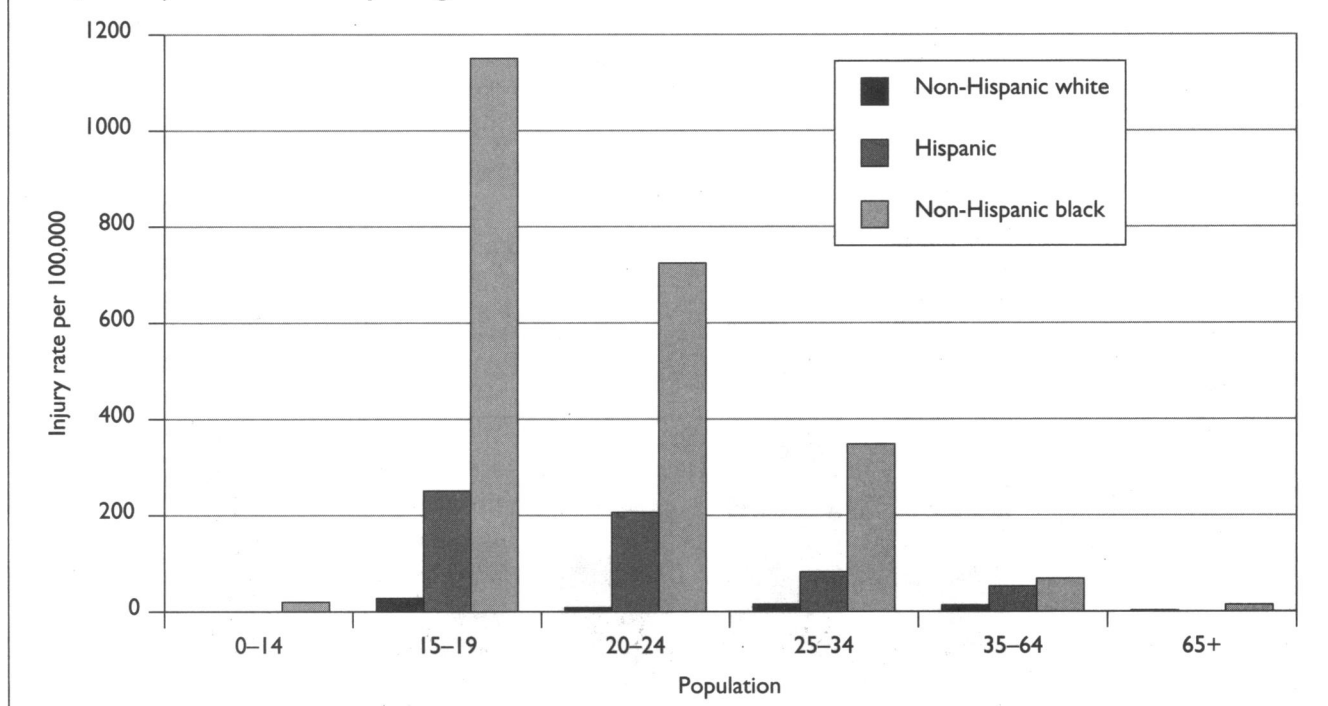
The new data also enabled researchers to determine case fatality rates, the proportion of cases resulting in death among all cases. Previously, without data on nonfatal injuries, it was unknown whether for every firearm death there were another two, five, ten, or more nonfatal injuries.

The most important determinant of the case fatality rate was found to be the type of incident precipitating the wound: self-inflicted injuries were by far the most lethal, violence-related injuries were markedly less so, and accidental injuries rarely ended in death.

Self-inflicted injuries. People who shot themselves intentionally almost invariably inflicted serious harm. Four out of five died, for a case fatality rate of 84%. All of those who did not die required hospital admission. Over 90% of those who shot themselves intentionally were males, and approximately 87% were white (see Table). The rates for completed suicides were higher among white residents than among black residents. Surprisingly, however, among nonfatal incidents, the reverse was true even though national trends have shown an increase in suicides in the young black population, perhaps reflecting increased access to guns.¹⁶

While those who shot themselves and survived were low in number (an estimated 28 after adjusting for underreporting), they were demographically quite distinct from those who died. A higher percentage of those who survived were urban-dwelling and young, half were black or Hispanic (in contrast to 3% black or Hispanic among completed suicides), and a greater number wounded themselves in non-vital areas. Medical providers’ narratives on the reporting forms suggest that some of these self-inflicted shootings

Figure 2. Male victims of violence-related gunshot wounds by ethnicity and age group of victim, Boston 1992 to 1993, not adjusted for underreporting



Among Boston’s male teenagers, black youths were at 41 times higher risk for gunshot wounds than white youths. This rate ratio went down progressively as the age of the victim increased. In other high risk cities, the demographic make-up of victims was markedly different. Teenagers and young adults were at about equal risk, as were young black and Hispanic men.

were not suicide attempts or gestures but acts of self-mutilation (for example, an intentional wound to the foot or genitalia as an expression of self-directed anger or resulting from delusional thinking).

Accidental injuries. Of all shootings, gun accidents were associated with the lowest risk for serious harm. Nearly all of the victims survived (four out of an estimated 91 died). What was most notable about the unintentional shootings was their even distribution across the state. Although gun violence clustered dramatically in urban areas (the firearm assault rate in Boston was 38 times higher than the rate in smaller communities of under 25,000 residents), gun accidents showed no such clustering by the size of the victim's community (Figure 1). Reported gun ownership rates were higher in non-urban areas, which would lead to an expectation of a higher accident rate in these areas. However, illegal and thus unreported gun ownership is likely to be higher in urban areas and a high proportion of illegal guns are thought to be in the hands of risk-taking teenagers, who may have young siblings at home, which might suggest that accident rates would be higher in urban areas. WRISS researchers are currently sending follow-up surveys to victims of gun accidents to learn more about the specific circumstances precipitating their injuries. Since so few gun accidents result in death, the geographic distribution and risk factors for unintentional injuries could not have been

explored without a surveillance system for nonfatal wounds.

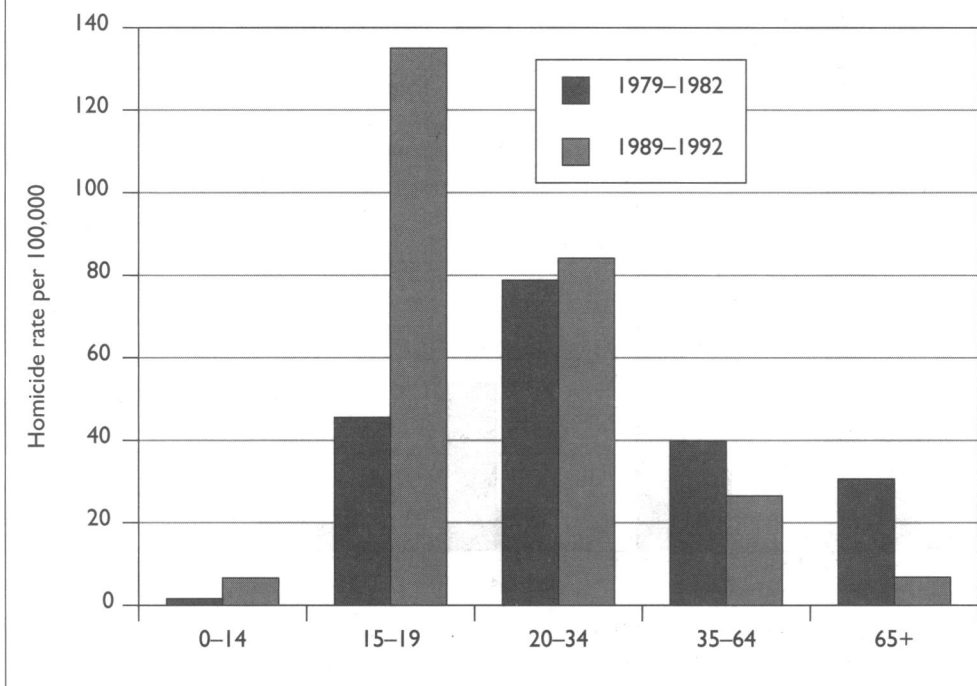
Violence-related injuries. Because WRISS was built on a preexisting state law that required reporting of both shootings and "criminally suspicious sharp instrument wounds,"¹⁵ its surveillance of violence-related incidents covers both types of weapons. This brings greater depth to the portrait of violent attacks in the state and places guns in a more meaningful context. Stabbings and slashings were by far the most common form of weapon assault, three times more numerous than shootings. An estimated 2521 stabbings and an estimated 873 shootings (both adjusted for underreporting) resulted from interpersonal violence. Shootings were over 12 times more likely to result in death than sharp instrument assaults. The case fatality rate for guns was 16.2%, and for knives 1.3%. For each gun homicide, five gunshot victims survived, while for each stabbing death, 78 stabbing victims survived.

Violence-Related Weapon Injuries: Who's Really at Risk?

Much of the focus of the WRISS project has been on examining who is at risk for weapon attacks. Media coverage of particularly grisly attacks seems to heighten fear levels in all communities, even those that haven't seen a serious assault in years. Yet an overall incidence rate of 14.5 gun

assaults and 42 knife assaults for every 100,000 residents in Massachusetts masks how dramatically risk levels vary depending on one's neighborhood, demographic characteristics, and, presumably, individual risk factors. For example, an astonishing one in every 38 black male teenagers ages 15 to 19 was shot or stabbed in Boston in 1994, a figure only slightly lower than the one in 34 risk for 1992-1993. The corresponding risk for white male teenagers was one in 422. Compare these rates, however, to a weapon assault risk of one in 23,294 for elders of any ethnicity living in urban areas and one in 56,083 for white females of any age living in the suburbs. The importance of focusing discussions of risk on particular populations becomes readily

Figure 3. Black male homicide rates by age group of victim, Massachusetts, 1979-1982 vs. 1989-1992

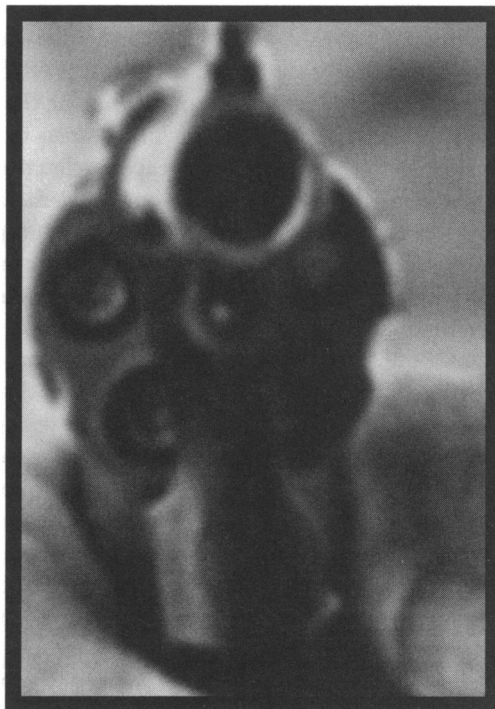


In Massachusetts, the homicide rate among black male youths skyrocketed during the years 1989 to 1992. Among older black men, the rates declined.

apparent. Some of the state's residents are living in a virtual war zone, while others are quite removed from danger. To examine these risks further, WRISS investigators created a relational database in which data about any subset of the injured population can be analyzed by features of the geographic community in which the victims reside. The community database uses information from sources as diverse as police departments, the U.S. Census, and the Massachusetts Department of Education.

Teenagers and Guns

Recent media focus on the problem of gun use by teenagers is not misplaced. One of the early epidemiologic investigations of the



WRISS project was a study of violence-related weapon injuries to Boston residents from 1992 to 1993. Teenagers ages 15 to 19 were the age group at highest risk for gunshot wounds, facing considerably higher risk than even 20 to 24-year-olds. This was surprising to WRISS investigators, given an earlier study of Massachusetts homicides which found that teenagers were *not* among the high risk groups for homicide in the early 1980s.¹⁷ Even more surprising was the distribution of 1992–1993 injury rates by ethnicity within each age group. Within the teenaged group, non-Hispanic black males were at 41 times higher risk of being shot than white males and at four to five times higher risk than Hispanic males (Figure 2). The differences by ethnicity became less

How the Reporting System Works

Three emergency departments began reporting weapon injuries to the Massachusetts Department of Public Health in 1990, and more sites were added each year, until by November 1993, all 85 acute care hospital emergency departments in the state were reporting. The system was built on a state law dating back to 1927 requiring physicians to report shootings and stabbings to law enforcement. Similar laws exist (typically for gunshot wounds and less often for stabbings) in most states in the nation.²⁴ In most states, however, reporting consists simply of telephoning police. In Massachusetts, hospital personnel both called the police department and filled out a short report form that they mailed to the state public safety office. The purpose of the central collection point was to assist local police in capturing suspected criminals who were wounded and sought treatment. While compliance with the old reporting system was very poor, hospital personnel were widely aware that they were *supposed* to report. Therefore, WRISS investigators determined that it was far easier to rejuvenate an existing system than to introduce a new reporting burden.

The WRISS case definition included patients treated for violence-related sharp instrument wounds or for wounds resulting from the intentional or unintentional discharge of a gun, including both firearms (handguns, rifles, and shotguns) and nonpowder guns (for example, BB, pellet, and air guns). Violence-related stabbings and shootings were defined as those resulting from assaults,

physical fights, acts of self-defense against an aggressor, shootings by police, and attacks intended for another victim (for example, drive-by shootings that strike an unintended bystander). Reporting at most of the 85 sites is initiated by the emergency department clerk and completed by a nurse or, at a few sites, a physician. The report form is designed to include both police and WRISS reporting on one page. Forms are mailed to WRISS, where they are entered into a computerized database.

In spite of rather low expectations by WRISS staff for the success of an emergency department-based system, hospitals report an average of 75% of the cases they should report, according to record reviews. WRISS investigators conduct annual record reviews at the 15 highest caseload hospitals and at a one-third sample of the remaining sites. While compliance varied from one site to the next, overall reporting was quite stable and did not vary from 1994 to 1995. Newsletters, reminder phone calls, record reviews, and annual hospital-specific data summaries help keep reporting rates relatively high. While a quarter of the cases go unreported, those that are and are not reported (identified through record reviews) are statistically compared to document any reporting bias in the system. The investigators discerned no significant reporting bias by patient demographics. Bias did exist, however, by the patient's diagnosis. Cases receiving general diagnoses such as "laceration" or "foreign body" were less reliably reported than those explicitly diagnosed as "stab wound" or "gunshot wound."

pronounced with increasing age of the victim. By the middle-aged years (ages 35 to 64), black males were at five times higher risk than white males and at about equal risk to Hispanic males. The injury rate among black teenaged males was so high, and so far out of proportion to the other groups, that one violence researcher approached a WRISS staff member following a presentation of these data saying, "I'm sorry to let you know that your calculations are off by a factor of ten." The calculations were not off; most research compares rates by ethnic group, not by specific age-sex-ethnic groups for which the most marked differences are revealed.

The WRISS team was anxious to learn more about the troubling incidence rates for teenagers. How recent is this trend? How long have black teenagers in particular been at such elevated risk? Are the dramatic differences by ethnicity limited to certain cities? For decades, national studies have found black residents at about six times higher risk of violent crime than white residents.¹⁸ Violence is highly correlated with urban poverty, and some studies have found that after controlling for differences in socioeconomic status, the risk ratio between blacks and whites flattens out.^{19,20} However, a risk ratio of 41 to one seems to signal that other factors are also at work.

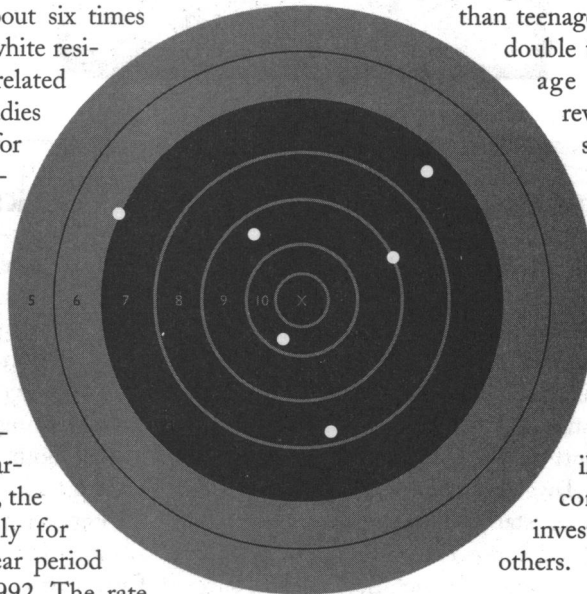
Because the WRISS emergency department surveillance data are very recent, the only historic evidence available for comparison are mortality data. Statewide, the homicide rate rose dramatically for black teenagers from the four-year period 1979–1982 to the years 1989–1992. The rate tripled from an already high level of 42.5 to an unprecedented 135 per 100,000 (Figure 3). Homicides among older black males during the same period actually declined. Among white teenagers, the homicide rate increased only slightly, from 4.8 to 5.7. (Hispanics could not be disaggregated in the earlier mortality data.) Clearly, something was happening to many black teenagers during the late 1980s.

According to mortality data, the entire increase in black teenagers' homicide rate was attributable to gun homicides. In Boston, the gun homicide rate of black teenagers increased fivefold from the years 1979–1983 to the years 1989–1993, while stabbing homicides showed no significant increase. Across the nation, similar trends during the late 1980s among black youths were noted by the National Center for Health Statistics.^{21,22}

By 1994, statewide reporting was in place in Massachusetts, and WRISS investigators were interested in learning whether the trends for black youths were similar across urban areas or limited to certain cities. Three cities had weapon-related injury rates about as high as Boston's: Brockton, Chelsea, and Springfield. The population of each was too low to provide the statistical power for city-specific analysis. However when data from the three were combined, an interesting epidemiologic picture emerged. Whereas in Boston incidence spiked among black teenagers, in these three smaller cities, teenagers (15–19) and young adults (20–24) were at about equal risk, as were Hispanic and black males in most age groups.

Five cities (Holyoke, Lynn, New Bedford, Revere, and Worcester) made up a third-tier risk group, showing yet another pattern. There, young adults were at considerably higher risk than teenagers, and black males were at about double the risk of Hispanic males in both age groups. What these findings revealed was that risk groups were specific to the local community; not all cities have been hit with the problem of extremely high rates among teenagers, and the ethnicity of the group at highest risk varies from one city to the next, probably reflecting specific local conditions (for example, economic opportunities and the characteristics of local markets in illegal drugs and guns). These local conditions are a topic for future investigation by WRISS researchers and others.

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while others are quite removed from danger.

Who's Got the Gun?

Most of the WRISS project's inquiries have focused on victims and the communities in which they live. But shouldn't an epidemiologic investigation also ask who was holding the gun and what kind of gun they were holding? Surely these are keys to understanding and preventing firearm injuries.

Supplementary Homicide Reports (reports filed with the FBI by local police departments) indicate that within the group at highest risk for murder—that is, young men—offenders are basically the demographic mirror of their victims.²³ Blacks generally attack blacks, whites attack whites, young people attack young people, and so on. This is less true among lower risk groups such as women, who are most often attacked by men; elders, who are attacked by people

younger than themselves; and children, who are attacked by people older than themselves. WRISS data include information on the relationship between the victim and the offender. For 63% of the 1994 gun cases, however, that information was unknown or unreported. Even among homicides investigated by police, no information about the relationship of the victim to the offender was known in 59% of cases involving firearms, according to 1994 Supplementary Homicide Reports. Among cases for which the relationship was reported, 72% of offenders were acquainted with their victims and 28% were strangers. Whether these ratios are likely to apply to cases in which police have not identified a suspect is unknown.



Semiautomatic Pistols: The New Weapon of Choice

We know something more about the guns used to injure people than about the people using the guns. Although medical providers typically cannot provide technical information on the guns that have injured their patients, police crime labs investigate gun incidents and provide authoritative reports. Two labs—those of the Massachusetts State Police Department and the Boston Police Department—handle all ballistics investigations for the state. Interestingly, data from these labs have been used only for case investigations and have never been assembled into a dataset capable of supporting statistical analysis. WRISS researchers abstracted cases

Toy Guns: Real Injuries, Real Weapons

In 1994, almost three-quarters of Massachusetts's youngest gunshot victims were injured not by the revolvers, pistols, or rifles that make up the arsenal most often associated with shootings but rather by a nonpowder gun such as a "BB gun" or "pellet gun."

These guns are technically referred to as nonpowder guns because they employ compressed air or gas or a mechanical spring action, rather than gunpowder, to propel ammunition. In general, the ammunition of a nonpowder gun has a lower mass and is propelled at a lower velocity than that of a conventional firearm. However, newer, more technologically sophisticated nonpowder guns are capable of shooting projectiles at velocities comparable to many pistols and, at close range, can inflict serious injury or death.²⁵

In 1994, 158 people were injured seriously enough by nonpowder guns in Massachusetts to seek treatment at hospital emergency departments: 50 victims were children under 15 years of age, and 53 were between 15 and 19 years old. The single 1994 pellet gun fatality in Massachusetts, a young man's suicide, tragically demonstrated the lethal potential of nonpowder guns. Most nonpowder injuries were the result of accidents, although almost 20% of injuries were violence-related. Nonpowder gun injuries occurred more frequently in small cities or rural areas than in urban areas. Victims were typically male (87%), but unlike victims of firearm injuries, almost 70% were white. A quarter of nonpowder gun injuries involved wounds to the head, eyes, or face, sometimes resulting in significant eye

injuries. Most (60%) nonpowder injuries occurred in, or around, the home, perhaps reflecting both the young age of the victims and parents' consent to use these guns.

We rarely think of nonpowder guns in the context of the current gunshot injury epidemic. But, as the data demonstrate, they are *real* weapons, and they cause *real* injuries, particularly to children.

Prevention Strategies

Massachusetts's injuries are a small fraction of the national toll of nonpowder gun injuries, estimated to range from 28,000 to 38,000 per year.²⁵ These findings should be a call to action.

Educating parents, the media, police, and medical providers about the injury potential of nonpowder guns is essential. Existing regulations on the sale and use of these guns should be enforced. Manufacturers should investigate ways to engineer safer guns. For example, design modifications that would permit easy verification of whether a gun is loaded should be explored. Early returns from an unpublished WRISS survey of gun accident victims indicate that many BB injuries occurred when adolescents handled guns they believed were unloaded.

Despite the fact that nonpowder guns represent a public health hazard, the injury toll rarely receives any media attention and the public perception that these guns are neither real weapons nor particularly dangerous remains unchallenged. A public health prevention model should be used to reduce or eliminate these injuries.

investigated by the two labs from every third year over a ten-year period (1985, 1988, 1991, and 1994). Only cases most likely to involve injuries were abstracted (homicides, suicides, assaults, and accidents). The result was one of the nation's only population-based datasets on the types of guns involved in injuries and deaths.

A total of 2302 cases were abstracted, divided about evenly between the two crime labs. Roughly two-thirds of the incidents involved handguns. Most revealing was how the specific type of gun changed over time. In 1985, revolvers were the leading gun implicated in the injury cases that were investigated by police (34%), followed closely by rifles and shotguns (27%). Semiautomatic pistols were third on the list at 23%. By 1994 the picture had changed dramatically. Semiautomatic pistols accounted for 52% of all injuries investigated. Revolvers declined to 21% of the total, and rifles and shotguns slipped to 12%. The caliber of the handguns changed as well. (Caliber refers to the diameter of the gun barrel. For example, a .22 caliber is 22 hundredths of an inch, a 9 millimeter is just over a third of an inch, and a .45 is almost half an inch in diameter.) The proportion of handguns in the larger-caliber category (.38 or above) grew from 65% in 1985 to 75% in 1994.

Why are these findings of interest from a public health perspective? Certainly a .22 revolver can be as deadly as a 9-mm semiautomatic. A larger bullet does not necessarily mean a more lethal wound since the distance and skill of the shooter and the configuration of the bullet, cartridge, and propellant are all important factors. But all things being equal, the larger bullet has greater odds of inflicting more damage. In addition, a revolver fires five or six bullets before needing to be reloaded, usually bullet by bullet. A semiautomatic carries seven or eight or sometimes as many as 20 to 30 rounds of ammunition in the magazine or "clip." Reloading is a simple matter of pulling out the old magazine and slamming in a new one. In a situation in which more than one shot is fired, the shooter with more ammunition that is available more rapidly has greater probability of inflicting injury.

Conclusion

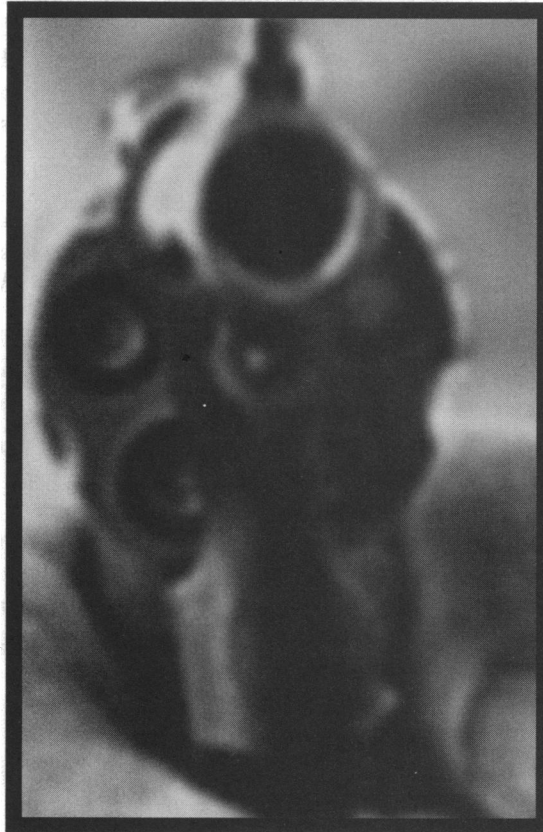
WRISS investigators have made important headway in developing datasets that deliver a comprehensive overview

of the health burden of firearm injuries for the state of Massachusetts. The project has demonstrated the feasibility and utility of emergency department-based reporting. In addition, as a surveillance *system* WRISS has taken advantage of multiple data sources. The emergency department database was useful in isolating black teenaged males as the group at highest risk for gunshot wounds. Historic homicide data revealed that the emergence of black teenagers as the highest risk group was a very recent phenomenon. The community dataset revealed that high teen incidence rates have not hit all cities and that within this age group, the particular ethnic group most affected varies by community. The linked fatal and nonfatal dataset demonstrated the much greater lethality of guns than of knives and also provided a fuller picture of gun accidents and self-inflicted injuries. Finally, the ballistics dataset documented that during the period characterized by dramatic growth in the teen homicide rate, a concurrent shift in weapon type occurred as the revolver lost ground to the semiautomatic pistol.

WRISS data have been useful to community groups throughout Massachusetts as they have developed new prevention strategies to prevent firearm injuries. The project fills three to four data requests weekly on average. Prevention strategies represent a variety of political viewpoints and range across the three *Es* of injury control: engineering, enforcement, and education. For example, a gun enthusiast contacted WRISS for

data to assist in marketing a childproof gun storage system he had designed. The state Attorney General's office used WRISS data in preparing legislation to block the sale of so-called "Saturday night specials" in the state. The Boston Police Department used neighborhood-level data to target new policing strategies to specific areas with heavy teen gun use. Various community- and school-based coalitions have also sprung up across the state to teach young people to set aside weapons and negotiate conflicts peacefully. WRISS data have been used in formulating these and many other prevention strategies and, over time, can assist in measuring a program's effectiveness in reducing injuries.

The WRISS project's findings that an estimated one out of every 38 black male teenagers was shot or stabbed in one year's time in Boston underscores the extent of weapon-related injuries and the imperative to respond. It is incumbent on practitioners in the fields of public health and crim-



inal justice as well as the broader society to help keep our young people safe.

All authors are with the Weapon-Related Injury Surveillance System, Massachusetts Department of Public Health (MDPH). Catherine Barber is the Co-Principal Investigator and Project Director, Victoria Ozonoff is the Principal Investigator and also the Co-Director of the MDPH Injury Prevention and Control Program, Maxine Schuster is the Research Coordinator, Beth Hume and Heather McLaughlin are Research Associates, and Laurie Jannelli is the Site Coordinator.

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Address correspondence to Ms. Barber, WRISS, MDPH, 250 Washington Street, 6th Floor, Boston MA 02108; tel. 617-624-5600; fax 617-624-5691. e-mail <cwbarber@aol.com>.

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