

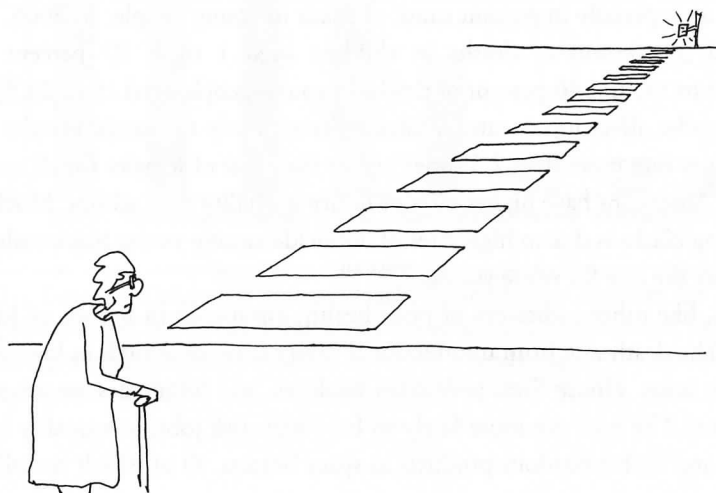
INTRODUCTION TO Public Health

Third Edition



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Injuries Are Not Accidents



An "Accident" Waiting to Happen

Injuries are the fifth leading cause of death in the United States¹(Table 31) (see Table 13-2). They are even more important than statistics suggest because injuries disproportionately affect young people and thus cause many years of potential life lost (YPLL). Injuries are the number one cause of death among people ages 1 to 44.¹(Table 31) In addition to the people killed by injuries, there are almost as many survivors left with permanent disabilities, a major economic and emotional drain on families and on society in general.

Traditionally, injuries have been thought of as "accidents," unavoidable random occurrences, or the results of antisocial or incautious behavior. It is only recently that public health practitioners have recognized that injuries can and should be treated as a public health problem, analyzable by epidemiologic methods and amenable to preventive interventions. While most injuries are caused to some extent by individual behavior, they are also influenced by the physical and social environment. Public health programs to prevent injury must find ways to change people's behavior by the classic methods of education and regulation, but for many types of injuries, prevention by changing the environment may be more effective.

Epidemiology of Injuries

Prevention of injury, like the prevention of most diseases, is based on epidemiology. Data are needed to answer the questions of who, where, when, and how, looking for patterns and connections that suggest where the greatest needs for prevention are as well as ways to intervene to prevent the injury. Fatal injuries are generally categorized as unintentional (sometimes referred to as "accidental") or intentional (homicide or suicide).

Injuries are an especially important cause of death in young people. In 2005, unintentional injuries caused 35 percent of deaths in children aged 1 to 4, 37 percent of deaths in children aged 5 to 14, and 46 percent of deaths in young people aged 15 to 24.¹(Table 31)

Race and gender affect injury rates. Males are more likely to sustain injuries than females, with a fatal injury rate more than 2.5 times higher than that of females for all age groups combined. African Americans have higher rates of injury mortality than whites. Much of the excess mortality among blacks is due to high rates of homicide among young black males, which is almost eight times the rate for white youths.¹(Table 44)

Injury rates, like other indicators of poor health, are higher in groups of lower socioeconomic status. The death rate from unintentional injury is twice as high in low-income areas as in high-income areas. House fires, pedestrian fatalities, and homicides are all more common among the poor.² The poor are more likely to have high-risk jobs, low-quality housing, older, defective cars, and such hazardous products as space heaters, all of which contribute to higher injury risks.

Figure 17-1 shows the leading categories of injury deaths in the United States. Motor vehicle injuries lead the list, followed by poisonings, with firearms fatalities third. As a result of the high priority the federal government has placed on prevention of motor vehicle-related injuries, as described in a following section, highway fatalities have declined over most of the past four decades. Firearm fatalities increased between 1968 and 1994, and the Centers for Disease Control and Prevention (CDC) predicted that if trends continued, the number of firearm-related deaths would surpass those related to motor vehicles by the year 2003.³ The trend in firearm injuries reversed in the early 1990s, however, while traffic fatalities remained steady, and it appears that motor vehicle deaths will continue to dominate the injury statistics, as shown in Figure 17-2.⁴ Death rates from poisoning increased by 80 percent between 1999 and 2005, mostly due to prescription drugs.^{5,6} Other major causes of injury deaths that have drawn significant public health attention are falls and jumps, suffocation, drowning, and fires and burns.

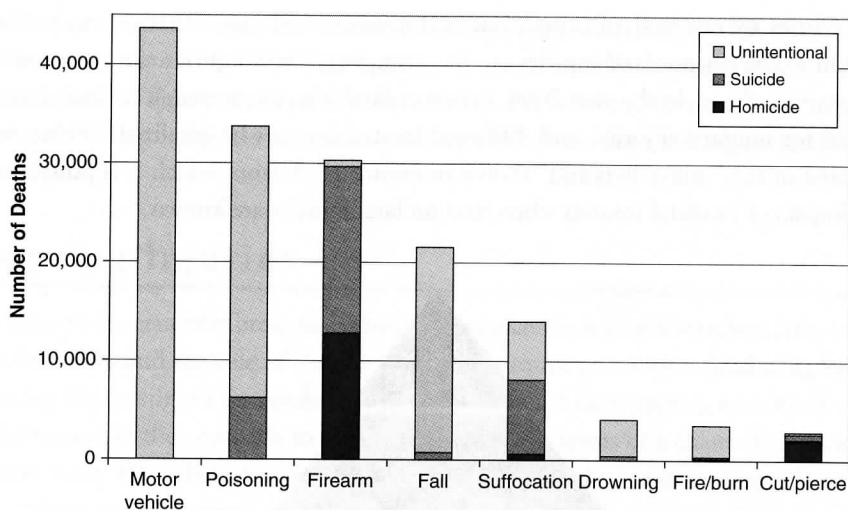


FIGURE 17-1 Leading Causes of Injury Death, 2006. *Source:* Centers for Disease Control and Prevention, "National Vital Statistics Report: Deaths: Final Data for 2005." www.cdc.gov/nchs/data.nvsrc/nvsrc57/nvsrc57_14.pdf. April 17, 2009. (Accessed November 8, 2009).

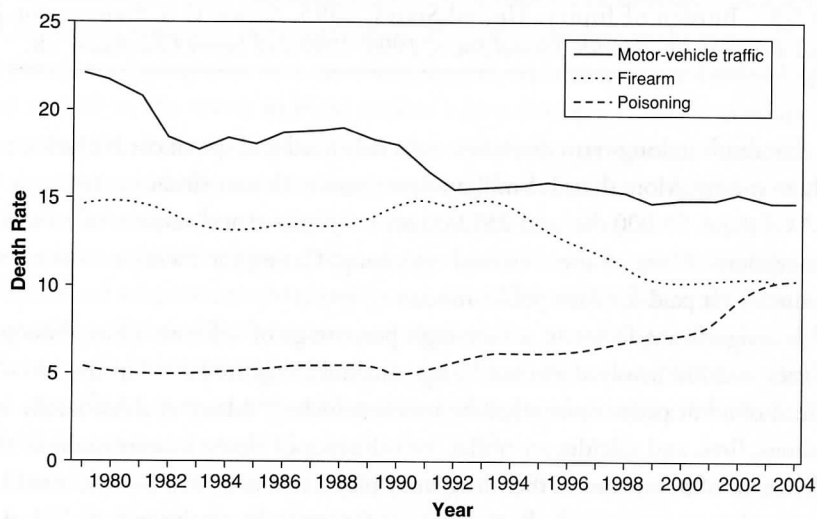


FIGURE 17-2 Observed and Predicted Firearm- and Motor-Vehicle-Related Injury Deaths, by Year, United States, 1968–2005. *Source:* U.S. Centers for Disease Control and Prevention (1994), *Morbidity and Mortality Weekly Report* 43, 38.

Many injuries are not fatal, of course, but fatal injuries are the ones that are most reliably reported. While data on nonfatal injuries are less complete, these injuries can have serious and even devastating effects. In the year 2004, for every fatal injury reported, 11.7 individuals were hospitalized for nonfatal injuries, and 398 were treated but not hospitalized.⁷ These numbers are illustrated in the “injury pyramid” shown in Figure 17-3, from which it is possible to estimate the impact of nonfatal injuries when data on fatal injuries are known.

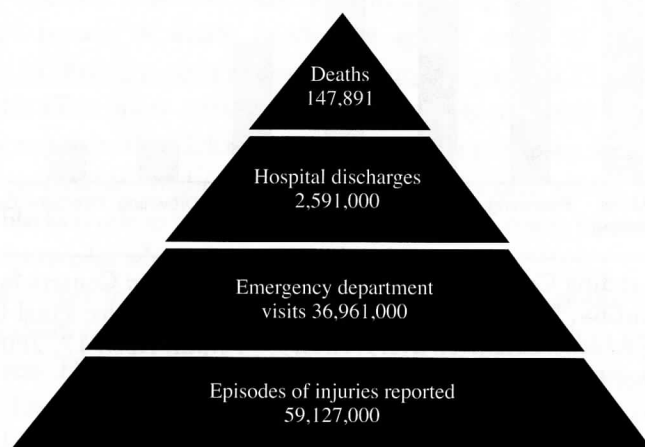


FIGURE 17-3 Burden of Injury: United States, 1995. Source: U.S. Centers for Disease Control and Prevention, *Health, United States, 1996–1997 and Injury Chartbook*, 18.

Injuries that result in long-term disability, especially head and spinal cord injuries, are particularly costly to society. More than 1.4 million Americans each year sustain a traumatic brain injury (TBI).⁸ Of these, 50,000 die, and 235,000 are hospitalized and survive, often with lifelong disabling conditions. Many of these victims are young. Caring for these patients costs billions of dollars, much of it paid for with public funds.

Alcohol is a significant factor in a very high percentage of injuries. Thirty-two percent of traffic fatalities in 2007 involved alcohol.⁹ High alcohol levels are found in the blood of more than one third of adult pedestrians killed by motor vehicles.¹⁰ Many of those fatally injured in falls, drownings, fires, and suicides are under the influence of alcohol, as are many of the perpetrators and victims of homicides. Other drugs may play a role in injury, but because blood alcohol tests are much more commonly done than tests for other drugs, the role of alcohol in injury is better documented.

The importance of alcohol's contribution to injury accounts for its high placement on the list of "actual causes of death" (see Table 13-3). To stress the importance of driving while intoxicated as a cause of death, the authors counted alcohol-related motor vehicle deaths in both the alcohol and the motor-vehicle categories, making alcohol the third leading cause and motor vehicles the sixth.¹¹

Analyzing Injuries

While injuries are generally brought on by human behavior, injury researchers have increasingly sought to understand the role of the environment in causing an injury-producing event and in influencing the severity of the resulting injury. The public health approach to injury control analyzes injuries, like the approach to infectious diseases, in terms of a chain of causation: the interactions over time between a host, an agent, and the environment. To analyze an injury-causing event requires information about the person who initiates the event and/or suffers the injury, the agent (automobile, firearm, swimming pool), and the environment (road conditions, weather, involvement of other people) before, during, and after the event.

To prevent certain injury-causing events from occurring in the first place—primary prevention—analysts seek to understand the conditions prevailing before each such event. For example, characteristics of the host (e.g., alcohol intoxication), the agent (e.g., defective brakes), and the environment (e.g., a dark and rainy night) are all relevant to whether a motor vehicle crash occurs. Conditions prevailing during the event affect the outcome of the crash. Thus, wearing a seat belt (host), equipping a car with an airbag (agent), and driving on a divided highway (environment) may allow the driver to avoid serious injury during a crash—secondary prevention. Tertiary prevention depends on conditions after the crash that determine whether the victim survives the injury and the extent of any resulting disability. The availability and quality of emergency care are major factors in tertiary prevention.

Because motor vehicle injuries cause so many deaths, they were the first category of injuries to be analyzed and subjected to systematic prevention efforts. Much data are available on conditions surrounding motor vehicle crashes, and methods for preventing motor vehicle injuries are highly developed. National highway safety programs were launched two decades before Congress identified injury as a general public health problem and established the National Center for Injury Prevention and Control at the CDC.

Injury-control efforts developed for motor vehicle injuries have served as a model for more embryonic efforts to control other categories of injury. Early prevention strategies focused on changing people's behavior by the classic public health methods of education and regulation. As with many public health issues related to behavior, regulation is usually more effective than ed-

ucation in getting people to change their behavior. In the earliest days of traffic safety efforts, for example, society learned that laws regarding speed limits and traffic lights were necessary to control the chaos on the roadways.

Modern injury control began, however, with the recognition that engineering plays an important role in the causation of injuries and their severity. Sharp objects cause more damage to the human body than blunt ones; an impact distributed over a broad surface results in a less severe injury than that to a smaller surface; if deceleration can be controlled and made less sudden, the body can better withstand the force. In general, automatic protections are more effective than measures that require effort, and the more effort a measure requires, the less likely it is to be employed. Thus the “three E’s” of injury prevention are education, enforcement, and engineering.

These insights, first applied in the auto industry, have also been applied to prevention of many other kinds of injury—especially childhood injuries—with considerable success. For example, when the New York City Health Department noted that a large number of children died from falls out of windows, it instituted the “Children Can’t Fly” program, requiring landlords to install window guards, and the number of fatal falls was reduced by half.¹² The number of children that drown in swimming pools has been reduced by laws requiring pools to be fenced. Poisonings in children can be prevented by childproof caps on medicine containers and some household chemicals. The use of smoke detectors has reduced the number of deaths from fires. State and federal regulation of the flammability of fabrics has also saved lives, especially those of children—due to laws on children’s sleepwear. As a result of these measures and others, fatal injury rates among small children have declined markedly in recent years.¹(Table 32)

Motor Vehicle Injuries

Attention was focused on the problem of motor vehicle injuries by Ralph Nader’s indictment of the automobile industry in his book, *Unsafe at Any Speed: The Designed-In Dangers of the American Automobile*, published in 1966. Congress responded by passing the National Traffic and Motor Vehicle Safety Act of 1966, which established the National Highway Traffic Safety Administration (NHTSA) and empowered it to set safety standards for new cars, such as installation of seat belts, laminated windshields, collapsible steering assemblies, and dashboard padding. Hundreds of thousands of drivers had died from being impaled on unyielding steering columns. Heads and faces of front-seat passengers had been cut by sharp dashboard edges and by glass from broken windshields. The safer designs mandated by the 1966 legislation led to an enormous reduction in both injury and mortality.¹²

NHTSA was also required to collect data on motor vehicle-related deaths and to conduct research aimed at prevention of motor vehicle collisions and amelioration of their effects. Among other activities, NHTSA has an ongoing program of crash-testing various vehicle models, seeking to understand how further improvements in engineering could protect occupants during a crash. These studies have led to further improvements in automobile design—including headrests that protect their occupants during rear-end collisions, strengthened side bars to protect occupants during side crashes, and airbags—now required by federal law.¹³

While requirements that vehicles more effectively protect their occupants during a crash are an important part of injury control (secondary prevention), preventing crashes from occurring in the first place (primary prevention) is the highest priority. Characteristics of the vehicle such as turn signals and brake lights help prevent crashes. State laws that require annual inspections of these devices, as well as of brakes and tires, are aimed at ensuring that defects in vehicles do not lead to injuries. Environmental features, especially improvements in highway design, have been shown to prevent crashes. Divided highways, raised lane dividers embedded in road surfaces, rumble strips at road edges, and “wrong-way” signs at off ramps can help to prevent mistakes by drivers.

Injury control methods that target the driver depend on both education and enforcement, and they exemplify the typical difficulties in getting people to practice healthier behaviors. Because alcohol plays such a major role in fatal crashes, laws against drinking and driving are virtually universal. Their effectiveness depends on how well they are enforced, however. The activism of volunteer groups such as Mothers Against Drunk Driving (MADD) has helped to raise public consciousness about the extent of the problem, and tolerance for drinking and driving has declined in recent years. In addition to imposing severe penalties for being caught driving drunk, many states have expanded legislation to make establishments that serve alcohol liable for serving minors or persons already obviously intoxicated.

After alcohol, the second most important factor in fatal crashes is youth: 13 percent of drivers in fatal crashes are under the age of 20, even though those under 20 make up only 6.4 percent of all drivers.¹⁴ According to NHTSA, 16-year-old drivers have crash rates that are three times more than 17-year-olds, five times greater than 18-year-olds, and twice those of 85-year-olds.¹⁵ This is believed to be due in part to inexperience: driving is a complex task, and new drivers are more likely to make mistakes. These crashes are also due to risk-taking behavior and poor judgment.

Some states are addressing the issue by implementing graduated driver-licensing systems by which young drivers must pass through one or two preliminary stages over a period of time before they are allowed a full license. NHTSA has developed a model law that includes the following provisions: With a learner's permit, a licensed adult must be in the vehicle at all times; the young person must remain crash-free and conviction-free before being allowed to take a

road test for a provisional license. Nighttime driving is restricted for those with a provisional license. Young drivers must remain crash-free and conviction-free for a year before moving to a full license. As of 2008, all states have adopted some form of the graduated system: 46 states have a 3-stage system and the other 4 states use a 2-stage system. Graduated licensing has been successful in preventing traffic fatalities among young people: states that have adopted the system have experienced significant reductions in crashes by drivers less than 20 years old.¹⁵

In addition to being inexperienced, young drivers may also be just starting to drink, and learning how to do both together can be fatal. In 2007, 31 percent of drivers 15 to 20 years old who were killed in crashes had alcohol in their blood.¹⁴ The federal government and many states have made concerted efforts to reduce drinking and driving among young people. One attempt to deal with the problem was a federal law requiring states to increase the drinking age to 21 to receive highway funds (the law became effective in 1988).¹² In 1995, a similar federal law required states to pass zero tolerance laws for drivers under 21 years old. Since 1998, all states and the District of Columbia have laws setting a limit of 0.02 percent blood-alcohol concentration or below, suspending driver's licenses for those found in violation. The evidence indicates that this is an effective approach to saving lives.¹⁶

Speed limits are an important factor in highway injuries. In 1974 Congress imposed a national speed limit of 55 miles per hour to conserve fuel at the time of the Arab oil embargo. That law, which contributed to a 16 percent decline in traffic fatalities between 1973 and 1974, was revoked in 1995 as part of the deregulation trend.¹² Many states have raised their speed limits as a result, including 28 states that have limits of 70 miles per hour or above.¹⁷

The use of seat belts has been shown to reduce fatalities by 40 to 50 percent. Child-safety seats can reduce the risk of a child's being killed during a collision or sudden stop by 71 percent.¹² These engineering measures require people to use them correctly, however, and even state laws requiring the use of seat belts and child safety seats are widely ignored. In states that have primary seat belt laws—laws allowing police officers to pull over drivers and ticket them merely for not wearing a seat belt—the rate of seat belt use is higher than it is in states that have secondary laws—laws that permit police to issue tickets for seat belt violations only after stopping a driver for another reason. As of January 1, 2010, thirty states and the District of Columbia have primary laws, and nineteen have secondary laws. New Hampshire has no seat belt law for adults.¹⁸ The federal government is trying to persuade more states to toughen their laws by offering extra highway funds to those that have primary seat belt laws.

An issue that has recently come to the attention of traffic safety advocates is cell phone use while driving. While the data are still sketchy on the risks, driving while using a cell phone is clearly enough of a distraction to degrade the driver's performance. NHTSA estimates that distraction from all sources, including cell phones, contributes to 25 percent of all police-reported traffic crashes.¹⁹ As of January 1, 2010, seven states and the District of Columbia had laws ban-

ning the use of hand-held cell phones while driving, and an additional 21 states ban their use by novice drivers.²⁰ No state has banned use altogether, although the evidence indicates that even hands-free phones can cause significant distraction to the driver. Even more risky than talking on a cell phone is text messaging, which has become increasingly common, especially among younger drivers. A study that used video cameras installed in the cabs of long-haul trucks found that when drivers texted, their risk of a collision increased 23-fold.²¹ Other studies suggest that the risk among drivers of passenger cars is similar. Nineteen states and the District of Columbia ban text-messaging while driving, and an additional nine states ban the practice for novice drivers.²⁰

In 1968, when implementation of federal traffic safety legislation began, almost 55,000 Americans died each year from motor-vehicle-related injuries. The national effort to reduce this toll has had significant success. By 1993, the number had declined to just over 40,000 fatalities per year despite the fact that many more cars were on the roads and that the number of miles driven has more than doubled.³ Since then, the downward trend has halted and remained more or less steady, with the number of deaths at 41,000 in 2007. However, the fatality rate per 100 million vehicle miles of travel was at an all-time low in 2007.⁹ Future progress in traffic safety could depend on factors such as the price of gasoline. High gas prices tend to lead people to drive less. They also encourage people to buy smaller cars. When gas prices are low, heavier vehicles such as minivans, pickup trucks, and sport utility vehicles are popular, contributing to increases in traffic fatalities because crashes between vehicles of widely disparate size and weight cause high risk to the occupants of the smaller vehicle. Sport utility vehicles and pickup trucks are more likely to roll over in crashes than sedans, however, offsetting the advantage occupants get from their size.⁹

Pedestrians, Motorcyclists, and Bicyclists

About 11 percent of people killed in motor vehicle crashes are pedestrians, and public health efforts are also directed at preventing these injuries.⁹ Elderly people have the highest risk for being killed by a motor vehicle while walking. Sixteen percent of pedestrians killed by motor vehicles are over seventy.²² Most of these injuries occur in urban areas. A 1985 study investigated reasons for a high fatality rate among older pedestrians along Queens Boulevard in a part of New York City inhabited by large numbers of senior citizens. It was found that elderly persons took an average of 50 seconds to cross the 150-foot wide boulevard, while the "walk" sign allowed only 35 seconds. Moreover, because of the boulevard's width and because vision loss is common among the elderly, many pedestrians could not read the "walk/don't walk" signs, which were located on the far side of the boulevard. The traffic safety unit installed additional signs on the median strips so that they could be more easily seen, and they reset the signs to allow more time for

crossing. After implementation of these and other measures, such as stricter enforcement of speed limits, the rate of death and severe injuries among pedestrians fell by 60 percent.¹²

Public health professionals viewed the Queens Boulevard story as a success, but residents of the neighborhood still call that stretch of roadway the “Boulevard of Death.” The city’s Department of Transportation has continued to make safety improvements, including more fences to curtail jaywalking, restricting vehicle U-turns and left turns, and posting safety signs to remind pedestrians about the danger.²³

Every year, an increasing number of motorcyclists (more than 5000 in 2007) and about 700 bicyclists are killed in crashes.^{24,25} Children younger than 16 years of age account for 15 percent of the bicycle-related fatalities, making this one of the leading causes of injury-related death in children.²⁵ The most important protective measure for bicycle and motorcycle riders is to wear a helmet. Head injuries account for more than 60 percent of bicycle-related deaths, and they are a leading cause of death in motorcycle crashes.^{24,26} Head injuries also cause profound, permanent disability in many survivors.

Public health advocates have devoted considerable efforts to promote the use of bicycle and motorcycle helmets. As discussed in Chapter 3, Congress (as part of the 1966 National Highway Safety Act) mandated that states pass laws requiring motorcyclists to wear helmets, leading to a dramatic decline in motorcycle fatalities.¹² Because of vigorous objections on grounds of personal liberty, the federal law was changed in 1976. In response, 27 states repealed or weakened their laws, and by 1980 motorcycle fatalities increased dramatically.²⁷ As of January 2010, twenty states and the District of Columbia required helmet use for all motorcycle operators and their passengers. In another 27 states, only those under a certain age, usually 18, are required to wear helmets.²⁸ In states where only minors are required to wear helmets, laws are difficult to enforce. Data on crashes in these states show that, despite the law, fewer than 40 percent of fatally injured minors wore helmets.²⁹ Only 21 states and the District of Columbia have laws requiring bicycle helmets, and these laws apply only to children.²⁸ The bulk of the public health effort regarding bicycle helmets focuses on community education programs.

Poisoning

Poisoning surpassed firearms as a cause of injury death in 2004, as shown in Figure 17-3. In fact, the death rate from poisoning rose by almost 80 percent between 1999 and 2005, and some states reported much greater increases.^{5,6} In 2005, unintentional poisoning caused more deaths than motor vehicle crashes among people 35 to 54 years old.

In trying to understand the dramatic increase in poisoning fatalities, scientists at the CDC analyzed death certificates recorded at the National Center for Health Statistics and found that the vast majority of them listed drugs, legal and illegal, as the cause of death.³⁰ Opioid pain medications were most commonly involved in the unintentional deaths, followed by cocaine and heroin. Suicide by poisoning most commonly involved psychoactive drugs, such as sedatives and antidepressants, followed by opiates and other prescription pain medications.

The CDC scientists noted that during the 1990s, pain specialists were arguing that opioid pain medications were being underprescribed because of fear of addiction, leading to suffering by patients who were being denied relief from chronic pain. In response, between 1990 and 2002 there was a dramatic increase in prescriptions written for these drugs, including hydrocodone, oxycodone, and methadone. The increase in sales of methadone was explained by prescriptions filled at pharmacies for pain management rather than distribution of the drug through narcotics treatment programs. The scientists' conclusion was that the increase in unintentional poisoning deaths was largely a result of nonmedical, recreational use of prescription pain relievers. Further evidence for this explanation is the age and sex distribution of the individuals who died, primarily middle-aged and male, rather than older females who typically suffer from chronic pain, and many of them had a history of drug abuse.³⁰

The CDC analysis leads to the conclusion that the medical prescription of opioid pain killers is being diverted for illegitimate and dangerous uses. The authors note that corrective actions may be necessary to reduce deaths without diminishing the quality of care for patients who need the drugs for pain relief. This may include better communication and education of healthcare providers to warn them of the risks and inform them how to recognize patients who may be prone to abuse. There may be a need for stricter regulation of opiates by the Drug Enforcement Agency, which registers physicians and pharmacies that handle opiates and tracks the buying and selling of these drugs.

The age group with the lowest poisoning mortality rates is children under 15 years old, in part thanks to public health measures designed to protect curious youngsters from ingesting toxic substances. Childproof caps on pharmaceuticals and cleaning products have helped to keep poisons out of the hands and mouths of toddlers, and poison control centers staff emergency phone lines 24 hours per day. Nevertheless, parents are advised to be alert to the risks of childhood poisonings.

Firearms Injuries

In 1994, firearms injuries had surpassed motor vehicle injuries as the leading cause of injury death in eight states and the District of Columbia. It appeared that firearms would soon become number one nationwide, as seen in Figure 17-2. However, the number of homicides

dropped dramatically in 1994 and 1995, and suicides and unintentional gun deaths fell slightly. The number of deaths caused by firearms continued to decline, falling from almost 40,000 in 1993 to below 30,000 in 2004. A number of reasons have been proposed for the decline, including tougher gun control laws, community policing, and demographic changes.³¹ The trend since 2004 is not yet clear, although the number of firearms deaths was somewhat higher in 2005 and 2006.^{32,33}

Violence is traditionally thought of as a criminal justice issue rather than a public health issue. Certainly no one is arguing that the criminal justice system should abandon its mission. But public health has a different mission: it focuses on prevention as opposed to punishment. The relative success of the public health approach against motor vehicle injuries has inspired calls for it to be applied against violence, especially against firearm violence, the behavior that has the most severe consequences for health.

There are plenty of grim statistics showing that America's permissive attitude toward guns is harmful to people's health. In 2006, firearms killed 30,896 Americans.³³ Of these, more than half were suicides, about 40 percent were homicides, and the rest were caused by unintentional shootings, legal intervention, or unknown causes. Teenagers and young adults are especially at risk. Twenty-three percent of people who die from firearms are between the ages of 15 and 24. More than one in four of these deaths among youths were suicides, and more than two-thirds were homicides. The death rate from firearms is six times higher for males than that for females. Young African American males are especially at risk, especially for homicide.³³

Homicide rates in the United States are two to four times higher than those in other developed countries.³⁴ Although suicide rates among Americans are comparable to those in other developed countries, a high percentage of them are committed with firearms. The easy availability of guns in the United States is believed responsible for many of these deaths. Homicide and suicide are more likely to succeed if guns are used rather than less lethal weapons. In 2006, 51 percent of suicides and 69 percent of homicides were committed with guns.³³ Suicide among young people is especially tragic. While rates of suicide among people 15 to 24 years old have declined since 1990, suicide is still the third leading cause of death in this age group.^{1(Tables 29,31)} Almost half of these suicides are committed with firearms.³³

About one third of U.S. households possess firearms, and half of the guns are handguns, the weapon most likely to be used in a fatal injury.³⁵ While many people own a handgun because they believe it will protect them, a number of case-control studies have shown that the opposite is true. One study found that the relative risk of death by an unintentional gunshot injury is 3.7 for people living in a home with at least one gun, compared to a home without guns.³⁶ Another study found that residents of a household with a gun present in the home are three times more likely to die in a homicide³⁷ and five times more likely to commit suicide³⁸ than when no gun is

available. In another study, a gun kept at home was found to be 43 times more likely to kill its owner, a family member, or a friend than an intruder.³⁹ An analysis by the National Academy of Sciences, however, cast doubt on whether the relationship between gun ownership and homicide or suicide represents cause and effect. The report stated that the data were too unreliable to draw firm conclusions and noted that information such as that collected on guns traced to crimes by the Bureau of Alcohol, Tobacco and Firearms is inaccessible to researchers.³⁴

The CDC has been collecting data on patterns of violence for almost two decades, and in the early 1990s the agency stepped up its efforts to identify and evaluate interventions to prevent and reduce the impact of violence. Politically, however, guns have been a much more difficult issue to deal with than motor vehicles. Many conservative politicians, with the support of the National Rifle Association (NRA), regard any attempt to control access to firearms as an attack on the Second Amendment to the Constitution. Limits on the depiction of violence in the media are also vigorously opposed in the name of protecting freedoms, although there is some evidence that viewing violent episodes on television or in the movies increases the cultural acceptance of violence and makes children and youths more likely to behave in aggressive ways.

Opponents of gun control have even gone so far as to try to prevent the CDC from conducting research on violence as a public health problem. In 1995 and 1996, conservative members of the House of Representatives, backed by the NRA, tried first to eliminate the CDC's National Center for Injury Prevention and Control and then to cut from the center's budget the exact amount—about \$2.4 million—that it had proposed for research on firearms injury.⁴⁰ President Clinton supported the CDC's work, and attempts to cut the center's budget failed. However, the political opposition had an impact. Legislation passed in 1996 explicitly forbade the CDC from using any of its funding "to advocate or promote gun control."^{41(p.190)}

Efforts to reduce firearms injuries are continuing nonetheless. The Harvard Injury Control Research Center, with funding from private foundations, developed a National Violent Injury Statistics System in 1999, modeled after the NHTSA's reporting system for motor vehicle injuries. In 2002, Congress appropriated funds for the CDC to implement the system, funding thirteen states to collect detailed data on homicides and suicides in order to better inform policy on violence and suicide.^{42,43} In 2006, the program was expanded to seventeen states. Eventually, the CDC plans to include all fifty states, territories, and the District of Columbia.

The successful passage of the Brady Gun Control Act in 1994 showed that there could be political support for limiting access to firearms even in an antiregulatory climate. However, the fact that the Republican Congress did not approve a renewal of the assault weapons ban in 2004, and still has not, even with a Democratic Congress in 2009, shows that the NRA still has clout in Washington. Some communities have had some success with violence prevention and youth development programs, including education to promote nonviolent resolution of argu-

ments. The economic cost of gun violence in medical care—calculated at about \$2.3 billion per year⁴⁴—has helped to persuade some states to pass stricter gun control regulations. About half the medical costs of firearms injuries are borne by taxpayers.

Public health advocates note that guns need not be banned in order to make them safer. The third “E” of injury prevention—engineering—has not been widely applied in the prevention of firearms injuries. Safety catches can be used to make guns childproof, for example, and there are even ways to personalize guns so that they can be used only by the owner. Safety features are required by law for many consumer products that are much less dangerous than guns. When the political climate is ready to support major efforts to prevent firearms-related injuries, the public health approach has much to offer.⁴⁵

Occupational Injuries

Workplace injuries have been a significant public health problem since the Industrial Revolution, if not before. In 1907, over 15,000 American workers were reported to have died on the job. Many states implemented occupational safety laws in the late 19th and early 20th centuries. In 1970, the Congress passed a federal law creating the Occupational Safety and Health Administration (OSHA), empowered to set standards, inspect workplaces, and impose penalties for workplace hazards. The law also created the National Institute for Occupational Safety and Health (NIOSH) to conduct research, recommend standards, and conduct hazard evaluations.¹²

The workplace is safer now, with 5657 fatal injuries reported by the Bureau of Labor Statistics in 2007, despite a large increase in the number of workers.⁴⁶ In part, this improvement reflects mandated safety measures and educational programs; in part, it reflects an economy less dependent on heavy industry. However, in addition to the deaths, almost 1.2 million Americans suffer an injury each year that leads to lost work days.

As in the pattern of injuries overall, motor vehicles are the leading occupational cause of death, with highway crashes accounting for 24 percent of all worker deaths.⁴⁵ The second leading cause of injury mortality in 2007 was falls, which reached a high since 1992, when the Bureau of Labor Statistics started keeping track. Workplace homicides, which rank third, have declined 44 percent from the high of over one thousand in 1994, following the general trend of decreasing firearms deaths. Other commonly reported causes of occupational fatality were “struck by falling object or equipment,” “overturned farm or industrial vehicle,” “caught or compressed by equipment or objects,” and “contact with electric current.”

Not surprisingly, workers in some types of jobs have higher risks of occupational fatality than others. Fishing and logging are the most dangerous occupations, with the highest rate of deaths per 100,000 workers. Loggers are likely to be struck by falling trees. Construction work-

ers have a high risk of falls. Agricultural workers are at risk for amputations by machinery, electrocutions, and pesticide poisoning. Occupations with the highest risk of homicide are police officers and supervisors of retail sales workers.

Nonfatal Traumatic Brain Injuries

In addition to the 50,000 deaths annually, it is estimated that over a million Americans are treated in hospital emergency departments for nonfatal traumatic brain injuries (TBIs), and uncounted others sustain the injury but are treated elsewhere or do not seek care. TBIs may be mild, such as a concussion, or severe. Severe TBIs may cause permanent disability, but even mild ones can lead to changes in thinking, sensation, or language, and may increase the risk later in life for Alzheimer's or Parkinson's Disease.⁴⁷ A well-known example of the latter is the boxer Mohammed Ali, who was diagnosed with Parkinson's Syndrome at the age of 43 after years of enduring blows to the head.⁴⁸

The CDC gathers information on TBI by funding selected states to report data on individuals who are treated in hospital emergency departments for these injuries. The data revealed that in all states, males were twice as likely as females to suffer a TBI, but the rates varied significantly among states. The age group at highest risk for hospitalization and death was individuals 75 years and older, while the greatest number of emergency department visits were by children aged 4 and under.⁸ The two leading causes of these injuries were falls and motor vehicle incidents, the latter including drivers, passengers, pedestrians, motorcyclists, and bicyclists.⁴⁹

The Consumer Product Safety Commission (CPSC) administers another surveillance system that collects data from a nationally representative sample of 66 hospital emergency rooms. This system focuses on injuries associated with consumer products and identifies TBIs associated with products such as bicycles, swing sets, or inline skating equipment. Accordingly, the injuries identified through this system have different causes and affect younger individuals than those included in the CDC system. The group found at highest risk by the CPSC are aged 10 through 14 years, and the leading causes of the injury involve bicycles, football, playground activities, basketball, and riding all-terrain vehicles. Like the CDC system, the CPSC found that boys are more than twice as likely as girls to suffer a TBI.⁵⁰

Recently, attention has been drawn to the TBI risks from playing football, both professionally and as students. In October 2008, a 16-year-old high school football player in New Jersey died after suffering a brain hemorrhage during a game, the fourth high school player to die of a head injury in the United States that year.⁵¹ The New Jersey student had had a concussion during a practice three weeks earlier, but had been cleared by a doctor to return to play. Young

brains are especially vulnerable to repeat mild TBIs within a short period of time, and the question of how long young athletes need to recover is controversial. Sports physicians note that athletes of all ages, eager to return to the game, tend to deny symptoms, and it is difficult for doctors to determine when it is safe for them to return.⁵²

Similar issues have troubled the National Football League (NFL) in trying to develop a policy on when players may return to the game after a head injury. Several observations have suggested that professional football players may suffer a high rate of brain damage due to repeated head trauma. A study of retired players found a statistical link between multiple concussions and later-life depression. After evidence accumulated that retired football players had a higher than average risk of dementia, an NFL program to assist these retirees was launched, and dozens more candidates than expected signed up. Another red flag was that when autopsies were done on five retired NFL players who had died before age 51, degenerative brain damage was found similar to that found in boxers with dementia. At a meeting of NFL officials, Troy Vincent, veteran player who is president of the players' union, noted that most players don't worry about concussions. He himself had had six documented concussions, he said, but possibly dozens more. "Outside of me being knocked out, asleep, I went back in the game on all the other occasions. And fifty or sixty times, I'm in the huddle, I don't know where I'm at, don't know the call, and I've got a player holding me up. I'm not sure if athletes really know what a concussion is—get some smelling salts and back in the game."^{53,54}

Tertiary Prevention

For any kind of serious injury, the promptness and quality of emergency medical aid play a significant role in whether a victim survives as well as in the extent of permanent disability. Lack of prompt emergency care accounts for the fact that death rates from motor vehicle crashes are higher in rural areas than in more populated ones. The establishment of special trauma centers and the use of helicopters to transport injured patients over long distances have improved the prospects in some locations, but many parts of the country still lack integrated trauma-care programs. Well-trained emergency medical technicians and well-equipped ambulances can make the difference between life and death. There is still a need for research to better understand the biomedical aspects of injury and to devise better treatments.

Conclusion

Injuries are a major cause of death and disability in the United States. They are of particular concern to public health because they disproportionately affect young people, and many injuries are preventable. Fatal injuries are categorized as unintentional—commonly called “accidents”—and intentional, a category that includes homicide and suicide. Motor vehicle crashes have been the leading cause of injury deaths for the past several decades. Poisoning ranks second, and injuries caused by firearms are third. Alcohol is a significant factor in a very high percentage of injuries. The number of deaths caused by injuries is just the tip of the injury pyramid, which shows that for every death there are many injuries resulting in hospitalizations, many more injuries requiring treatment in emergency rooms and physicians’ offices, and even more injuries treated at home.

Analysis of injuries provides guidelines for prevention. The analysis involves considerations of the host, agent, and environment and how they may be altered to prevent an injury from occurring (primary prevention), to minimize the damage (secondary prevention), or to prevent resulting disability by providing prompt treatment (tertiary prevention). This kind of analysis was pioneered in the analysis of motor vehicle injuries, which focused not only on the driver (host) but on making the vehicle (agent) safer and on developing safer highways (environment). Tertiary prevention included the provision of ambulances and trauma centers.

Prevention of motor vehicle injuries also includes campaigns to change people’s behavior by persuading them, or requiring them by law, to wear seat belts when riding in motor vehicles and to wear helmets when riding on motorcycles. Bicycle helmets, which are underutilized, are also an important safety measure.

The number of poisoning fatalities has increased dramatically over the last decade. Much of the increase is due to misuse of prescription drugs, especially painkillers. Regulatory approaches to reducing poisoning risks must be balanced against evidence that patients suffering from chronic disease have sometimes been denied the relief of appropriate medications.

Due to large numbers of firearms injuries, the United States has higher rates of homicides and childhood suicides than other industrialized nations. The easy availability of guns in the United States contributes to the high death rate from firearms injuries. Some studies have suggested that the presence of a gun in the home increases the risk that a resident will be a victim of homicide or suicide. However, data to support such studies is unreliable because of opposition by the gun lobby to the collection of such data.

Public health has made progress in preventing childhood injuries from falls, drowning, poisoning, and fires and burns. Much of this progress comes from laws requiring safety features such as window guards in apartment buildings, fencing around swimming pools, childproof caps on medicine containers, and fireproofing of children’s sleepwear.

Because TBI, in addition to causing deaths, can have serious consequences, including life-long disability, the federal government has surveillance systems in place to identify such injuries and their risk factors. Young people are especially vulnerable to TBI, because their brains are more easily damaged and take longer to heal than adult brains. Recently football injuries have drawn public health attention. There is evidence that professional football players may suffer degenerative changes to the brain because of repeated blows to the head, putting them at risk of depression and dementia. High school football players are even more vulnerable to serious consequences if they return to the playing field too soon after suffering a concussion.

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