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Taking up the challenge of injury control

Help your patients avoid injury by first raising your awareness of the occasions of harm, then counseling them on prevention--with the same importance you place on preventing coronary artery disease.

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The statistics on injury are relentless: Injury--of all types--is the leading killer of people between 1 and 34 years of age in the United States.[1] As many Americans are killed every year in motor vehicle crashes as were killed in the Vietnam War, at a cost of more than $60 billion in medical care, property

damage, and other losses[2]; and injury exacts a greater toll in potential years of life lost than cancer and cardiovascular disease combined.[3]

Yet, in 1985 the National Research Council of the Institute of Medicine reported that, for every dollar spent on cancer research, the federal government spent 11 cents on injury research.[4] Clearly, this is an area of public health that demands greater attention by researchers--and by clinicians.

What is the greatest barrier to successfully addressing the epidemic of injury? Perhaps our preconceptions. Injuries appear to be random, almost inevitable; we are told, after all, that "accidents happen."

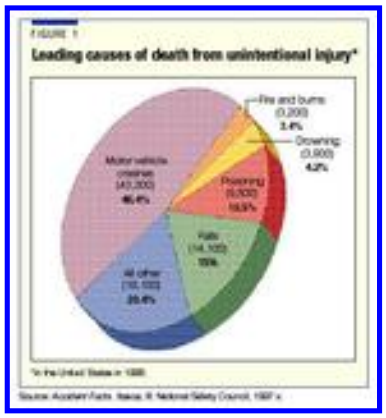
In fact, injuries are far from random: Events as disparate as a fall from a window and a Prussian cavalryman being kicked by a horse have been fitted into statistical models![5] Accidents may be unavoidable, but injuries are control- lable.

This article reviews the causes of injury and their descriptive epidemiology. It is also an introduction to concepts of injury control that you can utilize in practice.

Descriptive epidemiology

With notable exceptions,[6-8] much of the epidemiology of injury describes mortality; these are the statistics that are most readily available. And while lack of a comprehensive database led one researcher

to declare, "We simply do not know what the incidence of trauma is in this country, or where it occurs,"[6] we can learn much from mortality statistics. (Keep in mind William Farr's observation: "The death rate is a fact; anything beyond this is an inference."[9]) Figure 1, and Figure 2, illustrate aspects of the problem.



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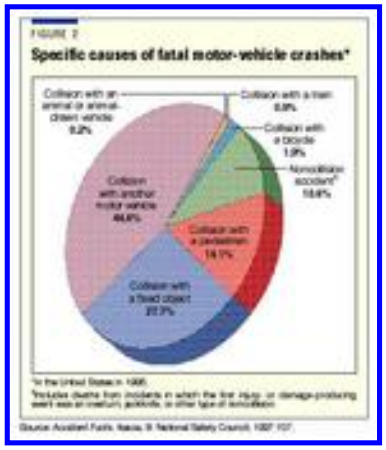

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Following is a brief review of the descriptive epidemiology of injury, classified by mechanism. Injury has traditionally been classified by intent--suicide, homicide, accidental--but for the purposes of prevention and control, the categorization used here makes more sense.[10]

Motor vehicle crashes are the leading cause of death by trauma worldwide; the number of victims surpasses even casualties of war.[3] A pronounced age-related pattern of death is evident: Among vehicle occupants, an increase after 13 years of age peaks at 18 years; among pedestrians, a peak is seen at 6 years.[11] Although the consequences of an injury from a motor vehicle crash (from any cause, for that matter) are greater for the elderly, this is a hazard of the young.

In the United States, deaths by motor vehicle declined from a high of about 55,000 annually in the 1960s to about 40,000 in the 1990s. Much of the decline is attributed to federal and state regulations, such as the 1966 National Traffic and Motor Vehicle Safety Act and the related Highway Safety Act.[12]

Most deaths of motor-vehicle occupants are caused by deceleration injury. Control measures have been aimed at decreasing speed on highways, improving the crashworthiness of cars, and distributing deceleration forces over a greater area of the body with seatbelts and airbags. Large trucks pose a particular hazard; they account for 1% of vehicles on the road but 10% of fatalities.[12]

Vehicle occupants account for 84% of motor-vehicle-related deaths.[1] Pedestrian death is the second major category of victim. Pedestrian injuries afflict the youngest and the oldest; among children, crash injuries

peak between the ages of 5 and 9 years and are associated with male gender, low socioeconomic status, and crowded housing.[1]

Because of the massive transfer of energy from vehicle to body in a crash, it would appear that the most effective public-health measures involve prevention. But some characteristics of the vehicle may be amenable to change. Vehicle size and weight, for example, contribute to the severity of pedestrian injury; as might be expected, the bigger the vehicle, the deadlier. Other contributors to the severity of injury are the shape of the vehicle, the height of the bumper relative to the height of the pedestrian, speed at impact, and braking action.[13]

Firearms are the second-leading cause of death by injury; the rate in the United States is 90 times that of any other country.[2] Handguns account for 25% of an estimated 100 million firearms in the United States but are involved in 80% of gun-related injuries.[2]

Guns are a particularly lethal mechanism of injury and are often involved in suicides and homicides. The case-fatality rate for assaults involving firearms is five times greater than for assaults involving sharp instruments such as a knife.[14] Homicide is the leading cause of death among black people between 15 and 34 years and "the leading cause of fatal occupational trauma in women, accounting for 47% of work

injury deaths."[14]

The second major category of injury (although not of accidental death) most often affects the elderly, with fracture of the hip among the most common of serious injuries. A 50-year-old white woman who has osteoporosis has a 40% lifetime probability of suffering a hip fracture.[15] Falls are the third most common cause of death from injury--but are the leading cause of hospitalization from injury.[12]

Possible means of control and prevention include epidemiologic surveillance to identify locations in the community where people are prone to fall, counseling, and exercise programs to increase the threshold of injury among people at greatest risk.

Poisoning accounts for as many as 15,000 deaths a year, most often involving adults, and for one half of suicides.[16] Carbon monoxide is the most common cause of death by poisoning, although deaths caused by opium and cocaine use increased greatly during the 1980s.[16] An injury-control success story is the Poison Prevention Packaging Act of 1970, which has been associated with more than halving the rate of salicylate poisoning in children.[15]

Smoke detectors have decreased fire-related mortality by 70%; additional lives could be saved by introducing fire-safe cigarettes, which are available but not marketed.[15] The Flammable Fabrics Act of 1953 has also contributed to a decline in fire-

related deaths.[12]

A simple means of preventing scalding is to lower the temperature on a home water heater: When water is heated to 60°C, for example, a third-degree burn develops in 2 seconds; at 50°C, the same burn takes 10 minutes.[15]

The importance of drowning varies geographically. In 10 states, drowning is the leading cause of unintentional-injury fatality. In most areas it is associated with rivers and lakes, except that in Los Angeles, most drownings occur in pools.[17] It is noteworthy that only 2% of drownings involve surfers and divers.

Personal and noncommercial business flights (such as one carrying a nonprofit medical care team serving a rural area) account for 88% of the 1,300 civilian aircraft crash deaths annually; the risk of a fatal crash is 40 times greater for these nonscheduled, so-called general aviation flights.[18] Among scheduled flights, a traveler on a smaller, so-called commuter flight is 9 times more likely to be involved in a fatal crash than a traveler on a large airliner. Almost 60% of deaths among active-duty naval officers are from a plane crash.[18]

Consumption of alcohol plays a role in many injuries. Most serious injuries occur on weekends and at night, when consumption is highest.

Although the role of alcohol in injury is not

completely understood, it is known that, controlling for the level of damage, the rates of death and disability in motor-vehicle crashes are increased when alcohol is involved.[3] Researchers in a case-control study found that alcohol intoxication among pedestrians, particularly the elderly, is a strong risk factor for death.[19]

There is correlation between the motor-vehicle death rate and the rate of other unintentional injuries, which may reflect common factors such as alcohol use.[11] An increased blood alcohol concentration is seen in 40% to 50% of adult drownings, for example.[17] In 1980, 53% of fatally injured passenger-car drivers had a blood-alcohol concentration of 0.10% or greater; each 0.02% increase doubled the risk of a fatal crash.[20]

Preventive measures have relied on punishment, yet almost 80% of intoxicated drivers killed in a crash had no convictions for driving while intoxicated. Increases in the price of alcoholic beverages have been shown to be effective in reducing alcohol consumption and related problems, such as injury.[12]

Addressing injury control in daily practice

Your first step should be to raise your level of awareness--to realize that it is as important to educate your patients about injury control as it is to counsel them about risk factors for heart disease. Next, you

must identify high-risk populations and tailor your counseling by teaching patients about common mechanisms of injury they are likely to confront.

Regrettably, comprehensive materials on injury prevention for health-care professionals are lacking.[21] The American Academy of Pediatrics (AAP) has developed The Injury Prevention Program (TIPP), which is based on developmentally appropriate protocols*; a brief review of AAP recommendations can be found in Table 1.[22] A summary of general recommendations for injury prevention from recent articles in the New England Journal of Medicine appears in Table 2.[1,15]

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As with any public health intervention, you must first educate yourself about where risky behaviors are found. A few examples:

* Some older children (and some adults) improperly place shoulder seat belts behind their back, which decreases the effectiveness of the restraint; counsel patients and parents against this practice

* Caution parents that children under 13 years should sit in the rear seat of a vehicle[1]; this is not a widespread practice

* To prevent burns, advise patients to install smoke detectors in their home and reduce the temperature of tap water at the water heater; offer guidelines for stove safety to protect toddlers and small children[23]

* Address the importance of pool safety when appropriate, educating parents on the necessity of constantly supervising young children and warning patients about the strong association between alcohol intoxication and drowning. (In one study, the odds ratio for drowning was 4.6 when a person's blood-alcohol level was 10 to 99 mg/dL; this increased to 31.8 at 100 mg/dL and above.[15])

* Make parents aware of how commonly children catch their fingertips in closing doors-often of an automobile.

Causation versus blame

Analysis of what cause injuries has been called the "long cut to prevention."[24] Many injuries are the result of use or misuse of technology, but manufacturers are loathe to admit design flaws as the cause of injury; instead, they point to behavior. But epidemiology cannot control for every behavioral variable. This debate--or avoidance of it--has important implications for injury control.

Focus on the physics of energy exchange (between the person and the environment) has been proposed as a solution to the debate of behavior versus engineering.[24] Dispensing medication packages with fewer pills than required for a lethal dose, for example, may reduce the rate of poisoning, regardless of who is, so to speak, at fault.

Lowering exposure to energy to below the tissue-damage threshold is a major means of injury control. Consider the effect of a seat belt: In a striking example of the ability of the human body to withstand exposure to energy, Stapp decelerated a rocket sled from 632 miles an hour to a complete stop in 1.4 seconds without seriously injuring the occupant of the sled.[25] The pertinent and modifiable variables were a long stopping distance, a harness that distributed energy over a large body area, and the inherent resistance of the body to transient forces.

Part of the debate arises from confusing cause with blame. Blame need not be assigned to determine cause. Epidemiologists have considered the idea of

causality; clear-cut criteria for cause, such as those proposed by Hill,[26] may be applied effectively to injury epidemiology:

* How strongly is the factor [proposed cause] associated with the injury?

* How specific and consistent is that association?

* Is the association plausible?

Questions such as these can lead to reliable conclusions, but the relative nature of causality must also be considered. It is telling that MacMahon and Pugh chose an injury as an example of the relative nature of causality:

"The pedestrian struck by an automobile and dying with a ruptured spleen shortly after admission to hospital is an example. The pathologist may ascribe the death to splenic rupture, the internist to shock, the surgeon to delay in diagnosis in the admitting room. The Registrar of Vital Statistics may be content to assign the death to 'Motor vehicle accident involving pedestrian.' The highway engineer, in defending his next annual budget, may attribute the death to lack of adequate separation of pedestrian and vehicular traffic, while the engineer responsible for automobile design may count the case among those due to brake failure."[27]

Add politics to the debate, as with gun control, and it becomes clear that assigning

blame is better left to political pundits and lawyers. You, however, can benefit from the work of epidemiologists and other experts in identifying possible avenues for controlling injury among your patients.

Do we want to control? or prevent?

Prevention is not the only, or the most effective, way to address injury. In a mechanized and technology-driven society, mishaps and misadventures are endemic: "Accidents" do, after all is said, happen. Your goal--the goal of society--should be to reduce the severity and consequences of end points, not just to prevent events.[28] Even the most conscientious postal employee drops a box; we're prescient by packaging it well.

To guide efforts to control injury, Haddon developed a matrix that categorizes factors and phases of an injury.[28] Factors are based on the epidemiologic triangle of host, agent, and environment.[29] In an injury the factors are most often human, vehicle, and environment. Phases refer to the time during which the injurious forces are marshaled: preevent, event, and postevent. A simple demonstration of a Haddon matrix for a motor-vehicle crash is shown in Table 3.

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You can easily adapt Haddon's approach to characterize the types of injury you see in your practice and your community. Haddon's matrix also makes clear that emphasizing only behavior ignores other possibly fruitful avenues of control. (Emphasis on the individual "results in blame being placed on the victim," as Barancik and colleagues noted; taking that approach to polio, we would still be trying to prevent the disease by keeping children out of pools.[6])

Most injury-control experts advocate a balanced approach based on a hierarchy of control measures--the so-called three Es of enforcement, education, and engineering.[30] Enforcement refers to seat-belt laws and penalties for driving while intoxicated, for example.

PAs naturally fall into the role of educators. Education and counseling have been shown to be effective in preventing injury. For example, when a community (in the northern end of New York City's borough of Manhattan) participated in a program of multiple safety-education initiatives, a 35% reduction in severe traffic injuries and a nearly 50% decline in severe assault injuries followed.[31, 32]

You should also be aware of the effectiveness of engineering approaches. For example, the simple measure of reducing the carbon monoxide content of natural gas decreased the incidence of suicide by carbon monoxide in Birmingham, England, by

45%.[15]

In conclusion: For your practice

Educate yourself about the epidemiology of injury, and you can identify at-risk populations and interventions and incorporate that knowledge into practice. If your educational efforts are to succeed, it may be best to concentrate on specific behaviors or actions--not just to offer a vague exhortation to "stay safe."[12]

As with many public health interventions, a balanced approach will be most successful; Haddon believed that any single measure is "guaranteed" to fail.[28] The so-called New York model introduced the three Es and described how to integrate them.[30] That integrated approach continues to be the goal of the medical and public-health communities.

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