Home and Leisure Injury Prevention

Part 1: Selected Injuries

Part 2: An Infrastructure for Injury Control

Home and Leisure Injury Prevention
— Contributors —

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Part 1:
Selected Injuries

Introduction

In 1988, 48,022 Americans died from unintentional injuries not related to motor vehicles. Most injuries occurred in leisure activities and in homes, although an inexact number were occupational (see the Occupational Injury Prevention Panel's report). Although most of the nonfatal injuries are scratches, bruises, and minor burns that heal quickly and are forgotten, significant numbers are quite serious. Thousands more Americans were severely injured but not killed. A national plan for this group of injuries should focus mainly on the factors that cause death, permanent damage (burn scars, brain and spinal cord injury, loss of limbs) or substantial hospitalization and medical care costs (hip fracture).

As members of the Home and Leisure Injury Prevention Panel, we have selected five types of unintentional injuries that deserve attention in the national agenda, either because they contribute enormously to morbidity and mortality or because they highlight the need for us to apply known prevention strategies and to develop research and new prevention strategies:

- Falls
- Drownings
- Poisonings
- Fire- and burn-related injuries
- Firearm injuries

These five injury types are also emphasized in the U.S. Department of Health and Human Services' Health Objectives for the Nation, detailed in the Appendix.

Because of space limitations, we cannot discuss every injury in detail. This does not imply that nothing should or can be done about these other injuries. On the contrary, with all severe injuries we should emphasize better surveillance of circumstances, expertise in the choice of interventions, and the implementation of known solutions for known problems. Less understood problems can be clarified by research. Resources to implement and evaluate these approaches must be identified.

General Scope

In 1986, more than 1,000 U.S. deaths occurred in each of the following categories of injury: falls, drownings, poisonings, fires and burns, choking on food and other substances or objects, firearm use, and machine use in agriculture, industry, building, or maintenance. The numbers of deaths and population-based rates in 1980-1986 for these types are presented

in Table 1, along with data on the aggregated "other" deaths and motor vehicle-related deaths. Despite a slight decrease in some of these rates from 1980 to 1986, in 1986, 48,410 people died from unintentional injuries unrelated to motor vehicles. These deaths accounted for 32% of the total injury deaths.

Costs

In a 1989 report to Congress, the lifetime costs in 1985 were approximately $21.0 billion for falls, $2.8 billion for fire- and burn-related injuries, $8.5 billion for poisonings, $2.1 billion for drownings or near-drownings, and $14.4 billion for firearm injuries (1). Rice and colleagues estimated lifetime costs of injury, using the human capital approach to valuing life. Productivity lost through premature death and disability is considered an indirect cost of injury. These are conservative estimates and do not include costs associated with pain and suffering or property damage from fires and firearm use.

Hospitalization and disability data are not available for several of the categories listed in Table 1 because few hospitalizations for injury are coded by circumstances. The costs of the other types of injuries in Table 1 are not estimated separately in that report because of a lack of detailed information.

Surveillance and Injury Control

The recommendations that follow emphasize the need for surveillance activities for all injuries. Surveillance activities at the federal, state, and local levels that rely on consistent definitions of injury are necessary for our complete understanding of injury control needs. Local investigations of injury events, including mapping of injury conditions, can yield crucial data on incidence, location, and circumstances. In addition, morbidity and mortality data E-coded from uniform hospital discharge data, emergency department data, and medical examiners are needed to describe injury circumstances. Surveillance at the state and local levels is needed to ensure that injury control measures are aimed at populations at highest risk and at the factors that place them at highest risk. Injuries that are not prominent in national data may be so in certain localities.

Two of the difficulties in forming a surveillance plan for a wide variety of injuries are the diversity of possible classifications — the types of energy exchange involved, the various reservoirs and conveyances of energy, the various places injuries occur — and the different characteristics that increase risk among different population groups. For example, drownings and fire- or burn-related injuries predominate among children; poisonings, drownings, and falls frequently involve those 15-64 years old; and falls stand out in persons 65 and older (Table 2) (2).

Number of Deaths and Rate Per Population of Major Causes of Unintentional Injury Deaths
United States, 1980 - 1986

Table 1

	1980	1981	1982	1983	1984	1985	1986
Motor Vehicle	51,930	50,196	44,713	43,428	45,208	44,822	46,867
Per 100,000 Pop.	23.4	22.4	19.7	19.0	19.6	19.2	19.9
Falls	13,294	12,628	12,077	12,024	11,937	12,001	11,444
Per 100,000 Pop.	5.9	5.5	5.2	5.1	5.0	5.0	4.7
Poisonings	4,331	4,523	4,733	4,633	4,911	5,098	5,740
Per 100,000 Pop.	1.9	2.0	1.9	1.9	2.1	2.2	2.4
Drownings	7,257	6,277	6,351	6,353	5,388	5,316	5,700
Per 100,000 Pop.	3.2	2.7	2.7	2.7	2.3	2.2	2.4
Fire- and Burn-Related Injuries	6,016	5,889	5,364	5,167	5,152	5,114	4,969
Per 100,000 Pop.	2.7	2.5	2.3	2.2	2.2	2.1	2.1
Aspiration (Non-food)	1,306	1,263	1,407	1,562	1,786	1,888	1,983
Per 100,000 Pop.	0.6	0.5	0.6	0.7	0.8	0.8	0.8
Aspiration (Food)	1,943	2,068	1,847	1,825	1,755	1,663	1,709
Per 100,000 Pop.	0.9	0.9	0.8	0.8	0.7	0.7	0.7
Firearm	1,955	1,871	1,756	1,695	1,668	1,649	1,452
Per 100,000 Pop.	0.9	0.8	0.8	0.7	0.7	0.7	0.6
Machinery	1,471	1,488	1,403	1,277	1,277	1,288	1,202
Per 100,000 Pop.	0.7	0.6	0.6	0.5	0.5	0.5	0.5
Other	16,215	14,501	14,431	14,524	13,829	14,618	14,211
Per 100,000 Pop.	7.3	6.2	6.2	6.2	5.9	6.0	6.0

Source: (2)

Table 2

Major Unintentional Causes of Injury Deaths (Excluding Motor Vehicles) United States, Percent by Age in 1986

	Age at Death (yrs)			
	0-4	5-14	15-64	65+
Falls	4.6	3.2	11.8	38.7
Poisonings	2.2	2.1	18.3	4.2
Drownings	29.2	34.2	16.7	3.9
Fire- and Burn-Related Injuries	26.1	17.3	8.0	8.5
Aspiration (Nonfood)	5.0	1.1	1.3	7.5
Aspiration (Food)	5.2	1.1	2.0	5.2
Firearms	1.3	11.1	4.9	1.1
Machinery	1.6	2.6	4.3	2.4
Other	24.8	27.3	32.7	28.5

Source: (2)

We are not implying that these injury categories reflect similar circumstances among various age groups. For example, we know that severe injuries from falls among the elderly usually involve relatively low energy exchanges but that severe falls among children are usually from heights. Moreover, different patterns of injury and severity are found in different income groups and in different regions of the country. Nevertheless, there are similarities in injury patterns and approaches to injury control that have permitted substantial reductions of injuries in a few documented cases. These cases can serve as models for preventing other unintentional injuries.

In addition to implementing model interventions, research is needed to develop new ones. For example, research on biomechanics — the study of the mechanical forces that cause trauma to human tissue — has led to safety advances in the motor vehicle field, such as air bags, safety belts, child restraints, and motorcycle helmets. This same type of research can lead to interventions that reduce the severity of falls. For example, hip pads and other devices that prevent or reduce injuries from falls among the elderly are possible topics of biomechanics research. Similarly, biomechanics research can focus on the effects of the muzzle velocity of firearms and the characteristics of ammunition.

Examples of the Model at Work

Successful programs to prevent definable injuries or reduce their severity provide the outline for a plan to accelerate reductions. Programs that have successfully reduced injuries as diverse as aspirin poisoning, burns from ignited sleepwear, and falls from windows have had several common elements: adequate surveillance to define the circumstances of the injury, recognition of an action that would probably reduce incidence or severity, and action by those in a position to initiate intervention.

The following common elements appear to be associated with most of the injury reductions resulting from these interventions (3):

- Surveillance of the injuries reveals that the pattern of injury circumstances is fairly obvious and consistent among exposed populations.
- A countermeasure exists in the form of a product or environmental modification that eliminates the hazard or reduces it demonstrably.
- The countermeasure, its cost, and the need for behavior change are accepted by the public, are sufficiently minor to be of little significance, or are overlooked entirely.
- Manufacturers and designers are persuaded or required to institute countermeasures. (As technology advances, some interventions — such as smoke detectors — represent profitable new markets for manufacturers.)
- The injury-producing product or environment is susceptible to relatively rapid modification or replacement over time.
- The need for behavior change by users is minimal.

In addition, national, state, and community coalitions of professionals as well as political and other leaders are needed in most areas of injury control if the model is to be implemented.

When manufacturers of children's aspirin were made aware that a significant number of child poisonings were the result of ingestion of their product, they reduced the dosage per package and modified the packages to reduce the ability of children to open them. Child poisonings from aspirin thus were reduced 80% (4).

After Congress amended the Flammable Fabrics Act in 1967 to permit broader regulation of clothing, the Information Council on Fabrics Flammability, a consortium of representatives from industry, government, and medicine, worked for passage of the two Children's Sleepwear Standards in 1972 and 1975 (5). The Consumer Product Safety Commission (CPSC) estimated that, in 1982, 97% fewer children aged 0-14 years died from burns caused by clothing ignition than died in 1970.

During the 1960s, personnel at the New York City Health Department noticed that about 30 to 60 children per year were being killed in falls from heights. A surveillance project to identify the circumstances was launched, and the findings indicated that 85% of the deceased children who were less than 5 years old, and 61% of those who were less than 15 years old had fallen from windows in high-rise buildings (6). With the "Children Can't Fly" program, the health department persuaded landlords and apartment owners to install window guards that children could not reach (7) and later required the guards if a tenant requested them. By 1980, the deaths to children from falls from heights were reduced to about four per year (8).

These examples of modest but important successes convince us that a systematic approach to identifying relatively homogeneous injuries, identifying ameliorative approaches that are relatively easy to implement, and organizing responsibility to implement and monitor injury prevention programs can substantially reduce common injuries. Clearly, some causes of injuries are national in scope (aspirin poisoning, ignited sleepwear), whereas others are regional or local (falls from high-rise apartment buildings). Personnel working at each of these levels must recognize their injury reduction roles and coordinate efforts to avoid duplicating their work or working at cross purposes.

Interventions that have reduced injuries or their severity include redesigned refrigerator and freezer doors to prevent child entrapment, ground-fault circuit interrupters, automatic stops for walk-behind lawn mowers, devices to prevent chain-saw kickback, and smoke detectors.

Other injury control efforts that have a reported effectiveness but that have not been uniformly applied include educating nurses and monitoring patient falls in a hospital (9), counseling parents about infant falls (10), installing fences with self-latching gates around public and private pools (11), requiring smoke detectors in homes (12), using breakaway bases for softball (13), organizing the community to prevent burn injuries (14), using group discussion in the community as an educational tool to reduce all injuries (15), requiring flame-retardant sleepwear (16), using child-resistant containers for various substances (17, 18), redesigning coffee maker filters to prevent spills (19), and instituting a community-wide bicycle-helmet program addressing lack of awareness, peer pressure, and cost (20).

Recommendation: Federal, state, and local health agencies, academic institutions, other private and not-for-profit agencies, and community-based organizations interested in home and leisure injury prevention should collaborate on nationwide efforts in surveillance, research, risk-factor assessment, and intervention strategies. Such coordination will promote consistency of data and avoid duplication of effort. These tasks should also focus on people in racial and ethnic minority populations and on women, both to understand risk factors and causes of injuries and to reach these high-risk populations with effective prevention strategies.

Alcohol Policies

Alcohol is implicated as a contributing factor in many types of injuries. Two policies regarding alcohol have been particularly effective — the 21-year-old legal minimum drinking age (21) and alcohol taxation (22). Although the 21-year-old drinking age has been adopted in all states, recent evidence suggests that the law is not being uniformly enforced. Moreover, inflation has eroded the effect of alcohol taxes.

Because these policies affect home and leisure injuries as well as motor vehicle-related injuries, we reiterate and endorse the recommendations of the Surgeon General's Workshop on Drunk Driving (23):

- Equalize federal excise tax rates by ethanol (pure alcohol) content for all beverages by raising rates for beer and wine to that for distilled spirits. Adjust the resulting equalized excise tax rate to reflect the change in the Consumer Price Index since 1970, and, in the future, annually adjust the resulting excise tax rate to reflect changes in the price index for the previous year.
- Strengthen enforcement of underage drinking laws with penalties for purchasers, sellers, and servers.

Falls

Where We Are

Dimensions of the Problem

Accounting for one out of five injuries and one-third of hospitalized injured persons, falls are the leading cause of all nonfatal injuries (1). Fall injuries result in morbidity conditions, such as hip and other fractures and head injuries (especially among children). They are the second leading cause of death from unintentional injuries after motor vehicle crashes (Table 1).

Each year, a fourth of all persons 65 to 74 years of age and a third or more of those aged 75 or older report a fall (24). Falls and fall-related injuries occur at every age, but the vulnerability and the longer recovery periods of old age make falls and other mobility-related injuries a serious threat to the health and functioning of older persons. Each year, more than 10,000 deaths among older persons in the United States are attributed to falls and fall-related injuries (25). The true number of deaths in which a fall is a contributing factor is likely to be much higher because of the way information is reported on death certificates. For example, the immediate cause of death might be pneumonia, which would not have occurred if an elderly person had not been bedridden because of a fall.

In 1985, falls among children ages 0 to 19 accounted for 328 deaths, 122,693 hospital admissions, and 3.6 million emergency department visits (26). Children under the age of 5 are at increased risk for fall injuries (0.5/100,000) (27). The incidence of childhood fall injuries is highest in infancy and declines throughout childhood (0.2/100,000 at ages 5-14). This decline is believed to be associated with the developmental process (28). For babies under 1 year of age, falls often involve furniture such as changing tables or baby walkers. Among toddlers, fatal falls are more common from windows or on stairs. As the child gets older, falls from roofs or playground equipment, bicycles, and horses are more common. When falling from a low surface (bed, walker, changing table, or step), children are at a substantial risk of head injury because of their relatively large head mass. Falls from heights greater than 10 feet are usually from windows for infants and toddlers, and from playing areas (trees, fire escapes, or roofs) for older children (7).

Costs

The total lifetime cost of falls in 1985 was an estimated $37.3 billion (1). With growing recognition of the costs of falls and related injuries, the federal government has recently targeted the reduction of falls among older Americans as a major public health objective (25, 29).

The lifetime cost of injury for people 65 and older is estimated to be $14.9 billion, of which nearly $10 billion can be attributed to falls (1). In addition to costs, fall-related injuries place a considerable physical and psychological burden on older people, their families, and society at large. Although serious fall injuries among children and young people ages 0 to 25 years are less frequent, most injuries during the first several years of life are due to minor falls from low levels. The estimated cost for injuries among this age group is $10.2 million because of their longer life expectancy relative to the elderly population. About 70% of these costs ($7.2 million) are indirect morbidity costs that reflect losses in productivity due to disability in a young population (25). Major cost savings could result from reducing the severity of falls at all ages.

Surveillance

Nonfatal falls associated with products such as floors, stairs, and bicycles are counted in the National Electronic Injury Surveillance System (NEISS), but other falls are not counted except in hospitals with adequate systems for E-coding and tracking injuries.

Research

Research on children's falls has focused on products. One good analytic study, however, has documented the relative risk of falls related to alcohol use among adults (30). Studies have also focused on when and where fall-related injuries occur. For example, in a study of falls among the elderly in Miami Beach, Florida, 74% of the falls occurred during daylight hours and 54% occurred in and around the home. For 38% of those that occurred in the home, more specific information was available: 42% occurred in the bedroom, 34% in the bathroom, 9% in the kitchen, 5% on the stairs, 4% in the living room, and 6% in other areas (31). Although few falls result in serious injuries or deaths, falls and other mobility problems are often associated with loss of confidence in the ability to function independently, restriction of physical and social activities, increased dependence, and an increased need for long-term care (32). Among persons 65 years of age and older, less than 50% of those hospitalized after a fall return home.

Programs

Research has shown that gait and balance disorders, use of psychoactive drugs, exposure to new surroundings, and poor environmental conditions (such as stairways) are risk factors for falls among the elderly (29). Several strategies aimed at reducing known risk factors appear promising and, in fact, are being implemented on a limited basis, albeit without any rigorous testing to document specific outcomes in particular populations. They include the following:

- Multidisciplinary geriatric assessment of older people at risk for falling to identify and ameliorate possible risk factors.
- Careful assessment and monitoring of older people's medication use (particularly drug-drug interactions, including drug-alcohol interactions) to reduce falls and hip fractures (see Year 2000 Objective 9.7 in the Appendix).

- Exercise programs to improve gait, balance, and muscle mass.
- Public and professional education to identify home hazards and stimulate appropriate behaviors.
- Environmental modification of the living quarters of elderly persons consistent with universal design philosophy (with attention to floor surfaces, lighting, bathrooms, stairs, traffic patterns, and accessibility) to reduce or eliminate hazards.
- Close monitoring of older people during the first few weeks of institutionalization and when they are moved to new units.

Promising fall-injury prevention efforts for children are under way at the state and national levels. For example, the Utah Department of Health and the New York City Health Department are successfully targeting injury prevention on playgrounds. A valuable national resource is the CPSC, which provides free handbooks on preventing fall-related injuries on playgrounds. Another national effort, the "National Safe Kids Campaign," promotes helmet use among children who ride bicycles.

To be effective, fall-prevention programs must avoid unintended negative consequences. For example, encouraging physical activity without proper supervision or attention to risk factors in the environment may actually cause injuries. In addition, programs designed to reduce injuries should measure a broad range of outcomes. For example, effects on older persons' quality of life (e.g., their autonomy and independence) are important outcomes. Studies on fall injuries should address as well the variety of circumstances, the seriousness of the injury, and the older person's pattern of life.

Where We Want To Be

Research

Despite the relatively high incidence of fall-related injuries, especially among older people, we are just now beginning to document the complexity of biomedical, behavioral, and environmental risk factors in childhood and later life and to identify strategies for modifying known risk factors. Although our research investment in this area has increased markedly within the past 5 years, many critical research needs remain, including the following: (a) understanding how physiological, behavioral, and environmental factors combine to put particular age groups at special risk; (b) designing and evaluating biomedical, behavioral, and environmental interventions; and (c) integrating efficacious interventions into existing medical and public health services in both community and institutional settings. The heterogeneity of the older population requires that we develop interventions for preventing injuries in relatively healthy people as well as for reducing injuries and their consequences in very frail, functionally disabled populations.

Areas needing further study include the following:

- The accuracy of fall and injury reports.
- Specific locations and circumstances of falls.
- Risk factors and risk relationships, especially the underlying mechanisms of falls and the interaction among risk factors as they change over time.
- Falls on stairs, including types of handrails; lighting; and step height, width, size and placement.
- Fall prevention programs, especially their specific components and any unintended negative effects they may produce.

Programs

The following interventions are known to reduce the incidence or severity of falls and should be targeted at high-risk populations:

- Installing window guards for high-risk houses and tenements, enforced by regulations such as those of New York City's the "Children Can't Fly Program."
- Installing safety equipment, such as gates, where risk of falls is present.
- Educating parents about the potential risks of falls (from baby walkers, stairs, windows, and changing tables).
- Prohibiting the manufacture of baby walkers (33, 34).
- Changing building code standards in order to reduce the space required between bannister railings from 6 to 4 inches.
- Monitoring medication among elderly patients.
- Promoting exercise for agility and strength among the elderly.
- Using sound environmental design in living quarters for the elderly.

The biomedical, behavioral, and environmental interventions being developed hold promise for preventing falls among the elderly, reducing the extent of their injuries, and limiting costly health care expenditures. Efforts to prevent the consequences of osteoporosis, either by strengthening older women's bone structure, increasing their awareness of hazardous behaviors, or instituting creative environmental modifications to buffer the effect of falls, could do much to reduce the estimated $7 billion cost associated with hip fractures or to reduce the incidence of vertebral fractures. For example, a new study suggests that an assessment of ambulatory nursing home residents can reduce their hospitalization that would result in an estimated yearly savings of $600 million (35).

How We Get There

Federal Government

- Support epidemiologic surveillance of fall injuries to identify circumstances and specific locations of falls.
- Support analytic studies of major factors contributing to fall injuries, including biomedical, behavioral, and environmental risk factors for injuries in later life (e.g., mobility, the effects of estrogen and calcium on osteoporosis, the effects of psychoactive and other drugs, the effects of polydrug use, the effects of alcohol use, personal risk factors, and environmental factors) and the interaction of these risk factors with age.
- Fund local injury prevention workers to interpret and act on results of surveillance and analytic studies.
- Develop and disseminate prevention programs.
- Ban baby walkers, which apparently cannot be made safer.
- Develop standards for changing tables and high chairs.
- Develop safety standards for playground equipment.
- Increase support of clinical trials to test strategies for injury reduction and rehabilitation in later life (e.g., avoidance of hazardous behaviors, increased exercise and physical activity, and the use of hip pads or other new devices).

State and Local Governments

- Conduct surveillance of the circumstances and specific locations of fall injuries.
- Develop, revise, or enforce standards for residential facilities for the elderly on the basis of the best evidence of optimal designs for stairs, rails, and grips.
- Require helmet use during recreational activities associated with significant head injury rates, such as bicycling, horseback riding, surfing, and snow skiing.
- Encourage research on optimal living designs, ensure that public and private building designs and codes take injury surveillance results into account, and enforce building code regulations that reduce major factors contributing to fall injury and its severity.

Private Organizations

- Health care providers should encourage increased clinical counseling of parents and caregivers regarding the risk of children falling from elevations, the need to stop using baby walkers, and the need to begin using barriers for stairs.
- Insurance companies should provide financial incentives, such as lower premiums, to encourage consumer compliance with safety standards.

- Health maintenance organizations (HMOs) and pharmacies should more vigilantly monitor the use of prescribed drugs, especially combinations of drugs that are likely to impair vision, gait, coordination, and judgment. In addition, HMOs and pharmacies should consider placing warning labels on drugs that may increase the incidence of falls and injuries among the elderly.
- Businesses should not serve or sell alcohol to intoxicated persons.

Academic and Research Institutions

- Conduct analytic studies mentioned under "Federal Government" (page 273).
- Conduct clinical trials to test strategies (e.g., avoidance of hazardous behaviors, increased exercise and physical activity, and use of hip pads or other new technologies) for fall injury prevention and rehabilitation in later life.
- Conduct analytic studies of stairs, innovative barriers, warnings, and alarms to prevent falls.
- Evaluate how fall injuries might be prevented by the use of hip pads, residential facility standards, and the quantity and quality of residential facility staffing.

Drownings

Where We Are

Dimensions of the Problem

In 1986, drownings (along with poisonings) were the third most common cause of death by unintentional injury in the United States (Table 1).

Drowning rates are highest for children under 5 years of age and for people from 15 to 24 years old (36). Drowning death rates are almost four times greater for males than for females, according to National Center for Health Statistics data for the years 1978 through 1984 (36, 37). The male-female difference in drowning rates is evident in every year from childhood through mature age (37-39).

Native Americans have the highest rates of drowning in the United States. This may reflect the fact that substantial numbers of ative Americans live in Alaska, which has the highest drowning rate of any state (2). The high drowning rate in Alaska has been attributed to the cold temperatures of its natural bodies of water, the swiftness of its rivers, and the fact that so many people travel over water or are employed in jobs that entail exposure to water, like fishing and logging (27). The U.S. rates for blacks are disproportionate as well — twice those of whites (36, 40). However, white children from 1 to 4 years old have twice the drowning rate of black children of this age, largely because of drownings in residential swimming pools. More whites than blacks also drown in boat-related incidents.

Costs

Rice and colleagues (1) estimated the cost of drownings for 1985 at $2.5 billion. In this cost study, drowning was defined as a death resulting from suffocation within 24 hours of submersion in water, and near-drowning was defined as survival beyond 24 hours after suffocation from submersion in water (1). The numbers and costs would have been larger if the definition had included all drowning deaths, no matter how long after the event the death occurred, and submersions that required any life support procedure.

Surveillance

Surveillance systems for drowning are very limited. Few states and municipalities have been willing to make the investment needed to begin such surveillance activities. Where surveillance activities are in place, they do not focus on all conditions for drowning. For example, the Arizona Department of Health Services, in cooperation with Maricopa county and Phoenix city health and safety officials, has developed a drowning surveillance system that

collects data important to our understanding of all components of drowning, both environmental and behavioral (41). The system, however, focuses mainly on drowning among small children in swimming pool settings. Most of the collected information would be relevant to any drowning surveillance system, but it would have to be expanded to include settings other than pools.

Each state needs to institute surveillance systems for injury conditions, including drowning. Such surveillance activities would need to be coordinated nationally in order to standardize definitions and monitor trends. In this way, we could monitor the number of drownings and partial suffocations and the effectiveness of innovative intervention strategies, involving legislation, technology, and education. The type of information to be captured by surveillance systems includes demographic data, the circumstances surrounding the submersion, how the event occurred, the type and condition of any existing barriers, the type and use of flotation equipment, whether alcohol had been consumed, if and when cardiopulmonary resuscitation (CPR) was administered, what type of medical care was given, and the outcome of the incident. Surveillance of the circumstances and locations of drownings is essential for targeting specific interventions to specific circumstances.

Research

We have identified several known and suspected risk factors for drowning. Young children have a different set of risk factors than older persons. Childhood drownings usually occur in swimming pools, bathtubs, and buckets. Lapses in adult supervision caused by chores, socializing, or phone calls are some of the risk factors implicated in drowning among children under 5 years of age. The danger of drowning among children also increases with the number of children present because of the difficulty of supervising several children at once. A lapse in adult supervision does not have to be long — 46% of young pool drowning victims in the CPSC study were out of sight for 5 or fewer minutes (42).

About 16% of drownings are associated with boating. More than 50 million persons engage in various recreational (noncommercial) boating activities on at least 8 days per year (43, 44), and 90% of all recreational boating deaths result from drowning. Unlike motor vehicle operators, recreational boaters are generally not required to be licensed, and many have received no formal training in boat operation and safety procedures. The effectiveness of licensure and training is unknown.

As many as one- to two-thirds of people who die in recreational boating incidents each year are found to have consumed alcohol just before death, although the baseline proportion of recreational boaters using alcohol at the same times and under the same conditions is not known. Therefore, the importance of alcohol as a risk factor for boat-related drownings needs to be clarified.

But we do know something about alcohol. We know that males are more likely than females to drink alcohol when on or near the water. We know also that 36% of boat owners use alcohol during aquatic activities. This finding is similar to results of a 1976 Coast Guard Survey (45), in which 40% of boaters reported having carried alcohol on board during routine outings. Despite alcohol's suspected role in drowning, more research on drinking behaviors and blood alcohol concentrations during aquatic activities is warranted. In a North Carolina study of drownings from 1980 through 1984, 53% of 752 drowning victims 15 years of age and older tested positive for blood alcohol, and 38% had blood alcohol concentrations (BACs) of 100 milligrams per deciliter or more (46).

Programs

Some programs have intervened in drowning. In New York State, for example, the safety guidelines for the operation of public bathing facilities were revised in March 1988 to reflect much of the new information that had been disseminated in research literature on environmental agents in water-related injury (47). Accordingly, for those facilities operated and regulated by the State of New York (natural waters and swimming pools), where safe diving and swimming were judged unavailable, diving boards were removed and diving prohibited, float lines and buoys were modified, and lifesaving equipment was upgraded (47).

Researchers from Australia and New Zealand have found that mandated pool isolation fencing alone has nearly eliminated child drownings in pools in those countries (11, 48). (Inner fencing, also called isolation fencing, means that a fence completely encloses the pool itself, isolating the pool from the house and yard.) No comparable data are available for the United States; however, in a multistate study of drowning and near-drowning conducted by the CPSC in 1987, researchers found that pools in which children drowned were significantly less likely to have had pool isolation fencing than were matched control pools (42). The support for pool isolation fencing is growing. In the CPSC study, researchers found that almost 40% of households with pools and resident children under 5 years of age had pool isolation fencing.

In one study in Phoenix, Arizona, researchers concluded that the presence of a pool isolation fence of adequate height could have prevented 35% of the drownings or near-drownings in pools (41). When combined with the findings about the role of inadequate gates and latches, we can assume that about 51% of the incidents may be prevented by use of passive barriers. Governing bodies in the Phoenix metropolitan area have passed mandatory fencing laws and barrier codes, and an educational campaign by hospitals and fire departments for the high-risk summer season is aimed at increasing the public's awareness of childhood safety relating to water recreation.

Where We Want To Be

Research

We particularly need to know the circumstances of drownings involving Native Americans and blacks and of drownings associated with boating. For example, are blacks and Native Americans who drown less likely to know how to swim? If so, are the waters in which they drown swimmable or do cold or swift waters offset their ability to swim? Does being able to swim a short distance increase or decrease the likelihood that swimmers will get into trouble? We need research to establish firmly the relationship between alcohol use and water recreation injuries, including drowning. More research is also needed on nonpool drownings.

Pool manufacturers have suggested swimming pool safety covers as an additional measure of drowning prevention. Research indicates, however, that children can become trapped and drown under certain types of pool covers and that very young children can drown in puddles of rain water that form on the surface of the cover (27). Pool covers have been accepted as an alternative to inner fencing for retrofit of existing pools without sufficient clearance for fencing. More research is needed, however, to determine the extent of the hazards that pool covers pose and the types of design modifications that could affect them. Research is also needed to determine the effectiveness of design changes such as energy-absorbing pool bottoms. These types of interventions are promising both in preventing drownings and in preventing certain severe but nonfatal injuries, such as spinal cord injuries related to diving.

Often, individuals and organizations have recommended that public education focus on the risks of drowning in all aquatic environments. This has not been evaluated in any state or local program. This untapped area of research should provide long-awaited answers about the effectiveness of programs already in use. Similarly, the effectiveness and timing of swimming programs for children as a strategy for preventing pool drownings has not been determined and warrants further research.

Programs

A pool isolation fence separates a residential pool from the house and yard. Such fences and self-latching gates should be mandated for all newly constructed and extant pools. The pool isolation fence should be at least 5 feet tall and otherwise comply with the CPSC guidelines.

The CPSC warns that inflatable rings, flotation devices, and swimming lessons are not adequate substitutes for adult supervision (27). Data from the Arizona study suggest that although fencing and constant supervision are effective prevention strategies, neither alone will prevent all drownings and near-drownings in backyard pools. Because it is unrealistic to believe that parents can observe a child 100% of the time, the use of passive barriers is

essential. However, many incidents occur when an adult and child are inside a fenced area or already in the water. Therefore, the education of parents about their child's safety at a pool should complement the emphasis on passive barriers to the pool. In addition, pool owners, parents, and other caregivers should be trained in basic rescue techniques and CPR.

Boat-related drownings occur under a variety of circumstances. Even so, there is an all-purpose prevention mechanism that can reduce this problem. Personal flotation devices, or life vests, can prevent many drownings, according to the U.S Coast Guard (27). These devices have been investigated widely, and we know that with their appropriate use during recreational boating, many drownings can be prevented. The Coast Guard and state and local governments, however, must enforce regulations requiring the use of personal flotation devices during all recreational boating activities.

Few states now require standard training or licensure to operate recreational boats. Some states require a boating education course, but these requirements are usually restricted to persons who are under 16 years of age. We still do not know the effect that licensing or education has on boat-related drowning, so further research is needed. Until we know more, states should require that boat operators demonstrate competency to operate boats of the size and engine power that they actually operate (27). At the 1981 National Conference on Injury Control, participants recommended that the sale and consumption of alcoholic beverages at boating, pool, harbor, marina, and beach areas be restricted (49). This proposed restriction still needs to be implemented.

How We Get There

Federal Government

- Advance research on the circumstances and specific locations of drownings and near-drownings that result in hospitalization, with special attention to minority populations, to drownings associated with water other than that in pools, and to potential means of prevention.
- Advance analytic studies of the characteristics of boats and motors involved in drownings and near-drownings.
- Support evaluations of the effectiveness of drowning interventions — swimming lessons by age, pool supervision, the use of certain types of pool covers, the use of barriers to high-incident sites other than pools, diving board removal, and licensure and training for boating.

- Develop, evaluate, and disseminate effective prevention programs.
- Fund analytic studies of alcohol's involvement with drowning in various settings.

State and Local Governments

- Conduct surveillance of circumstances and specific locations of drownings and near-drownings.
- Promote CPR training for all pool owners and for teenagers and adults among populations with high drowning rates.
- Require complete four-sided isolation pool fencing at least 5 feet high with self-closing latches for all swimming pools.
- Promote licensure and standard training for all boat operators.
- Enact and strictly enforce state laws that prohibit persons from operating boats while intoxicated.
- Enforce requirements for having personal flotation devices for all persons on boats.

Private Organizations

- The pool industry should sell safety equipment as part of the pool purchase and should develop new and more effective prevention technology such as energy-absorbing pool bottoms to reduce diving injuries (e.g., head and spinal cord injuries).
- The insurance industry should review actuarial drowning data and write homeowner insurance policies to reflect the presence of pools and spas, the presence of children under 5 years of age where a pool or spa is present, and the presence of protective barriers to pools and spas.
- The American Red Cross and other organizations should promote isolation pool fencing; poolside phones; and CPR training for all pool owners and for teenagers and adults among populations with high drowning rates.
- Private industry should develop technologies such as better personal flotation devices.

Academic and Research Institutions

- Conduct studies mentioned under "Federal Government," page 279.

Poisonings

Where We Are

Dimensions of the Problem

In 1986, about 5,740 people died of unintentional poisoning. Fatal poisonings among young children declined from 226 in 1970 to only 55 in 1985, but poisonings among young adults, associated mainly with drug use, have increased. Nonfatal poisonings occur in substantial numbers among young children — each year 80,000 to 90,000 of these children are seen in emergency rooms and about 20,000 are hospitalized (18).

Costs

In 1985, poisoning was estimated to cost $8.5 billion; these poisonings included some suicides and attempts that were not considered separately from unintentional poisoning (1). This cost does not include nonacute poisoning from lead and other substances.

Surveillance

Data on poisonings are mainly obtained from death certificates and records of poison control centers. Drugs are a major source of fatal poisoning (73%). Prescription and other legal drugs account for most of these poisonings, although cocaine and heroin account for a growing number (50).

Research

Most research on poisoning has been aimed at young children and the effects of poison-prevention packaging, the knowledge and use of ipecac syrup, and the availability of poison control centers. Major reductions in severe poisonings to children are associated with the introduction of child-resistant packaging of drugs and other household chemicals, but some backsliding in the use of such packaging has occurred. Ipecac syrup is effective for many ingested poisons, but it is rarely available to lower-income families or to childless households where children are visiting (27). Poison control centers have been found to be cost-effective but are in jeopardy because of losses in funding. Only 60% of Americans have access to a toll-free phone number for a poison control center.

Where We Want To Be

Research

Better identification of persons at risk for poisoning, particularly young adults, is needed. For example, how many persons who die of poisoning could have been identified by a previous, less severe episode that required medical attention? Drug education campaigns are often undertaken without research on the effects of the education on actual drug use. Research is needed to identify the effective programs and to weed out the ineffective ones.

Programs

Studies in New York State indicate that a net savings in medical care costs of some $18 million is realized from the operation of six regional poison control centers (51). Funding for poison control centers among the states varies widely by amount and by source (52). The legislature provided that the centers be funded from hospital insurance revenues; however, funds are needed for 24-hour-per-day, 7-day-per-week coverage, particularly in rural areas where emergency rooms are often distant.

How We Get There

Federal Government

- Support surveillance of the circumstances and locations of severe and fatal poisonings.
- Support analytic research on the distribution of and access to both legal and illegal drugs.
- Review standards for the packaging of drugs and household chemicals and tighten standards for child-resistant containers that are frequently involved in child poisonings while considering needs of the elderly.

State and Local Governments

- Support continued funding for poison control centers, including funding from insurance and Medicare and Medicaid payments.
- Provide a toll-free telephone number for information on poisons for people who do not have access to a local poison control center.

Private Organizations

- Conduct campaigns to increase the availability of ipecac syrup in all households.
- Cooperate with scientists in the evaluation of campaigns against drug use.
- Discourage advertisers from linking alcohol use to sports activities and from sponsoring television programs glamorizing drug use.

Academic and Research Institutions

- Conduct analytic studies on the extent to which persons at risk for poisoning can be identified.
- Conduct evaluations of the effectiveness of poison prevention and drug use treatment programs.

Fire- and Burn-Related Injuries

Where We Are

Dimensions of the Problem

From 1980 to 1986, deaths from fires and burns declined (Table 1), perhaps largely because of the widespread adoption of smoke detectors. Nevertheless, fires remain a formidable cause of death, resulting in nearly 5,000 deaths in 1986. House fires cause three-fourths of all fire and burn deaths, with smoke inhalation and resulting carbon monoxide poisoning causing two-thirds of these deaths (1).

Each year, some 54,000 persons are hospitalized from burns, and about 1.4 million people experience burns that do not necessitate their being hospitalized (1). A severe nonfatal burn is among the most devastating injuries a person can survive and may result in permanent scarring and disability. Scalds are the most common burn injury; and flame burns are the most severe (53).

Groups at higher risk for fire or burn deaths include the very young, the elderly, and minority populations. Deaths due to house fires are highest among the very young and the elderly (2), whereas clothing ignitions occur mainly among the elderly (54). Children under age 4 are at the highest risk of nonfatal burns (two-thirds from hot-liquid scalds) resulting in hospitalization. Cigarette lighters in the hands of very young children are a major cause of fatal fires (55). Males are at higher risk of both fatal and nonfatal injuries resulting from fires and burns, although the risk differences between the sexes are not as great as for other injuries (56). Elderly black males are at highest risk for death from residential fires; elderly black females are at a higher risk than whites of either sex (53). Eight states — Alabama, Alaska, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina — have particularly elevated fire-related death risks, and fire- and burn-related deaths also tend to cluster in city neighborhoods.

Costs

Lifetime costs for fire- and burn-related injuries in 1985 were estimated to be $3.8 billion — $920 million in direct costs, $1.5 billion in morbidity costs, and $1.4 billion in mortality costs (1).

Surveillance

In many jurisdictions fire departments maintain data on types, locations, ignition sources, and property damage of fires that generate fire department response, and these departments can be a source for data on those fire-related injuries. Other burns (scalds, electrical,

and radiation) are not included, but have specific external-cause-of-injury (E) codes. However, since only a few of all the burn injuries occur in structural fires, hospital discharge records are the most useful source for data on burns. For use in surveillance, these data must be E-coded, since without this E-coding the type of burn (flame, scald, contact, chemical, radiation, or electrical) cannot be distinguished (57).

Research

The most common ignition source in house fires is a cigarette dropped on furniture or bedding (58). Clothing ignition is a major risk factor, particularly among the elderly while cooking (5). Thus, commercially viable flame-resistant housecoats and robes for older adults should be developed. Alcohol is involved in more than 40% of fatal fires (59), but analytic studies to determine relative risk related to general alcohol use have not been done. Gasoline-involved burn injuries accounted for 62% of all admissions of children aged 10-15 years of age at a pediatric burn unit (60). More than two-thirds of the very young children hospitalized for burns were scalded when hot food or drinks were spilled on them (56).

Programs

Cigarettes can be manufactured to be less likely to ignite furniture (58); however, manufacturers have yet to do this.

Smoke detectors and residential sprinklers also save lives. People living in homes without smoke detectors are twice as likely to die in fires as those in homes with detectors (61). Smoke detectors are now present in 83% of U.S. households, but about a third of the detectors do not function because of dead or missing batteries (62). Residential sprinklers, now technologically feasible, could protect all populations, particularly persons impaired by age, disability, or substance abuse. Installation of residential sprinklers is estimated to cost about 1% of the total cost of a new home (63). In addition to saving lives, the use of residential sprinklers could reduce insurance premiums and property damage costs (64).

One state's legislation regulating the temperature settings of new hot water heaters has reduced injuries from exposure to scalding tap water, and resulted in a voluntary industry standard that requires heaters from the factory to be set at 120° F (65). After identifying a particular design of coffee maker involved in many scald burn injuries, Danish doctors facilitated the redesign and aggressive marketing of a new coffee maker, which resulted in a marked reduction in such burns (66). Clothing ignition burns have been reduced by the use of less flammable fabrics and more closely fitted garments (5).

Where We Want To Be

Research

Research is needed to determine possible causes for the high incidence of fire- and burn-related deaths in the eight-state "fire belt" and in particular city neighborhoods. Research should also focus on designing preventive interventions. Possible factors include poor housing construction, extensive use of space heaters, and use of space heaters in trailers.

Special studies and in-depth investigations of burn events, particularly kitchen scalds and gasoline-fire burns, should be conducted to determine whether any product or environmental modifications could prevent these injuries.

Programs

The National Institute of Standards and Technology is developing an ignition-propensity standard for cigarettes. When work is completed, all cigarettes manufactured or sold in the United States should be required to meet this standard.

To assure that smoke detectors are effective, the nation should launch a media campaign to encourage people to replace their smoke detector batteries each fall when they change their clocks to standard time. In addition, the responsiveness of smoke detectors to actual smoke must be checked periodically to identify problems not related to the device's battery and electrical wiring.

Sprinkler systems should be required in all new residential constructions.

All new bathroom faucets and shower heads should contain antiscald devices, and the thermostats on all hot water heaters should be preset at a maximum of 120^{o} F by the manufacturer.

How We Get There

Federal Government

- Support surveillance of the circumstances and specific locations associated with burns that result in fatalities or hospitalizations.
- Support analytic studies of kitchen scalds, coupled with research by engineers and product designers to remedy correctable hazards.

- Advance analytic studies of burns involving gasoline, coupled with research by engineers and product designers to remedy correctable hazards associated with containers and storage.
- Fund the development and evaluation of community-based prevention programs in high-risk urban and minority communities.
- Support research on the problems of burns among older people and the influence of cognitive impairment, mobility, and environmental features as risk factors in order to devise preventive measures.
- Require cigarettes sold in the United States to have a low potential for igniting upholstered furniture.
- Conduct an in-depth investigation of clothing-ignition burns in children to determine if the flammable fabrics standard for children's sleepwear is being undermined by the labelling of sleepwear as daywear.
- Apply the flammable fabrics standard to loose-fitting housecoats and bathrobes now commonly worn by older persons who are burned while cooking and smoking.
- Regulate disposable cigarette lighters to make them child-resistant.

State and Local Governments

- Conduct surveillance of the circumstances and locations associated with burns that result in fatalities or hospitalizations.
- Collaborate with the CDC and CPSC in conducting in-depth investigations of clothing ignitions, kitchen scalds, and burns involving gasoline.
- Require antiscald devices in new showers and tubs.
- Develop or enforce maximum hot water temperature regulations for residential institutions.
- Develop, implement, and enforce codes to address burns in residences, including codes requiring smoke detectors, sprinklers in new housing, and antiscald devices in hot water systems.

Private Organizations

- Safety organizations should form a coalition among themselves and with local fire departments to launch a media campaign encouraging consumers to routinely change batteries in smoke detectors when clocks are changed to standard time each fall.

- Utility companies should check hot water temperatures when meters are read and recommend settings at 120^{o} F or less, if necessary.
- The American Association of Retired Persons should push for the development of flame-retardant clothing for the elderly.
- Insurance companies should support the installation of sprinklers in multifamily homes by reducing insurance premiums (Appendix, see Year 2000 Objective 9.16).

Academic and Research Institutions

- Conduct analytic studies mentioned under "Federal Government," page 287.
- Evaluate fire department, community, and school-based fire and burn injury prevention education.
- Study the characteristics of appliances and utensils that may affect the incidence and severity of burns.

Firearm Injuries

Where We Are

Dimensions of the Problem

In 1986, firearms accounted for 1,452 deaths classified as unintentional (Table 1), but when intentional firearm deaths (homicides and suicides) are included, the total firearm death toll is second only to that for motor vehicle-related deaths. In recent years, more than 31,000 deaths, 65,000 injuries requiring hospitalizations, and an additional 236,000 less severe injuries have occurred annually from firearms (1). Although unintentional injuries from firearms account for only 5% of all firearm deaths, many potential interventions apply to both intentional and unintentional injuries from firearms.

Costs

The *Cost of Injury* report indicated that all firearm injuries (intentional and unintentional) cost the nation about $14.4 billion in 1985 (1). The report did not distinguish between intentional and unintentional injuries.

The firearm death rate is highest among males 15-44 years old, especially among blacks 15-34 years old, white teenagers, and Native Americans (2). Until recently, handguns accounted for more than three-quarters of firearm deaths, but the recent increase in the use of machine guns and assault rifles may have changed the proportion. In the 1960s and 1970s, the increase in firearm deaths paralleled the increase in new firearm sales (67). Newspaper reports suggest that machine pistols and assault rifles increase the numbers of people hit by stray bullets.

Surveillance

Surveillance of the types of guns involved and the circumstances of firearm injuries is needed. How many injuries are sustained while hunting or cleaning weapons? How and where are children injured by firearms? (See Appendix, Year 2000 Objective 9.15.)

Research

Many of the effects of firearm characteristics and gun control apply to unintentional as well as intentional injuries. We have substantial evidence that in firearm deaths the intent of the assailant is usually less important than the lethality of the weapon. For example, the muzzle velocities of firearms and bullets range widely, creating energy ranging from 124 to 4,440 foot pounds at close range, and the fragmentation of bullets in tissue greatly increases the severity of the injury. The international convention (Geneva Convention), requiring that

military bullets be fully jacketed and retain their original shape while moving through tissue, have not been applied to bullets sold for domestic use in the United States (68).

Programs

Most firearm injuries occur in disputes among acquaintances and families in private residences (69). Comparison of assault rates and death rates between the United States and other countries suggests that assault rates are similar but that death rates are much higher because of the availability of firearms in the United States (70,71). The effectiveness of strict state and local gun control laws is limited by the transport of firearms from jurisdictions with little or no regulation.

The regulation of firearms in the United States is a disorganized patchwork of federal, state, and local laws. A few weapons are banned by federal regulation, but such regulations have not kept up with the changes in weapons. Access to firearms is discussed in greater detail in the position paper on violence. Limiting access to firearms is a Year 2000 Objective (see Appendix, Objective 9).

Where We Want To Be

Research

Studies of the circumstances of teenagers' and children's access to firearms in cases where they are injured while playing with firearms should help us devise countermeasures. Better research on the history of the firearms involved in such injuries might identify points where interventions are feasible. Analytic studies are also needed to determine the relative risk of injury from firearms and ammunition by various characteristics, such as firing rate, trigger tension, safety catches and locks, visible indicators that the firearm is loaded, muzzle velocity, and bullet shape and fragmentation. Also needed is research on how firearm injuries affect the psychology and social relationships of individuals and how they affect communities and their economies.

Programs

The public's desire for greater regulation of firearms (72) should be enforced through public policy. Regulation of the characteristics of firearms and ammunition should be commensurate with their effect on the public's heath. Programs that promote safe procedures during target practice, hunting, and the cleaning of firearms are also needed.

How We Get There

We observed that many of the Violence Panel's recommendations apply to unintentional as well as to intentional firearm injuries. (For the full text of the Violence Panel's recommendations, see the panel's position paper.) We fully endorse all of the Violence Panel's recommendations. In particular, we endorse the panel's suggestions regarding the need to (a) minimize ready access to handguns and other firearms through a variety of strategies focused on three broad areas: educational or behavioral change interventions, technological or environmental interventions, and enhanced and new legislative or regulatory effort; and (b) continue rigorous scientific research to delineate with greater precision the risks and benefits of ready access to firearms. In addition, we make the following specific recommendations:

Federal Government

- Recognize firearm injury as a public health problem and establish the regulatory authority for promulgating safety standards for firearms, addressing trigger locks, muzzle velocity, and visible indication as to whether the gun is loaded (see Appendix, Year 2000 Objective 9.15).
- Establish the regulatory authority for promulgating safety standards for all ammunition, applying the international laws (Geneva Convention) and current military ammunition safety standards.
- Support surveillance of firearm injuries, including a history of the involved firearm, its make and model, characteristics of the weapon and ammunition, circumstances of the injury, storage of the weapon, and means of access.
- Support analytic studies of characteristics of firearms and ammunition that are thought to increase the incidence and severity of injury.
- Develop and implement prevention programs, including strategies to store guns in secure facilities outside of homes.
- Evaluate the effects of firearm safety training on injuries.

State and Local Governments

- Collaborate with CDC in increased surveillance.
- Enact legislation requiring waiting periods and background checks for firearm purchases and building codes for firearm storage.
- Enforce extant regulations.

Academic and Research Institutions

- Conduct analytic studies of characteristics of firearms and ammunition involved in injury.
- Conduct evaluation of the effectiveness of firearm education and gun control laws and regulations.
- Conduct research on the psychological, social, and economic effects of firearm injuries on the injured, the shooters, the families of both, and communities.