Injury as a Field of Public Health: Achievements and Controversies

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The mission of public health is to assure the conditions in which people can be healthy and to reduce the occurrence of death and disability attributable to disease and injury. From the distinctive perspective of public health, the target is the health of the population as a whole, with a particular concern for vulnerable populations within the whole. Although public health is grounded in science, the mission and perspective of the field are shaped by the ever-evolving values of the society. Ethics and law are therefore constituent disciplines of public health policy and practice. One of the major challenges confronting contemporary practitioners of public health is the need to broaden and deepen their understanding of legal and ethical aspects of their work. This special issue of the Journal of Law, Medicine & Ethics responds to this challenge. This article describes how the mission of public health has come to encompass the prevention and treatment of injury and highlights some of the political and ethical controversies now confronting the field. It does so from an internal perspective — i.e., embracing the preventive mission and orientation of injury practitioners and policymakers — rather than from an external evaluative perspective, whether of law or ethics.

Origins of the Injury Field

For centuries, human injuries have been regarded either as random and unavoidable occurrences ("accidents" or "acts of God") or as untoward consequences of human malevolence or carelessness. From this perspective, the main strategies for prevention are prayer and human improvement. With the advent of industrialization in the nineteenth century, the environmental risk factors for injury became more discernible, and the challenges of "accident prevention" and industrial safety began to receive sustained attention. Railroad, textile, and mining industries began recording work-related injuries in the early 1800s. Political movements for worker protection developed in Europe in the mid-nineteenth century and later in the United States. Early developments include the creation of the National Safety Council in the United States in 1913 and the Royal Society for the Prevention of Accidents in England in 1916.

Although interest in worker safety, child safety, and driver safety grew over the course of the twentieth century, systematic scientific inquiry was rare, and the ameliorative efforts undertaken by interested private constituencies were episodic and unconnected. This situation changed dramatically during the 1960s and 1970s when two developments converged to establish the intellectual and programmatic foundation for a new field of research and social action: (1) the emergence of injury science as a distinct interdisciplinary field of public health; and (2) a substantial social investment in injury prevention, spurred by a burst of federal regulatory action.

Scientific innovations

Modern injury science began to take shape as a distinct field in the mid-1960s. Perhaps the key conceptual development was the recognition that patterns of injury distribution and causation can be analyzed using the epidemiological tools of public health, and that the etiology of injury includes environmental factors and interactions between human and environmental factors. The formulation of the prevailing scientific paradigm for studying the causes and prevention of injury is generally attributed to William Haddon, a public health physician.
Building on the work of John Gordon and James Gibson, Haddon observed that all injury events are attributable to the uncontrolled release of one of five forms of physical energy (kinetic, chemical, thermal, electrical, and radiation). From a preventive or ameliorative standpoint, interventions can be made during three temporal phases in relation to the injury event: (1) a "pre-event" phase, during which the energy becomes uncontrolled; (2) a brief "event" phase, in which the uncontrolled energy is transferred to the individual, resulting in injury if the energy transfer exceeds the tolerance of the body to absorb it; and (3) a "post-event" phase, during which attempts can be made to restore homeostasis and repair the damage. This three-phase conceptualization of injury causation can be combined with the traditional public health categorization of risk factors and intervention opportunities — host (the potential injured person); agent (the energy and the vehicle through which it is transferred); and environment (both physical and social) — to create a twelve-cell matrix that can be modified to apply to any circumstance of injury (see Figure 1). Using this model to identify risk factors and potential interventions during all three temporal phases, Haddon summarized the range of interventions as follows: (1) preventing or limiting energy build-up; (2) controlling the circumstances of energy use to prevent uncontrolled release; (3) modifying the energy transfer phase to limit damage; and (4) improving emergency response, treatment, and rehabilitative care to limit disability and promote recovery.

Policy and practice innovations
Haddon’s ideas had a demonstrable impact on public policy. Spurred by public concern about vehicle safety that had been aroused by the publication of Ralph Nader’s Unsafe at Any Speed in 1965, Congress enacted the Highway Safety Act in 1966, signaling a national commitment to reducing injuries and deaths on the nation’s highways. In this path-breaking legislation, Congress empowered a new federal agency, the National Highway Safety Bureau (now the National Highway Traffic Safety Administration), to set motor vehicle safety standards and to make grants for research and programs promoting highway safety. Haddon became the first director of the new agency. Four years later, the federal Occupational Safety and Health Act established a regulatory agency (the Occupational Safety and Health Administration) to set and enforce workplace safety standards and a separate research agency (the National Institute for Occupational Safety and Health). This period of federal regulatory innovation was consummated with the enactment of the Consumer Product Safety Act and companion legislation in 1972 that established the Consumer Product Safety Commission.

Throughout this formative period, diverse initiatives were undertaken by a variety of other federal agencies, state governments, foundations, and citizen activists to promote safety and ameliorate the burden of injury. Examples include Kellogg Foundation grants for home accident prevention in the 1950s and 1960s, the founding of the American Trauma Society in 1968, the establishment of 600 poison control centers in the 1960s and 1970s, the creation of a federal program on emergency medical services in the 1970s, the funding of state injury prevention programs by the Division of Child and Maternal Health of the Department of Health, Education, and Welfare in 1979, and the founding of Remove Intoxicated Drivers in 1978 and Mothers Against Drunk Driving in 1980. Although these activities were not coordinated, they reflected a common aspiration and a shared recognition of the potential benefits of concerted social action to reduce injury. Taken together, they substantially increased the number of individuals and organizations engaged in injury prevention research and practice, and thereby began to build the infrastructure for a new field.

**Figure 1. Injury Prevention and Amelioration: The Haddon Matrix.**

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<thead>
<tr>
<th>Factors</th>
<th>Individual Behavior</th>
<th>Physical Environment</th>
<th>Socioeconomic Environment</th>
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<td><strong>Phases</strong></td>
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The National Academy of Sciences oversight
The National Academy of Sciences (NAS) has taken a strong interest in developing and strengthening the scientific foundations of injury prevention and treatment. In 1966, NAS's Division of Medical Sciences and the National Research Council (NRC) issued Accidental Death and Disability: The Neglected Disease of Modern Society, recommending that the nation’s public and private resources be mobilized to reduce accidental death and injury in an effort equivalent to the (then) recent assaults on polio and cancer. The recommendations in the report focused mainly on improving emergency medical care, but the committee also addressed trauma research and injury prevention, recommending the creation of a National Institute on Trauma at the National Institutes of Health (to sponsor and conduct a program of injury treatment research) and a National Council on Accident Prevention in the executive branch (to coordinate and advise federal regulatory agencies and to provide support for research and program development).

Nearly twenty years later, a Committee on Trauma Research established by the NRC and NAS's Institute of Medicine (IOM) conducted a new study at Congress's direction and issued what has become a landmark report, Injury in America: A Continuing Public Health Problem. That committee recommended a major national program of research to address "serious, but remediable, inadequacies in the understanding of and approach to injury as a health problem." The significance of Injury in America lies both in its intellectual contribution and in its influence on national policy. Intellectually, the committee set forth the rationale for conceptualizing "injury prevention and control" as a distinct field of interdisciplinary research, drawing together what had been separate strands of scientific study within the framework of public health. In terms of public policy, the committee recommended a major investment in injury research, commensurate with the magnitude of the problem, and proposed the creation of a center for injury research within the Centers for Disease Control, now the Centers for Disease Control and Prevention (CDC). Soon after Injury in America was released, Congress appropriated funds for a pilot program for injury control at the CDC, and two years later, a new committee within the NRC reviewed its progress. In Injury Control: A Review of the Status and Progress of the Injury Control Program at the Center for Disease Control, this committee concluded that the program had been sufficiently successful to warrant permanent support.

In 1997, a new Committee on Injury Prevention and Control was established by the IOM with funding from the Robert Wood Johnson, W.K. Kellogg, and John D. and Catherine T. MacArthur foundations to review the present status and direction of the field and to make appropriate recommendations for advancing the field and for reducing the burden of injury in America. The committee's charge was broader than those of the previous committees established by the NRC and IOM. It included studying "opportunities and barriers" for practice as well as research (Injury in America focused exclusively on research) and "the response by public and private agencies," not only the activities of the CDC's program at the National Center for Injury Prevention and Control. The committee's report, Reducing the Burden of Injury: Advancing Prevention and Treatment, published in 1999, provided a broad overview of the field of injury prevention and treatment, and made numerous recommendations for strengthening the scientific infrastructure of the field and for improving policy and practice. The committee noted in the report's preface that the panel "was conceived at a moment of confusion (if not crisis) in the field."

Among other concerns, questions had been raised about the validity and value of research conducted by injury specialists concerning the benefits and risks of owning and carrying firearms, and on the effect of "gun control" interventions. When the Republican Party took control of the House of Representatives after the mid-term elections in 1994, the continued existence of the CDC injury center was in doubt. In the end, Congress forbade the use of CDC funds to support gun control. An important issue before the new IOM committee was "whether the priorities of injury policymakers, researchers and practitioners had become distorted by an undue emphasis on firearms, and perhaps by a bias in favor of gun control." More broadly, the committee also asked, "whether prevention of violence is being over-emphasized in comparison with the field's traditional emphasis on unintentional injuries."

These important questions have major implications for the future of public health — its mission, its priorities, and its credibility. Drawing on the IOM committee's work, we reflect on the policy questions about the mission of public health underlying the gun control debate, and on the intellectual history of the injury field during its formative years, before turning to other challenges confronting the field at the beginning of the twenty-first century.

Injury as a Public Health Problem
Injuries constitute a major public health problem because, in the aggregate, they produce an enormous toll of disability and premature death, draining health-care dollars and weakening the nation's productive capacity. In 1999, there were about 150,000 injury deaths, 2.6 million hospitalizations, and 30 million visits to emergency departments. It has been estimated that injury accounts for 12 percent of all medical spending. In 1995 (the most recent year for which a cost estimate is available), the direct and indirect social cost of injuries amounted to approximately $260 billion. In 1988-89, unintentional injury and violence accounted for about 30 percent of all lost years of productive life before age 65, exceeding losses from heart disease, cancer, and stroke combined. Fortunately, these consequences can be reduced or
améliorated by using the analytic tools and preventive perspectives of public health. Indeed, because the public health paradigm can embrace all etiologic factors bearing on prevention, it has been widely accepted by analysts in all disciplines, even though many of the interventions lie outside the expertise and capacity of public health agencies.

This is not to say that the public health approach is the only useful perspective for thinking about injuries. Some perspectives are remedial rather than preventive, and normative rather than empirical. Conceptually, issues concerning the remediation of injuries (e.g., compensation of injured persons, corrective justice or the punishment of persons or entities responsible for “causing” or failing to prevent injuries) are extrinsic to issues of prevention. Operationally, however, they may converge (e.g., punishment of wrongdoers or imposition of liability can achieve preventive effects through deterrence) or diverge (e.g., the risk of tort liability faced by companies often reduces hazards, but sometimes creates disincentives to disclose safety information and may thereby retard safety innovation).

To say that injury is a public health problem should not be understood to mean that the social response should be mounted primarily or exclusively by public health agencies; nor does it imply that a public health response is superior to other forms of response. Public health agencies lack expertise and command over most of the interventions suggested by the Haddon matrix (see Figure 1). Injuries represent a complex set of social problems. Prevention and remediation of these problems are and should be the responsibility of a wide variety of social institutions, including medicine, engineering, alcohol control, fire safety, mental health, criminal justice, the tort system, and many others. Public health agencies should be playing a much more substantial role in injury prevention than they are now, but their role should be understood as a contributory one, in collaboration with other agencies.

The strength of public health lies in its scientific and analytic methods — in its capacity to assemble and interpret relationships between health outcomes and a wide array of individual, social, and environmental variables. If reducing injury-related morbidity and mortality is stipulated to be the goal (the mission), public health science can help identify possible means for doing so. What public health science cannot do, however, is tell us how important that goal is in relation to other values and goals or tell us which means to select. Injury science can tell us how effective any particular intervention is likely to be, and perhaps can quantify some types of costs, but the choice of means is inescapably grounded in the traditions and values of the community.

**Mission of the Injury Field**

The mission of the injury field is prevention, amelioration, and treatment of injury and the reduction of injury-related disability and death. The field is defined by its focus on the injury, whatever the mechanism by which it was immediately caused and regardless of the contributing role of human intent. This understanding, which emerges clearly from *Injury in America* (the 1985 NRC report), has profoundly important implications for the boundaries of the field because, by drawing no distinction between unintentional and intentional injuries (i.e., homicide, assaultive injuries), it broadens the reach of prevention research and practice beyond the traditional domain of “accident prevention.”

**From “accident prevention” to “injury prevention”**

In 1985, through the publication of *Injury in America*, the NRC and IOM explicitly recognized that the public health paradigm (measurement, surveillance, and intervention, as elaborated in the Haddon matrix) could be usefully applied to the prevention of intentional injuries as well as unintentional ones. The report identified knowledge about assaultive injuries as a major gap in current research:

> Nonfatal assaultive injuries and homicides have been subjected to little prevention-oriented research. Typically, they have been regarded as a “crime problem,” rather than as a health problem, and blame and punishment of the perpetrators have been emphasized, rather than measures to reduce the frequency and severity of such injuries.

After identifying several potentially useful interventions for the prevention of firearm-related injuries, the report noted, “assaultive injuries involving other weapons or personal force are virtually unresearched.” Similarly, although *Injury in America* recognized that much research had focused on the diagnosis and treatment of depressed or suicidal people, the report observed that little attention had been paid to public health approaches, such as modifying products or environments to reduce the lethality of means of suicide. It encouraged research into the “validity of the widespread assumption that nonfatal suicide attempts represent a lack of desire to kill oneself, and therefore involve the choice of less lethal means” and on “reducing the lethality of common means of committing suicide.” In retrospect, this observation in *Injury in America* appears to have been the first step on a path of research that has provoked an ongoing struggle between public health officials and opponents of firearm regulation.

Despite its emphasis on the need for greater attention to assaultive and self-inflicted injuries, *Injury in America* focused mainly on unintentional injuries, primarily those caused by motor vehicle crashes. Three years later (with the publication of *Injury Control* in 1988), an NRC committee reviewed the status and progress of the injury control programs at the CDC; that report reiterated the need to intensify the study of intentional injury:
The study of intentional injury can be characterized as a neglected but potentially productive research field. The nation now has hundreds of programs aimed at reducing the incidences of suicide, homicide, and other intentional injuries, but there is no commensurate effort to evaluate the effectiveness of the programs.\textsuperscript{24}

A broader field

During the 1990s, research and program development within the injury field gave greater attention to the study of intentional injuries, reflecting a broader movement within medicine and public health embracing the cause of violence\textsuperscript{23} prevention.\textsuperscript{26} The increasing interest of medicine and public health in violence drew the attention of injury scientists to the mechanisms of these injuries, principally firearms.\textsuperscript{27} However, as noted above, these developments exposed critical tensions within the injury field about its identity, mission, and future direction. Some believe this trend to be a deviation from the core scientific mission of the field and worry about the diversion of limited resources from the chronically neglected problems of unintentional injuries to areas in which the potential contributions of the field are limited. They also believe that it is a strategic mistake for the injury field to take on the daunting, complex, and highly politicized subject of violence. Others believe that the scientific and programmatic advantages of integrating the field, and its potential contributions to the cause of violence prevention, require steadfast continuation of the present course.\textsuperscript{28}

From the internal perspective of the injury field, the issue can be posed either as one of boundaries or as one of priorities: Does the prevention of intentional injuries lie within the domain of the field? If so, how should the priorities for research and action be set within such a diverse array of important social problems? From a societal perspective, the argument raises questions about the added value of a public health perspective to the society’s capacity to prevent suicide and violence, problems traditionally understood to lie within the respective domains of mental health and criminal justice.

This controversy signifies an important stage in the development of the injury field, and the 1999 IOM report titled \textit{Reducing the Burden of Injury: Advancing Prevention and Treatment} addresses it in some depth.\textsuperscript{29} In the report, the IOM committee acknowledged the arguments for disaggregating the prevention of violence and suicide from the prevention of unintentional injuries, including the greater importance of motivational factors and individual vulnerabilities in understanding and responding to violence and suicide and the traditional preeminence of the criminal justice and mental health disciplines in these areas. However, despite the important differences associated with intentionality, the committee strongly endorsed and reaffirmed the previously stated position of the NRC and IOM for continued integration of all injury prevention activities within a common framework of research and program development. It gave several reasons.

First, the surveillance systems that undergird injury prevention collect data on all injuries regardless of intent; they focus on the mechanism of injury (e.g., falls, burns, cuts, drowning, firearms) because the information regarding intent is often unavailable or difficult to interpret. Second, even though differences in intentionality are often associated with different risk factors and different targets of intervention, responsibilities for carrying out preventive interventions in the field often converge on the same programs and agencies, particularly in public safety, emergency medical and other health care, and public health. In other words, in the world of practice, “911” responds to the injury regardless of intention. Finally, epidemiologic evidence highlights the powerful etiologic role of several factors that cut across all injury categories, whatever the mechanism and regardless of intention. Prominent examples of these factors are alcohol use and adolescent impulsivity. Examples of broadly effective interventions to reduce the incidence and severity of both unintentional and intentional injuries include reducing alcohol availability,\textsuperscript{30} home visitation for first-time new mothers,\textsuperscript{31} and eliminating the carbon monoxide content of domestically used coal gas.\textsuperscript{32}

Viewed in this way, injury prevention is necessarily a collaborative undertaking. The main contributions of injury science lie in its population-based perspective; its capacity to identify and frame interventions for a broad array of risk factors, particularly environmental ones; and its tools for measuring outcomes. However, injury scientists and prevention practitioners need partners in order to mount any successful preventive intervention. Interventions targeted at product design and the physical environment require collaboration with product manufacturers, safety engineers, and so forth. Interventions targeted at human behavior or the social environment require collaboration with schools, family service agencies, mental health agencies, and alcohol control agencies, among others. Interventions aiming to reduce self-inflicted injuries, assaults, and various types of unintentional injuries require different collaborators, but the basic approach is the same: The injury field provides the wide-angle lens, while the specific focus is provided by specialists from pertinent disciplines in adjacent fields.

In summary, by proclaiming that “violence is a public health problem,” leaders in medicine and in the public health establishment have summoned a growing body of researchers and practitioners to the cause of violence prevention. Perhaps an analogous effort will be undertaken for suicide prevention, as urged by the Surgeon General in his 1999 report on suicide.\textsuperscript{13} However, it is important to clarify the implications of this declaration for the future of the injury field. Conceptually and scientifically, the prevention and treat-
ment of injury (whether intentional or unintentional) may be productively studied and understood from a public health perspective. However, organizing a successful social response to injury is not a conceptual and scientific challenge; it is a political one. To say that violence is a public health problem is not necessarily to say that the public health community should be at the center of the social response to violence. The public health approach, however, may bring a new dimension to organizing the social response to violence by de-emphasizing criminality and focusing instead on changing behavior. What is required is a coordinated effort to harness social energies for a more effective program of studying and preventing violence. As the 1999 IOM report emphasized, the tools and resources of public health should be allocated prudently to this effort.4

Vocabulary
Choices of terminology often signify positions on disputed issues of perspective or policy. Although the vocabulary of the injury field is less contentious than in many other fields, a few terms are laden with policy significance and require clarification.

Injury and accident
Architects of the injury field in the United States have made a concerted effort to displace the term “accident,” which implies random events and bad luck, with the term “injury,” implying predictability in the epidemiological sense and therefore amenability to prevention. Injury, moreover, refers to the health outcome being addressed. By focusing the attention on result or outcome, the term “injury” is neutral with respect to causation, intentionality, and fault. The terminology has thereby facilitated scientific communication and helped disentangle issues of description from assumptions about etiology and fault.

Erasing the term “accident” from the vocabulary of the field has not erased it from everyday speech, however, and the general public and policymakers seem to understand the phrase “accident prevention” much better than they understand “injury prevention.” Moreover, as noted by Bijur, abandoning the term “accident” has left the field without a generic term for energy-releasing events that may or may not result in bodily injury; instead, many such terms are used to describe specific events of this kind (e.g., crash, collision, fire, poisoning, fall, shooting, fight).3 Interestingly, the phrase “accident prevention” continues to be used in the United Kingdom without the implications of fatalism feared by the field in this country, and Avery has proposed that this term be revived throughout the field to refer to interventions aiming to reduce events that present a significant risk of injury.5

However, the committee that authored the 1999 IOM report agreed with Bijur that this approach is inadvisable, not only because of its inescapable etiological connotations, but also because it leaves no room for injuries that are intentionally caused (and are in no sense accidents).3

Intentionality
Although the injury field focuses on preventing and treating a condition (the “injury”) and ameliorating its consequences, intentionality (e.g., the actor’s purpose and awareness of the risk of injury) is an important variable in studying the causes and prevention of injuries. According to the standard practice, injuries are divided into two categories: the term “unintentional” is used to refer to injuries that were unplanned (“accidents” in the earlier terminology), whereas the term “intentional” is used to refer to injuries resulting from purposeful human action (whether directed at oneself or others). This nomenclature is embodied in the International Classification of Diseases, which requires a determination on intentionality before any other coding decisions.

Some injury scientists, however, are increasingly dissatisfied with this terminology and believe that intentionality is more sensibly understood as a continuum, ranging from inadvertence to conscious risk-taking, to purposeful harming. Among other concerns, they point out that the focus on intentionality can divert attention to issues relating to individual moral and legal responsibility and away from the broad array of risk factors and interventions represented in the Haddon matrix, many of which can prevent both intentional and unintentional injuries. In addition, assigning cases to one of the two categories in coding for injury surveillance often requires complex judgments based on inadequate information. (For example, was a high-speed, single-vehicle fatal crash into a tree at 3 a.m. unintentional or was it a suicide?) Admittedly, these characterizations cannot bear too much weight, and coding decisions will be imperfect in many cases. Notwithstanding these shortcomings, however, the 1999 IOM committee concluded that whether an injury is “intentional” or not is reasonably ascertainable in most cases, and that these terms are useable — albeit oversimplifying — categories for aggregating and interpreting injury data.3 In the absence of any alternative conceptualization, this terminology is likely to be retained. Among intentional injuries, greater refinement can be achieved by using the terms “assaultive injuries” (including intentional homicide if death occurs) and “self-inflicted injuries” (including suicides if death occurs). Although the category of unintentional injuries encompasses a wide variety of risk-creating behavior (ranging from inadvertence to gross recklessness), greater refinement cannot reasonably be achieved outside a courtroom.

Prevention and treatment
In the 1999 IOM report, the committee used two terms — prevention and treatment — to refer to the array of activities
terdisciplinary field of science and practice with five components:

1. Epidemiology
2. Prevention
3. Biomechanics
4. Acute care
5. Rehabilitation

In 1985, the authors of *Growth and cohesion in injury in America* envisioned an interdisciplinary field of science and practice with five components: (1) epidemiology; (2) prevention; (3) biomechanics; (4) acute care; and (5) rehabilitation. In the follow-up report, *Injury Control*, the committee referred to these components as the “five core disciplines” of injury control. The most recent IOM committee, formed in 1997, distinguished between the applications of knowledge (prevention and treatment) and the scientific disciplines that provide the methods and analytic tools for acquiring such knowledge. From this perspective, the range of contributing disciplines is far broader than one might infer from *Injury in America*. In addition to epidemiology, biomechanics, acute care, and rehabilitation, for example, contributing disciplines include psychology, criminology, economics, health outcomes research, and other social and behavioral sciences. One sign of the increasing sophistication of the field, and of the power of its scientific methods, is the inclination of leading economists and public policy experts to embrace the perspectives and vocabulary of public health. As already noted, the central role played by social values in the choice and design of interventions emphasizes the need for recruiting specialists in ethics and law to the field.

Increasing numbers of individuals, from a wide variety of disciplines and occupational settings, identify themselves as participants in the field of injury prevention and treatment rooted in the intellectual perspectives and methods of public health. When the CDC and the Johns Hopkins University convened the First National Conference on Injury Control in 1981, it was attended by approximately twenty-five individuals, representing about half of all those working in the field at the time. In comparison, more than 1,000 people participated in the November 2000 Safe America Conference. The latest National Directory of Injury Prevention Professionals lists more than 1,200 individuals. It also appears that the injury field has achieved a significant degree of cohesion, notwithstanding the diversity of disciplines and the variety of specialized spheres of interest. The field has drawn together specialists interested in various domains of prevention (e.g., highway safety, fire safety, product safety, occupational safety, child protection, and violence and suicide prevention) as well as basic scientists and clinicians interested in various types of trauma (e.g., burns, orthopedic injuries, and head injuries). As has occurred in the cancer field, these specialists have come to see scientific, programmatic, and political advantages to characterizing injury as a single “disease.”

### MATURATION OF THE INJURY FIELD

The 1999 IOM committee was assigned the task of reviewing the progress of the injury field since the publication of *Injury in America* and *Injury Control* and making recommendations to further develop the field and reduce the burden of injury. It concluded that the field had grown in size, achieved a significant degree of cohesion, and matured in perspective. However, the IOM committee concluded that further development of the field had been hampered by inadequate opportunities for training and scientific communication.

### Growth and cohesion

In 1985, the authors of *Injury in America* envisioned an interdisciplinary field of science and practice with five components: (1) epidemiology; (2) prevention; (3) biomechanics; (4) acute care; and (5) rehabilitation.
The growing cohesion of the field (within public health) is evidenced by the growth of the Injury Control and Emergency Health Services section within the American Public Health Association, and the development of the field is reflected in, and symbolized by, the ten multidisciplinary injury control research centers (ICRCs) established over the past decade by the CDC.

Links between researchers and practitioners are also developing, with national conferences in the field drawing together science and practice in both prevention and treatment. The ICRCs have played an important role in this effort, holding conferences for practitioners and facilitating the implementation and evaluation of interventions. In addition, several journals are now devoted exclusively to the field, including the Journal of Safety Research; Injury Prevention; Accident Analysis and Prevention; and the Journal of Trauma. In addition, an increasing amount of space is devoted to injury-related articles in journals with general professional readerships, including the American Journal of Public Health; Pediatrics; the Journal of the American Medical Association; and the New England Journal of Medicine.

Another intriguing aspect of the emergence and composition of the injury field has been the close collaboration of prevention and treatment. An analogous development has occurred in the fields of cancer and heart disease. One might say that these partnerships can be explained entirely as expressions of political self-interest. Voices raised in support of injury prevention (including fire, violence, and suicide prevention) and in support of trauma care and rehabilitation are most likely to be heard if they are raised in unison. But the IOM committee concluded that much more than political strength would be lost if the prevention and treatment communities were to lose their sense of common identity. Injury epidemiology straddles prevention and treatment, serving as a bridge and source of information and insight in both directions. Designing strategies for protecting people from the effects of injury-causing events requires ongoing scientific communication between scientists in biomechanics, molecular biology, and clinical pathology. Implementation of public education and other prevention programs requires participation of surgeons and rehabilitation specialists to convey information about consequences.

Although the task of drawing together specialists in injury prevention and treatment is unfinished, remarkable progress has been made. A recent example is the Crash Injury Research and Engineering Network (CIREN) established by the National Highway Traffic Safety Administration in 1996. CIREN links trauma center clinicians and crash investigators in a nationwide computerized network. This enables engineers to better understand injury-producing mechanisms and to develop better criteria for vehicle safety design, while also informing clinicians about emerging injury patterns and thereby facilitating triage, diagnosis, and treatment of crash injuries.

### Intellectual maturity

A vibrant interdisciplinary field, encompassing biomedical, engineering, and social and behavioral sciences, cannot thrive in the face of intellectual orthodoxy. In the formative years of the injury field, a major challenge has been to open a discourse between environmental and behavioral perspectives. Until the 1960s, the predecessor field of accident prevention was dominated by a behavioral perspective, and the standard array of proposed interventions relied heavily on changing individual behavior, primarily through education and persuasion. Partly in reaction to the perceived failure of health education, Haddon and others highlighted the importance of mechanical and environmental factors. What Haddon had in mind was an extension of injury prevention from one cell of the matrix in Figure 1 (pre-event, individual behavior) to all the cells.

However, during the late 1960s and early 1970s, the pendulum swung in the other direction, and the developing injury field was characterized by a strong (almost single-minded) emphasis on environmental intervention (and passive protection) and a deep skepticism about the efficacy of behavioral intervention. This perspective has long been regarded as axiomatic in the literature, and behavioral perspectives (e.g., of economists or health educators) have often been discounted or strongly criticized. In recent years, however, this intellectual tension has receded and behavioral perspectives are now increasingly viewed as complementary rather than antagonistic to environmental perspectives. The field's increased receptivity to behavioral perspectives and interventions is directly attributable to the unanticipated success of several traffic safety interventions, particularly mandatory seat belt laws, which increased the rate of belt-wearing from about 10 percent in 1981 to 70 percent in 2001, and the multifaceted interventions related to drunk driving, which have reduced the rate of alcohol-related motor vehicle fatalities by 39 percent since 1982. Injury specialists have also recognized that behavioral interventions are often cheaper and more cost-effective than environmental ones even if they are more circumscribed in scope.

A related issue is the need to embrace different perspectives on the weighing of risks. A developing literature on risk analysis has described the factors that affect people's judgments about what risks are acceptable (e.g., whether they are voluntarily assumed) and how different types of risks are compared with one another, and has helped to highlight the ways in which the benefits and burdens of risk-taking behavior are differentially distributed. These contributions have enriched our understanding of the ethical dimensions of preventive interventions and have located the injury field in the larger landscape of risk regulation. Injury specialists have not yet adequately incorporated these methods and insights into the discourse of the field.
CONTROVERSIES IN THE INJURY FIELD

Because the injury field, like all of public health, is mission-driven and action-oriented, some controversies concerning the ethics and politics of prevention tend to recur. A continuing challenge for participants in the public debate, and particularly for leaders in the field, is to become conversant with the methods, principles, and themes of practical ethics, and to develop rhetorical strategies for promoting public consensus on controversial issues.

The costs of regulation

Injury prevention is not free. All preventive interventions have costs, including possible trade-offs with other important social values. In the early years of the field, injury specialists were almost reflexively inclined toward regulation, particularly of consumer products, industrial machinery, motor vehicles, and environmental risks. This orientation was understandable in light of the weaknesses of legal regulation at the time, and the strong resistance to regulation shown by the affected industries. In recent years, however, the arguments have become less polarized, and the injury field has begun to incorporate the perspectives of economists, particularly the need to consider all of the behavioral effects of an intervention (including behavioral adaptation, risk compensation, and unintended consequences), to measure costs and to seek a reasonable balance between benefits and costs.

Cost-effectiveness and cost-benefit assessments are commonplace in consumer product regulation and traffic safety regulation. All of these analyses implicate the nagging ethical issues raised by the quantification of the value of life and the discounts in value for disability. Additional ethical puzzles are raised by statutes, typical in the environmental health and safety arena, that direct regulators to achieve the “lowest feasible risk” without regard to cost. Because the Occupational Safety and Health Act does not require cost to be taken into account (aside from the extreme case of economic infeasibility) in setting safety standards (and precludes consideration of cost for health standards), disputes about the excessive costs of safety regulation regularly arise. The controversy over repetitive motion injuries, reflected in the promulgation and rescission of the Occupational Safety and Health Administration’s proposed ergonomics rule, is illustrative.

The paternalism problem

Injury prevention interventions often aim to protect people from the consequences of their own risk-taking. In some instances, critics may characterize these interventions as “paternalistic” because they curtail people’s freedom “for their own good,” rather than protect the interests of other people. The most clear-cut examples are mandatory motorcycle helmet laws and other regulations requiring people to use safety precautions to protect themselves. More ambiguous examples include prohibiting manufacturers from selling products thought to be too risky (e.g., three-wheel all-terrain vehicles) or requiring manufacturers to protect adult consumers from their own negligence (e.g., machine guards) when doing so increases the product’s cost or reduces its utility for certain purposes.

In this nation’s political culture, it is prudent for public health advocates to recognize that a presumptive opposition to paternalistic government action is deeply embedded in the conventional moral framework of public policy and law. In the present context, we are dealing with individual freedom to incur risks of injury (to oneself) in pursuit of one’s own lawful ends — recreational pleasure (boxing, skiing, helmetless cycling), personal security (storing a loaded weapon in a home without children), or even the thrill of risk-taking itself. In any debate about injury prevention, advocates of intervention need to think carefully about the most persuasive arguments for responding to a charge of paternalism.

One type of paternalism is generally accepted as legitimate — so-called “soft” or “weak” paternalism that aims to protect the interests of people who may lack the capacity to make rational self-interested choices. Thus, unabashedly paternalistic arguments are often used, and are often appropriate, in situations where society is attempting to protect vulnerable populations from risk, as in the case of children and the elderly. These populations are at high risk of injury, either because they are still developmentally immature or because age has resulted in a deterioration of their decision-making capacity or other self-protective mechanisms. Child-resistant packaging and restrictions on access to alcohol represent prominent examples of weak paternalism in injury regulation. Many other injury interventions are also focused on youthful risk-taking and impulsivity, such as licensing and minimum age requirements for driving and access to handguns. (In the latter case, another vulnerable population is also pertinent — depressed individuals, who are more likely to attempt suicide (and to succeed) if firearms are accessible.) Sometimes, however, critics may ask whether the focus on youths or other vulnerable populations is merely a pretext for “hard” or “strong” paternalism aimed at adults.

The argument that an intervention aimed at competent adults is impermissibly paternalistic can be contested on a variety of grounds. In some instances, it might be argued that the intervention is designed to correct or compensate for irremediable deficits in information that prevent people from appreciating the risks they face or otherwise making informed risk-benefit judgments. For example, it can be argued that motorists who fail to buckle up and cyclists who refuse to wear helmets fail to appreciate the real significance of the cumulative risk that they face. Everyone would agree that irremediable information deficits or defective risk perception, if proven, provide an ethically appropriate basis for
regulation. However, disagreements arise about whether these deficits actually exist or whether they are merely a pretext for countering the fully informed "irrational" choices that some people make about risk-taking behavior. Although proponents of protective interventions may believe that people sometimes need to be protected from their own irrational risk-taking, resting the case for intervention on these grounds leaves the intervention fully exposed to the charge of paternalism — i.e., that the intervention improperly substitutes the government's values and preferences for the individual's.

Another category of arguments responds to the charge of paternalism by emphasizing that the intervention actually avoids harm to other people (or enables other people to reduce harm to themselves). This is most evident when individual risk-taking exposes third parties to risk of injury — e.g., risk-taking by automobile drivers, by people operating machinery when other people are within the zone of foreseeable danger, or by gunowners who leave their loaded firearm unsupervised, such that it is susceptible to theft or impulsive use by other people, including children.

Less direct harms to others, or to society, are also possible — for example, an unfair distribution of injury costs. Proponents might defend supposedly paternalistic regulations by arguing that those who are injured as a result of their own risk-taking rarely "internalize" the medical and other direct costs of their injury, thus forcing others to unfairly share in their payment. Therefore, reducing risk-taking is necessary to avoid an unfair distribution of these costs. Of course, this argument may be rebutted by showing that the costs of injury can be internalized through pricing or insurance mechanisms (as with motorcycle licensing fees). The argument might also be rebutted by showing that a proposed intervention might actually increase the net costs to society by saving and/or prolonging lives that otherwise would have been more quickly terminated. This is a popular argument in the motorcycle helmet debate because helmetless riders are more likely to be killed, while helmeted riders suffer disabling brain injuries. However, opponents of interventions are naturally reluctant to make this argument.

So far, all of these arguments would probably be accepted as legitimate "other-regarding" arguments (in principle, at least) by antipaternalists. However, some arguments are more controversial. For example, is it a sufficient response to a charge of paternalism that there are substantial "indirect costs" of lost productivity (using a human capital social cost analysis)? Most injury interventions are designed to minimize the indirect costs of premature death or disability. From an economist's perspective, these costs are internalized by the individual, so the argument is not legitimately "other-regarding." Instead, on this view, the argument is predicated on an ethically unacceptable a priori assumption that society is "entitled" to the contributions of its members. From a public health standpoint, though, this is often the most powerful empirical justification for injury prevention — recall, for example, that injury accounts for 30 percent of all years of productive life lost before age 65.9 Quite often, the charge of paternalism comes down to this: Is the "saving" of indirect costs of injury (lost years of productive life) a legitimate justification for intervention, or is it simply a pretext for protecting the individual from the consequences of his own risk-taking?

Finally, public health advocates might argue that even if the intervention is paternalistic, it still may be justified as long as some other criterion is met (e.g., that the aggregate social benefits of the intervention outweigh its costs). Recent studies have shown, for example, that mandatory helmet laws and mandatory safety belt laws substantially reduce injury costs.60 In the final analysis, opposition to mandatory safety belt laws virtually evaporated in the face of unequivocal evidence that the safety gains (lives saved and disability avoided) far outweighed the costs of enforcement and the slight reduction in freedom.61

Trade-offs between safety and freedom

Regardless of one's views on the issue of paternalism, injury prevention interventions always require attention to costs and benefits, and a restriction of individual freedom should be weighed as one of the "costs" of any proposed intervention.62 One example is the argument that reducing the blood-alcohol level that constitutes conclusive evidence of drunk driving (from 0.10 g/dL to 0.08 g/dL) will curtail the opportunity for social drinking in bars and restaurants by many people who would not have posed a higher crash risk. How does one quantify the "costs" of this reduced freedom to drink and weigh them against the safety gains affected by the change in the legal blood-alcohol level? Another contentious example is the argument that reducing access to handguns in the home poses a trade-off between the value of the lives that would be saved by the presence of fewer handguns and the increased sense of insecurity for homeowners. One of the important challenges facing the injury field is to promote rational discourse about the empirical issues and value judgments raised by these recurrent conflicts between safety regulation and personal freedom.

Risk-risk trade-offs

Another ethical problem sometimes faced in injury prevention is trade-offs among risks, accompanied by concerns about the distribution of such risks. Safety regulation typically reduces target risks without creating new risks. Although it has been shown that consumers sometimes "consume" some of the benefits of safer products by increased risk-taking or reduced caution, consumers are usually better off as a result of the safety enhancement.63 Thus, the ultimate policy question is whether the safety gains have been achieved at reasonable cost.
However, sometimes the product change does create new risks. A particularly intriguing example is currently being faced by the National Highway Traffic Safety Administration in airbag regulation. The problem is that, even though airbags save the lives of many crash victims who otherwise would have been killed, the reverse is sometimes true: The airbag might cause injury or even death in situations where the crash victim would not otherwise have been injured or killed if the airbag had not deployed. As data regarding actual experience with airbags began to emerge in the late 1990s, it became apparent that small female drivers sitting very close to the steering wheel were at risk of airbag-induced fatalities; although this risk has been reduced by depowering the airbag, this change has resulted in many more deaths among larger, unbelted male drivers.

The ethical dilemma is even more pronounced in relation to passenger-side airbags, which became mandatory in 1997. The data showed that the risk of airbag-induced fatalities was particularly high among children. Although the risk to children could be eliminated by putting them in the back seat, and by restraining them properly in the front seat, the data led some authorities to question the soundness of making passenger-side airbags mandatory. Should passenger-side airbags be mandatory if they were shown (hypothetically) to save 1,000 lives per year (mainly of unbelted young adult males), but at the cost of killing 100 people, many of whom are children? The still developing story of passive restraints in automobiles exposes the values at stake in risk-risk trade-offs as clearly as any other example of safety regulation.

The Role and Limits of Advocacy

Public education, advocacy, and constituency-building are key elements of modern public health practice at the state and community levels. Proactive "marketing" of public health is needed to arouse public awareness and concern, to counteract complacency or sluggishness, and to prod policymakers into action. The need for injury officials and program directors to embrace advocacy as a core professional role is a recurrent theme in the field. In 1988, the IOM noted in The Future of Public Health that educating legislators and political leaders "on public health issues and on the rationale for strategies advocated and pursued by the health department" is a key element of public health leadership. Eight years later, another IOM committee noted:

Even when promising solutions exist, public health agencies too often have difficulty generating support for intervention among elected officials and the general public.... A key struggle for [public health leaders] is making the benefits of community-based, population-wide public health activities and initiatives more recognizable, and finding allies who will speak on behalf of those initiatives and the unique role for government public health agencies in carrying [them] out....

These important activities—public education, constituency-building, and advocacy—must be implemented with a proper sense of balance. Two pitfalls must be avoided. One is crossing the line between advocacy and the traditional constraints on lobbying that apply to many people and organizations in public health. The second pitfall is allowing a commitment to advocacy to undermine scientific credibility—precisely the problem that endangered the injury field in the 1990s.

Advocacy and lobbying

Public health advocacy must be carried on with due regard for long-standing legal constraints on lobbying. These constraints are designed to limit contact with legislators, either directly or through grassroots efforts, concerning specific legislative proposals. Federal grantees may not use federal funds for lobbying, and non-profit organizations may lose their tax-exempt status if they devote too much of their activities to lobbying. However, these restrictions leave public health organizations free to engage in a wide range of educational activities, including non-partisan analysis, study or research, and promotion of general ideas or positions. Unfortunately, many organizations in the injury field appear to be unsure about the boundaries between advocacy and lobbying and are thus uncertain about the legitimate scope of educational and constituency-building efforts. In 1999, with the release of Reducing the Burden of Injury, the IOM panel took note of this problem:

Some individuals and organizations may have been deterred from engaging in entirely permissible activity, while others could be endangering their non-profit status. Non-profit organizations in the injury field should understand federal and state rules that govern lobbying. They should understand that some lobbying by non-profit organizations is permissible, and that certain efforts to provide information to policy-makers or the public do not fit the definition of lobbying. By better understanding these rules, non-profit organizations can maximize their effectiveness as advocates for the public’s health, while minimizing the likelihood that they will jeopardize their non-profit legal status.

The federal government itself has recognized that changes in state and local policy are often necessary to help effectuate national public health policy goals. Many of the goals of Healthy People 2010, a statement by scientists sponsored by the U.S. Department of Health and Human Services, focus
on state legislative action.\textsuperscript{69} While Congress often makes state eligibility for federal program support conditional upon state legislative action (for example, establishing a 21-year-old minimum drinking age before being eligible for federal highway funds), Congress is not so directive in many other situations, relying instead upon public education and local constituency-building to arouse public support and eventually to achieve legislative action. It is well-understood that non-profit organizations interested in public health issues devote substantial resources to public education and issue advocacy, even though they are limited in lobbying for a specific piece of legislation.

Thus, advocacy for national public health objectives by federal grantees and non-profit organizations is often encouraged by federal policy. Against this background, however, recent proposals to curtail advocacy by federal grantees and non-profit organizations stand out. For example, proposals have been made to preclude federal grants to organizations that spend more than a specified amount on "political advocacy," thereby broadening the conventional lobbying constraint and implicating the use of non-federal funds.\textsuperscript{70} The 1999 IOM committee observed that achievement of national public health priorities, including injury prevention objectives, would be significantly impeded if Congress were to broaden the traditional constraints on lobbying by federal grantees and non-profit organizations, beyond their long-accepted meanings and boundaries, to include advocacy.\textsuperscript{71} Traditional restrictions adequately defend the federal government’s legitimate interest in avoiding taxpayer-subsidized political activity and the distortion in the political process to which subsidized political activity might lead. (State employees are also prohibited from lobbying under state law.) More sweeping restrictions on the advocacy of ideas or positions would not only have a chilling effect on constitutionally protected activities by federal grantees and tax-exempt organizations, but would also undermine the national government’s strong interest in promoting public understanding of and support for national public health objectives.

**Advocacy and science**

In any value-laden field where research is highly susceptible to political bias, special efforts are required to preserve the integrity of the scientific process through peer review of proposals and publications and through the corrective effects of replication and reinterpretation of scientific findings. Similarly, economic influences can also have a powerful influence, as described by Bero and her colleagues regarding industry-sponsored tobacco research.\textsuperscript{72} The intensity of opinions on firearm regulation (on both sides) also raises a red flag for the possibility of bias. Research can never be value-free, of course. Inevitably, a researcher’s values influence the topics he or she chooses to investigate and the discussion of the possible implications of study findings. Yet every reasonable effort should be made to minimize the influence — and the appearance — of bias on the study methods and the analysis of results.

It is also important for investigators to avoid becoming so invested in a particular policy position that they compromise public confidence in the objectivity and integrity of the scientific process. To some extent, this has occurred in the context of firearms research by public health specialists. (Of course, the same can be said about research conducted by persons with pro-gun biases.) However, to caution investigators about becoming too invested in a particular side in a debate is not to say that injury scientists or other public health specialists should be encouraged to abstain from advocacy altogether. Advocacy on behalf of injury prevention is a key component of public health practice, and some injury scientists may properly want to assume the burdens — and risks — of advocacy. How to balance the demands of science and advocacy is one of the ongoing challenges for the injury field, as elsewhere in public health.

To acknowledge the need for self-restraint by injury scientists is not to endorse political interference with the scientific process. Freedom of scientific inquiry is a powerful engine for advancing knowledge and promoting technological innovation. Science must be accountable to the public, of course, but political interference with the customary process of scientific inquiry should ordinarily be avoided. Peer review has traditionally served as the main mechanism for assuring accountability, even when public funding is at stake. The merit of a controversial study must be judged according to whether it is good science, not whether it is good politics. The decision to predicate public policy on contested research (e.g., funding for needle exchange programs or sex education programs) is properly a political judgment, but whether research does or does not show that these programs reduce HIV transmission (and whether the question is studied at all) should be primarily scientific questions, not political ones. By this measure, case control research on the risks associated with the presence of firearms in the home, or the effect on injuries of restrictions on carrying weapons, for example, should be judged by the yardstick of scientific excellence, not according to preconceived positions on the virtues or vices of gun ownership. From this perspective, the 1994 congressional decision to curtail the National Center for Injury Prevention and Control’s support for firearms research represented an unwarranted interference with scientific inquiry.

**CONCLUSION**

As was noted above, the distinctive virtues of public health, including the injury field, lie in its population-based perspective, in its strong scientific methods, and in its protective mission. When a societal consensus exists on the principles that should guide public policy, the tools of public health can
be used, uncontroversially, to facilitate informed policymaking. Under these ideal conditions, the main role of public health is to provide adequate information. Poor information can lead either to overreaction (and perhaps to unwarranted restriction of individual freedom) or to indifference and neglect (and perhaps to unfair distribution of the burden of disease and injury to the most vulnerable). Good science is a necessary (though not sufficient) predicate for ethical policymaking. For this reason, one of the highest priorities in injury prevention and treatment is to improve the nation’s capabilities for injury surveillance, interpreting injury data and translating data into policy-relevant terms, and predicting and measuring the effects of interventions. In Reducing the Burden of Injury, the 1999 IOM committee recommended several important initiatives for improving injury data and research. For example, the committee urged better data on homicides and suicides, perhaps through a surveillance system modeled after the National Highway Traffic Safety Administration’s highly successful fatal accident reporting system (FARS). Another high priority is to fill the large gap that now exists for data on the epidemiology, treatment, and outcomes of non-fatal injuries. Too often, the available data relate only to fatalities, and fatality rates are not necessarily good proxies for injury rates in general or for rates of serious injuries, significant medical costs, or severe disabilities.

In many contexts, however, we are not operating under ideal conditions, and the principles that should guide policymaking are in dispute or the values at stake are in profound tension. This is often true in the sphere of injury prevention where, as we have shown, regulatory choices often require complex cost-benefit judgments, including risk-risk trade-offs, and often implicate fundamental questions about the role of government in a free society. Two beacons should guide public health officials in such contexts: Do not allow advocacy to undermine scientific credibility, and acknowledge the competing values at stake rather than suppressing them. Together, good science and transparency can help earn and maintain public trust.

REFERENCES


6. Id.


9. Id. at 2.


12. Id. at viii.


15. Id.


20. See National Research Council and Institute of Medicine, supra note 8.

21. Id. at 44.

22. Id.

23. Id. at 45.


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29. See IOM Injury Report, supra note 11.


34. See IOM Injury Report, supra note 11.


37. See Bijur, supra note 35; IOM Injury Report, supra note 11, at 28.


39. Id. at 29.

40. Id. at 30.

41. Id. at 262–65.

42. See National Research Council and Institute of Medicine, supra note 8, at 16.

43. See National Research Council, supra note 10.


47. IOM Injury Report, supra note 11, at 31–32.

48. See Haddon, supra note 5.

49. The tension between behavioral and environmental perspectives is explored in eleven papers in "Children's Injuries: Prevention and Public Policy," a special theme issue of the Journal of Social Issues, 43, no. 2 (1987). The issue editors were M.C. Roberts and PH. Brooks.


59. See text at note 19, supra.


62. See Bonnie, supra note 58, at 133.

63. See IOM Injury Report, supra note 11, at 100–01.

64. See Graham et al., supra note 60.


68. IOM Injury Report, supra note 11, at 200.


71. IOM Injury Report, supra note 11, at 200–01.