

692

Approaches to Prevention of Injuries\*

William Haddon, Jr., M.D.\*\*

\* Prepared for presentation at the American Medical Association Conference on Prevention of Disabling Injuries, Miami, Florida, May 20, 1983.

\*\* President, Insurance Institute for Highway Safety, Watergate 600, Washington, D.C., 20037.

IIHS MASTER FILE COPY

Let us consider the principles on which injury control is based and their relationships to the other preventive concerns both of our profession and of society.

The purpose of prevention is to reduce the frequency and severity of the health impairments of individuals and of the populations they comprise. In contemporary language, to reduce, with respect to impaired health, what the businessman calls the "bottom line". We accomplish this by measures that modify or completely block one or more of the three phases of interactions that lead to the bottom-line totals of death and impairment with which we are concerned, phases I have termed, respectively, the "Pre-event", "Event", and "Post-event" Phases (Haddon, 1968, 1972a, 1972b, 1980b).

In measures directed at the first, or Pre-event Phase, we interfere with interrelationships that can initiate pathologic processes. In illustration, we sterilize surgical instruments, purify water, and pasteurize milk to prevent infections; we avoid hazardous drugs in pregnancy to prevent malformations; and we further proper nutrition to prevent deficiency diseases.

In addressing the second, or Event Phase, we detect, limit, block and alter the progression of harmful processes that have already been initiated, or are anticipated. Examples, which are legion, include our use of antibiotics, antihypertensives, and other pharmaceuticals; immunization; and cancer surgery.

In the third, or Post-event Phase, we attempt to counter pathology already produced. We repair, retrain, and rehabilitate.

In close parallel, preventive measures directed at injuries address the same three phases of interactions leading to the bottom-line totals that concern us and that underlie this conference.

Since injuries are the various kinds of damage to people that result from acute interactions with each of the several forms of energy and with a variety of chemical agents, in the Pre-event Phase we interfere with the factors that can initiate damaging interactions with such agents. In illustration, we deny drivers licenses to children; select, train, and supervise workers; restrict the production and availability of firecrackers and other explosives; use rails on the sides of cribs and of many hospital beds; and restrict exposure to sources of dangerous thermal, electrical, ionizing and mechanical energy, and to dangerous gasses, liquids, and solids.

In addressing the interactions with the agents of injury that take place in the Event Phase, we detect, limit, block, and alter the harmful processes that have already been initiated, or are anticipated. The many illustrations include use of smoke and other detectors; fuses and sprinkler systems; vehicle-occupant "crashpackaging"; and eliminating sharp edges and points on impact surfaces in many situations.

In the case of injuries, as with other pathologies, in the Post-event Phase we repair, retrain, and rehabilitate after the harmful processes have ended.

Not only do injury control strategies closely parallel those addressed to diseases, "there are no basic scientific distinctions between injury and disease. In some cases the etiologic agents are

identical: for example, the result of brief exposure to high concentrations of a toxic gas is called 'injury', whereas the eventual pulmonary effect of chronic exposure to low concentrations of the same agent is called 'disease'. Similarly, mechanical forces produce 'injury' to the spine when applied in large doses; in smaller doses over long periods they produce lumbar disc 'disease'. Nor is there a logical distinction between injury and disease in total length of causal exposure: a single brief exposure to ionizing radiation can cause rapidly fatal 'injury' or subsequent aplastic anemia, a 'disease'. In effect, the concept of injury is coextensive with the concept of disease." (Haddon and Baker, 1981) (reference in original omitted).

#### THE ANTIQUITY OF PHYSICIANS' CONCERN WITH INJURIES

Nor are injuries a recently discovered concern either of our profession or of society. The Edwin Smith Surgical Papyrus, a copy of an earlier work from c. 2500 to 3000 B.C., describes the external causes, signs, symptoms, pathologic anatomy, physiology, treatments, and prognoses of injuries in often astonishingly astute detail (Breasted, 1930). Moreover, Hippocrates understood the essence of what we mean today when we observe that it is not, per se, the exchange of mechanical (or other) energy with the body that determines the occurrence of injury, but rather the way in which that exchange occurs. He also wrote, with respect to injuries of the head, "Of those who are wounded in the parts about the bone, or in the bone itself, by a fall, he who falls from a very high place upon a very hard and blunt object is in most danger of sustaining a fracture and contusion of the bone, and of having it depressed from its natural position; whereas he that falls

upon more level ground, and upon a softer object, is likely to suffer less injury in the bone, or it may not be injured at all..." (Hippocrates c 400 BC/1939). He also elaborated in parallel in discussing weapons design in relation to the type of injury produced. "Weapons of an oblong form, being for the most part slender, sharp, and light, penetrate the flesh rather than bruise it, and the bone in like manner...." He was also undoubtedly familiar with the reverse principle reflected in the design of shields and other protective gear to dissipate incident energy both in space and in time -- an approach which we use in many ways (Haddon et al., 1964).

Throughout history, measures to prevent or lessen injury have been ubiquitous. They have ranged from those used by individuals, such as shoes, shields, helmets, and protective clothing, to others undertaken by entire societies. The latter have included the building of city walls and dykes; evacuation to escape damage from floods, forest fires, and invaders; and, more recently, placing high voltage lines out of reach and cleaning up toxic waste dumps. Indeed, societies have often survived and flourished in proportion to their willingness and ability to take all steps necessary to deal with the military and other environmental hazards of their situations; our own society is no exception (Haddon, 1980b). This is important because various special interests would have us believe that effective hazard control today is often somehow either not in our best interest, or simply not worth the effort.

#### INJURY CONTROL IN MODERN TIMES

The workplace injuries that accompanied the industrial revolution gradually led to the development of the various preventive measures now used by safety engineers, fire prevention experts, and others. In addition, our superb ability to treat the injured had its roots more

than a century ago. With these exceptions, however, the modern era in injury control began about 1940 with the work of the late Hugh De Haven at Cornell Medical College.\* Knowing that some people experienced high speed impacts but sustained little or no injury, he studied survival in falls of up to 150 feet to find out why. He found that, in the transient force loadings typical of falls and motor vehicle crashes, the body is far less fragile than had generally been believed, that the structural environment is the dominant cause of injury, and that mechanical structure can be altered to eliminate or greatly modify many of the injurious results of mechanical energy exchanges (Haddon et al., 1964). Basically, he quantified Hippocrates' insights and provided the first scientific evidence that most serious injuries produced by exchanges of mechanical energy need not be harmful, or as harmful, if the exchanges are properly managed. Since such exchanges are far and away the leading source of injuries of all severities, this pointed the way to their eventual great reduction.

De Haven's work, which was followed by that of Stapp and many others (Damon et al., 1966; Haddon et al., 1964; Stapp, 1957), thus provided the first foundations for a central, highly quantitative part of the injury control field. Concerned with the characteristics of mechanical energy interacting with the body, and the ways in which

---

\* See references (De Haven, 1942; Haddon et al., 1964; Haddon, 1980b) for entry to De Haven's contributions and to commentary concerning his work. His collected papers are in the library of the Cornell University Medical College, New York.

such interactions can be modified, this part of the field is analogous to medical attention to the characteristics of bacteria and other agents interacting damagingly with the body and to the preventive measures that can be used to block or ameliorate the processes involved.

The next major advance in understanding injuries was Gordon's recognition, in 1949, that injuries in many respects are a problem in medical ecology, being characterized by point epidemics, seasonal variation, long-term trends, and geographic, socioeconomic, and rural-urban distributions -- in other words that, in populations, injuries behave, in many respects, like the classic infectious diseases and other well-understood pathologies (Gordon, 1949; Haddon et al., 1964). A corollary was the recognition that, as with all other pathologies, all known injury distributions are non-random in their distributions in time, place, and person, just as one would expect from the non-randomness of their causes (Haddon, 1980b).

#### THE AGENTS OF INJURY

It was not until the early 1960's, however, that first Gibson and shortly later I independently recognized the nature of injury "agents", using the term agent in its most classic epidemiologic and clinical sense of an environmental entity whose action is necessary to produce the specific pathology of interest and without which it cannot occur (Haddon, 1980b). Gibson, an experimental psychologist at Cornell, described his insight as follows:

Man...responds...to the flux of energies which surround him -- gravitational and mechanical, radiant, thermal, and chemical. Some limited fields and ranges of energy provide stimuli for his sense organs; others induce physio-

logical adjustments; still others produce injury....

Injuries to a living organism can be produced only by some energy interchange. Consequently, a most effective way of classifying sources of injury is according to the forms of physical energy involved. The analysis can thus be exhaustive and conceptually clear. Physical energy is either mechanical, thermal, radiant, chemical, or electrical (Gibson, 1961; Haddon et al., 1964).

#### THE VECTORS AND VEHICLES OF INJURY AGENTS

The next advance in developing the theoretical basis for systematic injury control came in 1963, when it was recognized that injury agents often reach the body in ways analogous to the transmission of infectious and other pathologic agents (Haddon, 1963).

Energy that may reach the body and substances that may interfere with its normal function are usually carried by inanimate objects or living organisms corresponding to the "vehicles" and "vectors" of infectious diseases. Thus, electric lines are vehicles of electricity, hot rivets are vehicles of thermal energy, poison containers are vehicles of their contents, and moving objects are vehicles of mechanical energy. Similarly, poisonous plants and animals are vectors of their toxins, and animals that injure by tearing and crushing are vectors of mechanical energy. This concept is a use-

ful one, since many preventive measures must be directed against the vehicles and vectors rather than against the physical and chemical agents they transmit (Haddon, 1967).

#### VARIATIONS IN HUMAN SUSCEPTIBILITY

It was also recognized that variations in susceptibility to these agents greatly influence injury occurrence and severity, in close analogy to the influence of variations in immunity on infectious disease occurrence and severity (Haddon, 1967). Some such variations in injury susceptibility are genetically mediated. In illustration, hemophilia and osteogenesis imperfecta are of clinical interest predominantly because of the increased susceptibility to mechanical energy transfer injuries they involve. Others are acquired, for example, in scurvy and, probably, postmenopausal osteoporosis. Consequently, one of the basic strategies for reducing injury (see below) is increasing body resistance to injury agents, by raising abnormally low injury resistance (the treatment of hemophilia, scurvy, osteoporosis), by preventing its decline (maintaining proper nutrition and normal exercise), or by increasing it above normal levels (athletic training and deliberate sun-tanning).

#### THE HOST, AGENT, ENVIRONMENT INTERACTION

Casting the discussion in slightly different form, it is often useful to view injury prevention in terms of the classical host-agent-environment epidemiologic triad considered separately in each of the three phases of interactions to which I made reference earlier. Thus, the characteristics of the host, the agent, and the environment interact in the Pre-event Phase to determine whether injurious inter-

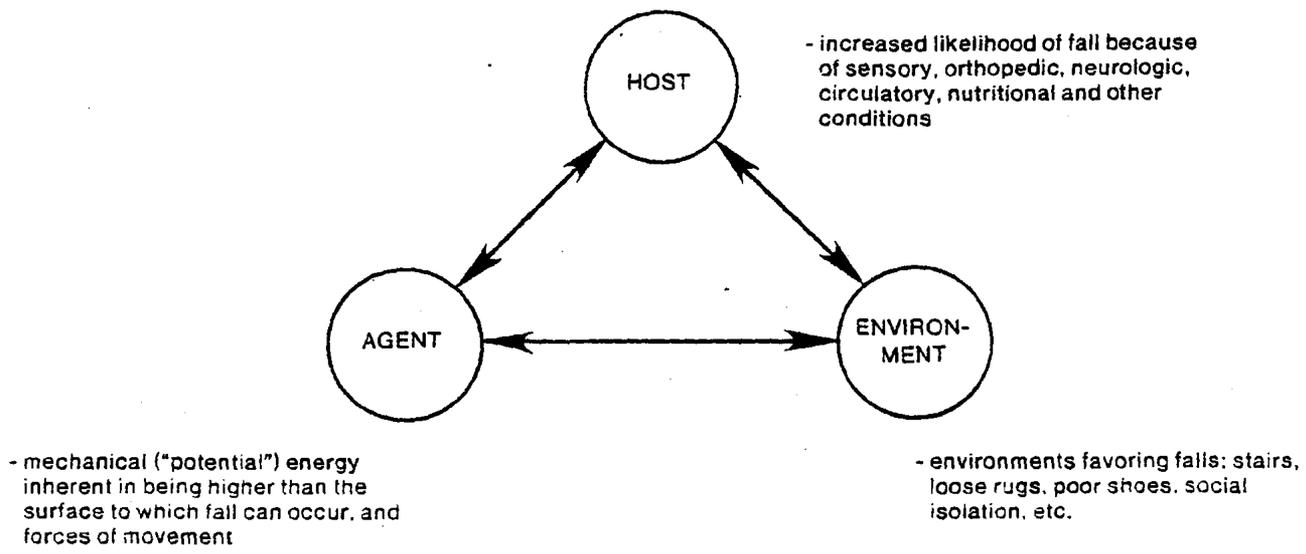
actions are initiated; in the Event Phase to determine injury type and severity; and in the Post-event Phase to determine the extent to which the injury already produced is successfully treated or otherwise countered. The falls of elderly women illustrate these three interactions, Figures 1-3.

(Figures 1-3 here.)

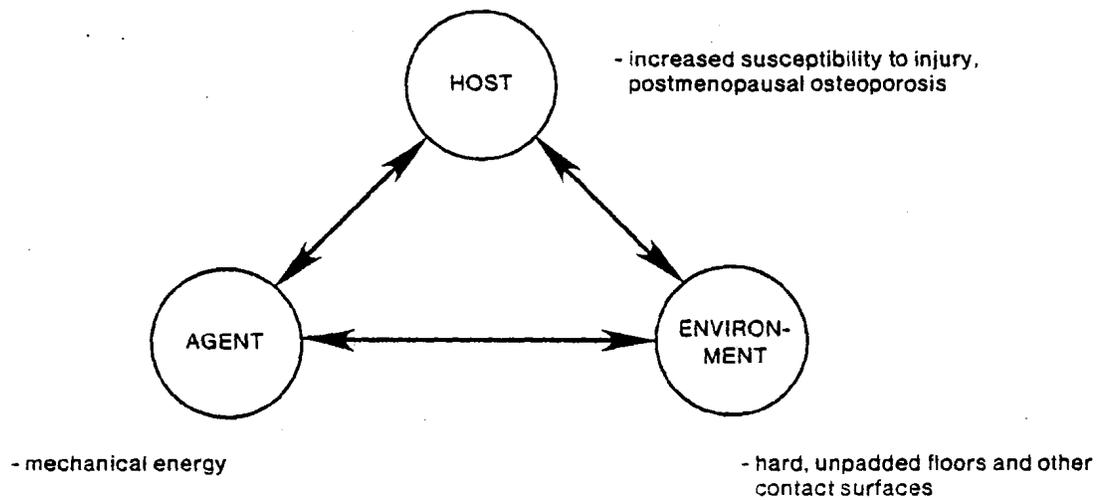
Using such models with injuries of all types, one can begin to sort out systematically the causal factors involved and the opportunities for intervention. It is important, however, that often the primary emphasis of such intervention should vary with the circumstances. For example, in conditions such as hemophilia, in which abnormal susceptibility to injury converts normally non-injurious exposures to mechanical energy to injury-producing events, the first priority is correcting that susceptibility, as physicians have long done.

In situations in which an abnormal hazard in the environment produces injury in normally non-injurious activity, the first priority is often to eliminate, suitably modify, or relocate that hazard. An example is the type of underfloor heater whose very hot metal grill flush with the floor produces the "tic tac toe" burns of children who come in contact with it (Waller, 1961).

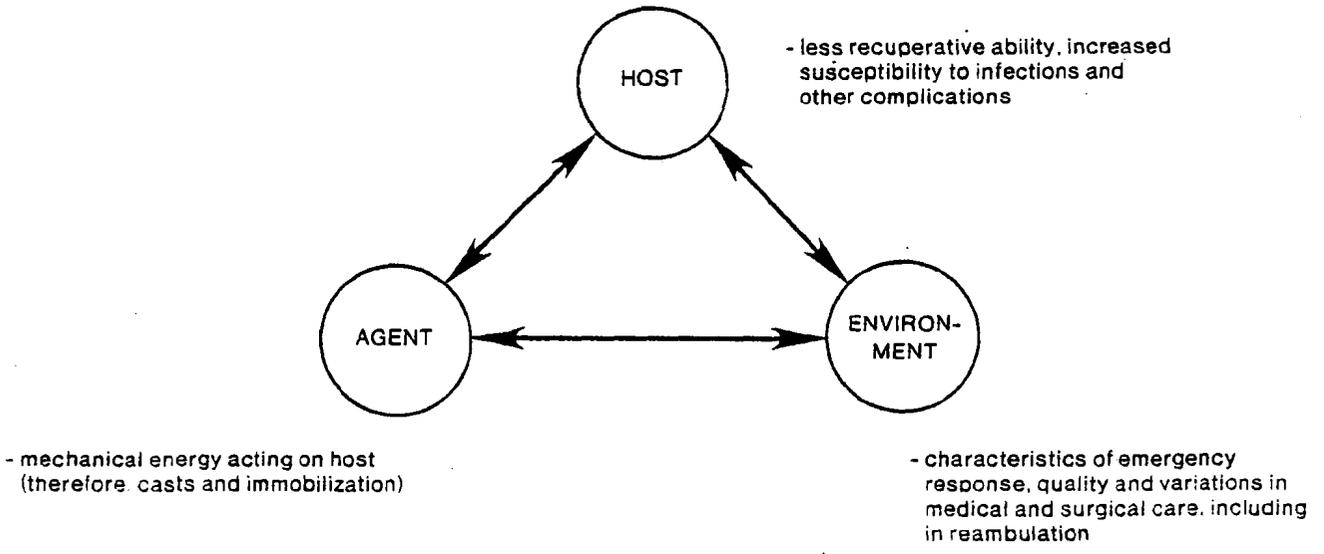
In many other situations in which an abnormally hazardous agent is producing the injuries, elimination or modification of the agent itself should be the primary focus. Examples include elimination of firecrackers and not heating tap water to likely-to-be-injurious temperatures.



**FIGURE 1**  
**Interactions of the Pre-Event Phase Illustrated by Falls of Elderly Women**



**FIGURE 2**  
**Interactions of the Event Phase Illustrated by**  
**Falls of Elderly Women**



**FIGURE 3**  
**Interactions of the Post-Event Phase Illustrated by Falls of Elderly Women**

In most situations, however, it is inadequate to direct preventive measures to only one or even two components of the triad, or to only one or two of the three phases of interactions involved. As with most other pathologies, a wide range of interventions is usually necessary to maximize the desired bottom-line reductions.

#### INJURY CONTROL MATRICES

The host-agent-environment model can be recast with or without modification into various matrices. This is especially useful in complex situations in which machines as presently designed act as the vehicles (in the epidemiologic sense) which transmit energy injuriously to people. I have been responsible for a family of such matrices especially applicable to the motor vehicle area (Haddon, 1968; 1972a; 1972b; 1980a; 1983b; Robertson, in press a; in press b). These are aids in sorting questions and knowledge concerning causal factors, in considering resource allocations, and in analyzing the interrelationships and influence of various intervention strategies and tactics on the bottom-line injury and other losses of concern. Figure 4 gives an example of such a matrix, and Figures 5-8 (Haddon, 1983b) illustrate its use.

(Figures 4-8 here.)

#### THE TEN OPTIONS FOR INJURY CONTROL

There are various additional ways to sort out options and tactics for reducing human and other damage. In describing one of these, which I developed beginning in 1962 (Haddon, 1963; 1970; 1973; 1975a; 1980b; 1980c; Robertson, in press b), I wrote:

		FACTORS			
		HUMAN	VEHICLES AND EQUIP.	PHYSICAL ENVIRONMENT	SOCIO-ECONOMIC ENVIRONMENT
PHASES	PRE-CRASH				
	CRASH				
	POST-CRASH				
	LOSSES	DAMAGE TO PEOPLE	DAMAGE TO VEHICLES & EQUIP.	DAMAGE TO PHYSICAL ENVIRONMENT	DAMAGE TO SOCIETY

Figure 4.

The "Haddon Matrix", a device for sorting out the pieces of the motor vehicle loss problem, and preventive measures directed at its reduction.

# EXAMPLES OF CLASSIFICATION OF PRE-CRASH PHASE VARIABLES IN HADDON MATRIX

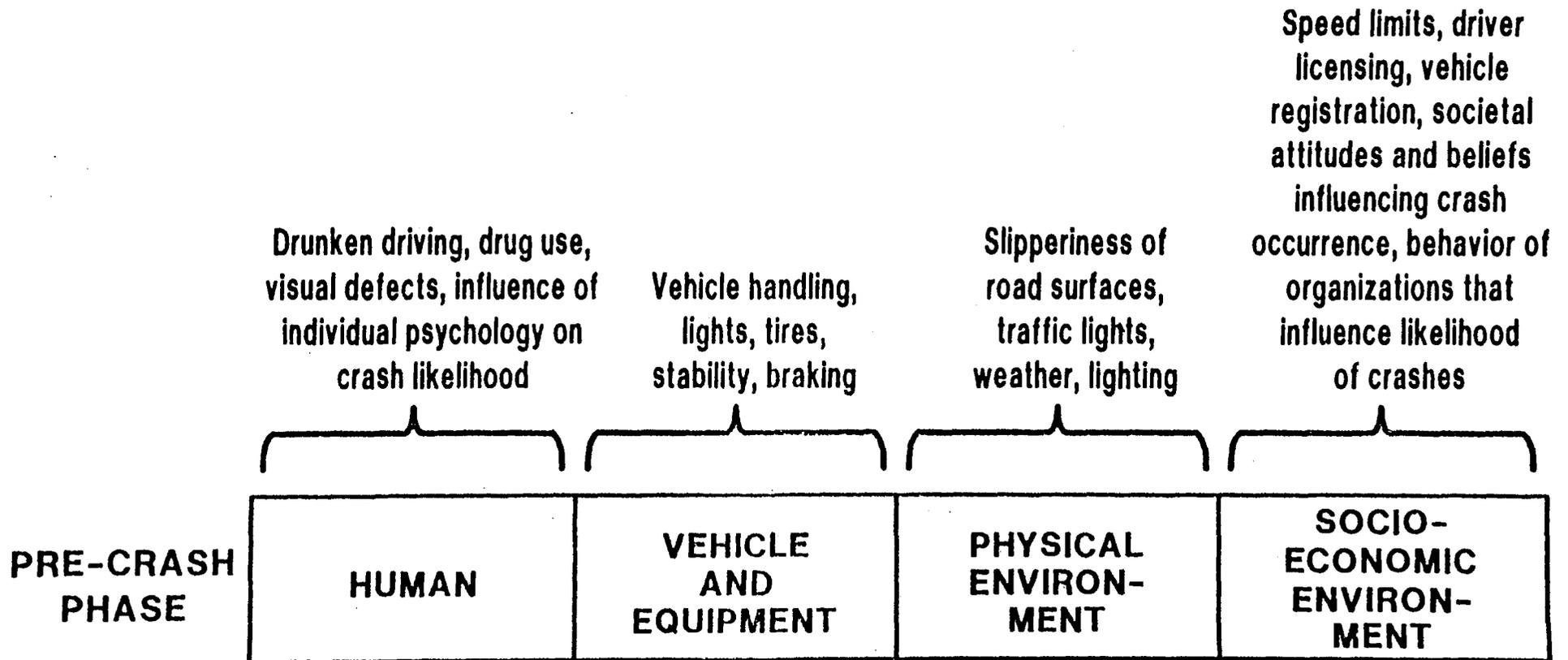


Figure 5

# EXAMPLES OF CLASSIFICATION OF CRASH PHASE VARIABLES IN HADDON MATRIX

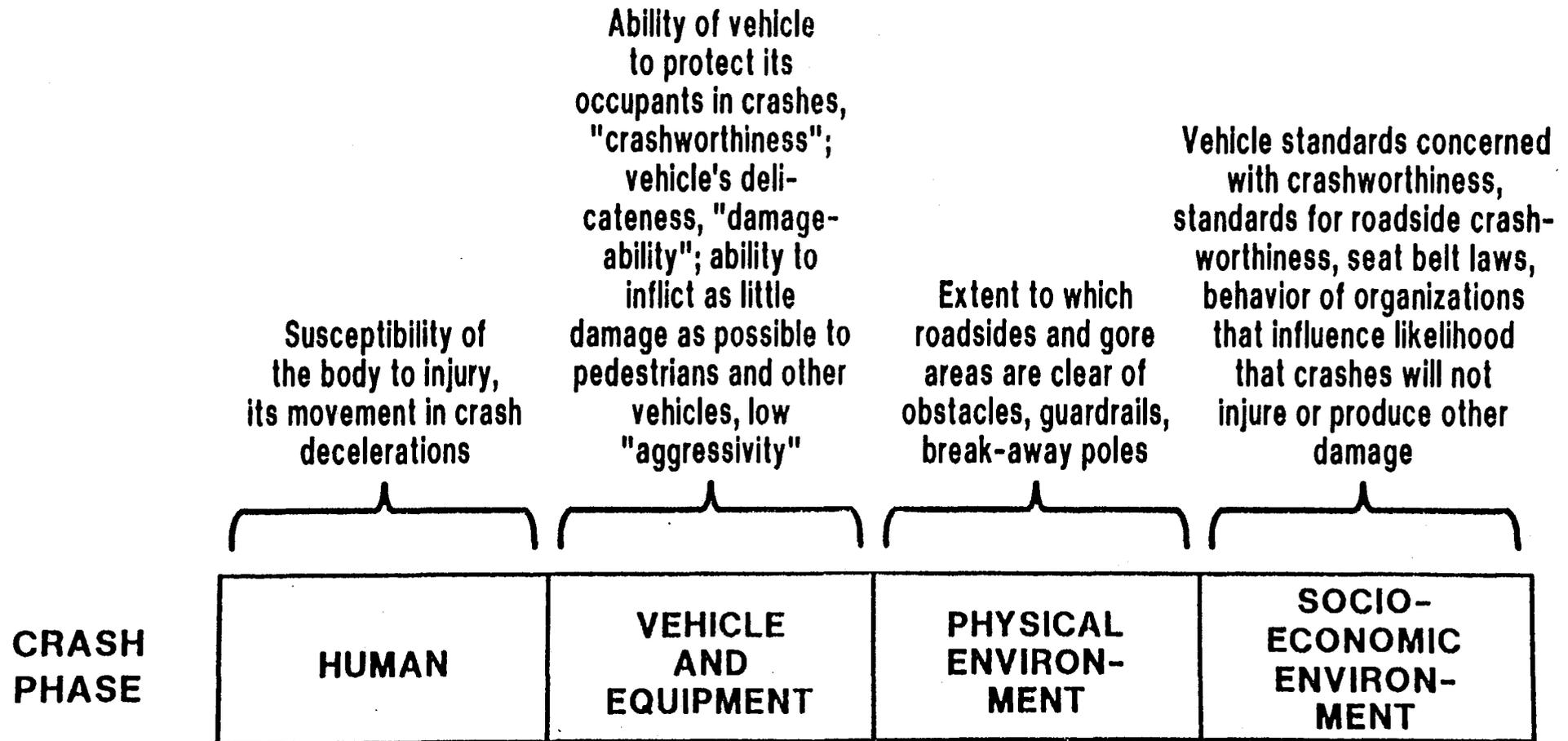


Figure 6

# EXAMPLES OF CLASSIFICATION OF POST-CRASH PHASE VARIABLES IN HADDON MATRIX

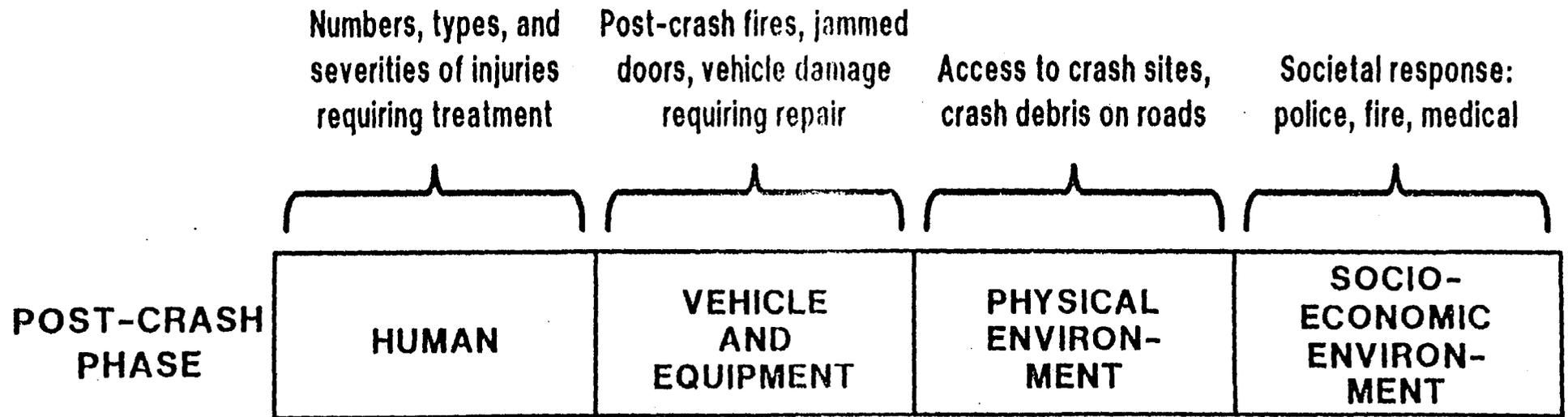


Figure 7

# EXAMPLES OF CLASSIFICATION OF LOSSES IN HADDON MATRIX

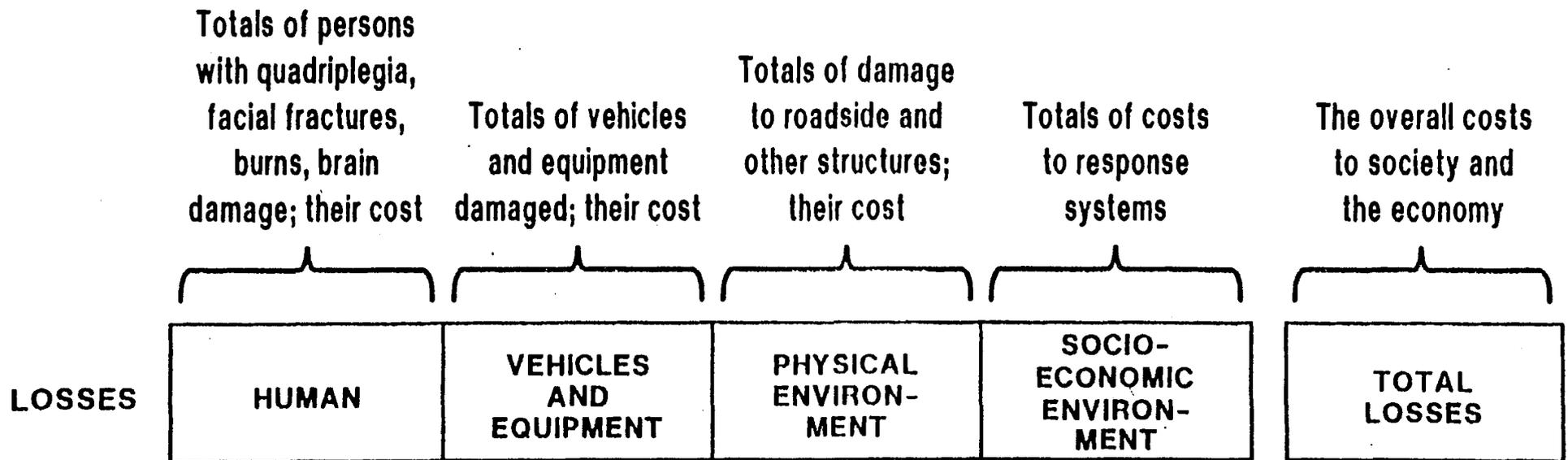


Figure 8

A major class of ecologic phenomena involves the transfer of energy in such ways and amounts, and at such rapid rates, that inanimate or animate structures are damaged. The harmful interactions with people and property of hurricanes, earthquakes, projectiles, moving vehicles, ionizing radiation, lightning, conflagrations, and the cuts and bruises of daily life illustrate this class.

Several strategies, in one mix or another, are available for reducing the human and economic losses that make this class of phenomena of social concern...( Haddon, 1970).

I then identified the ten mutually exclusive, all inclusive strategy options available to reduce such energy-damage. These strategies, which are commonly called the "Tigers strategies" from the name of the paper ("On the Escape of Tigers") in which they were first completely spelled out, are illustrated by what I wrote with respect to one of them:

The fifth strategy is to separate, in space or time, the energy being released from the susceptible structure, whether living or inanimate: the evacuation of the Bikini Islanders and test personnel, the use of sidewalks and the phasing of pedestrian and vehicular traffic, the elimi-

nation of vehicles and their pathways from community areas commonly used by children and adults, the use of lightning rods, and the placing of electric power lines out of reach. This strategy... has as its hallmark the elimination of intersections of energy and susceptible structure -- a common and important approach (Haddon, 1970).

Since many kinds of injury to people, systems, and property involve agents other than the various kinds of energy per se, many people urged me to generalize the analysis to apply to hazardous agents of all types (not only to those that produce "injury"), and I did so several years later (Haddon, 1980b; 1980c). This yielded the following "ten generalized strategies":

1. To prevent the creation of the hazard in the first place. Examples: prevent production of plutonium, thalidomide, LSD.
2. To reduce the amount of hazard brought into being. Examples: reduce speeds of vehicles, lead content of paint, mining of asbestos.
3. To prevent the release of the hazard that already exists. Examples: pasteurizing milk, bolting or timbering mine roofs, impounding nuclear wastes.
4. To modify the rate or spatial distribution of release of the hazard from its source. Examples: brakes, shutoff valves, reactor control rods.

5. To separate, in time or space, the hazard and that which is to be protected. Examples: isolation of persons with communicable diseases, walkways over or around hazards, evacuation.

6. To separate the hazard and that which is to be protected by interposition of a material barrier. Examples: surgeon's gloves, containment structures, childproof poison-container closures.

7. To modify relevant basic qualities of the hazard. Examples: altering pharmacological agents to reduce side effects, using breakaway roadside poles, making crib slat spacings too narrow to strangle a child.

8. To make what is to be protected more resistant to damage from the hazard. Examples: immunization, making structures more fire- and earthquake-resistant, giving salt to workers under thermal stress.

9. To begin to counter the damage already done by the environmental hazard. Examples: rescuing the shipwrecked, reattaching severed limbs, extricating trapped miners.

10. To stabilize, repair, and rehabilitate the object of the damage. Examples: post-traumatic cosmetic surgery, physical rehabilitation, rebuilding after fires and earthquakes.

## EMPHASIS IN INJURY CONTROL

Most real-world injury prevention programs necessarily involve a mixture of such strategies, varying greatly in their emphasis and tactical details. Moreover, there is often neither the necessity to use all ten strategies, nor the opportunity to do so. Whatever measures are used, it is usually a fundamental error to assume, a priori, that the earlier in the sequence (from initiation to the bottom-line result) the preventive countermeasures are directed, the better. To the contrary, the objective is to maximize the reduction of the bottom-line losses by whatever means work best, not to automatically give priority to intervention at as early a point in the causal sequences that lead to them as possible.

This is illustrated in the prevention of paralytic poliomyelitis: trying to alter the behaviors that exposed people to the viral hazard by closing swimming pools, theaters, and schools, produced no discernible lessening of the disease; addressing a later point in the causal sequence and altering the body's interaction with the hazard by immunization did. The point is also illustrated by the fact that in many transportation situations it is far more efficient to protect the cargo, whether teacups or people, than to attempt to prevent potentially damaging mishaps in transit. However, there are no "magic bullets" in most transportation and other complex loss situations, and "mixed strategies" that maximize overall loss reduction by using a multiplicity of preventive approaches are imperative (Haddon, 1975a).

It is crucial also that variables of many other kinds are relevant to the applicability of each of the basic loss reduction options. These typically include legal, medical, technological, research, psy-

chological, cultural, economic, and many other dimensions. For example, with respect to the eighth strategy (to make what is to be protected more resistant to damage from the hazard), virtually all of these, especially behavioral and cultural variables, substantially determine the success of attempts to increase immunization or to make structures more fire- and earthquake-resistant. It is often an error to assume that given kinds of variables are inherently more relevant to some strategies than others -- for example, that behavioral variables are more relevant to the initial strategies than to all of those that follow. In illustration, physicians whose work centers on the repair and rehabilitation of the injured (preventive strategies nine and ten) are just as involved with behavioral variables as those who work to decrease the initiation of injury-producing interactions by altering behavior and other means.

I mentioned earlier that there are no theoretical distinctions between injuries and disease. There is, however, a practical difference of profound influence. Whereas most disease processes occur relatively slowly, over periods ranging from days to years, those that produce injury are typically of much shorter duration, so short that, for most, there is no opportunity for clinical intervention while they are under way. In illustration, typical motor vehicle crash impacts commence and are over in less than a tenth of a second. This means that, with the exception of some poisonings and other injury interactions which occur more slowly, preventive measures directed by physicians and society at the Event Phase must usually be entirely anticipatory, the events themselves being too transient to permit interventions not arranged in advance.

## THE ACTIVE/PASSIVE DISTINCTION

Long experience in the prevention of diseases shows that, other things being equal, the less people to be protected must do, the more successful is the preventive measure. Thus, pasteurizing milk and purifying water at their sources are far more effective in preventing milk and water-borne diseases than asking their ultimate users always to do something such as boiling them or adding disinfectants. Similarly, measures that require but one treatment (for example, vaccines that require only one administration) are more successful than those that require multiple treatments (for example, vaccines that require repeated booster shots).

So it is, too, with injury prevention measures. We use insulation on lamp cords rather than trying to get everyone to put on gloves each time they must handle the cords. And, we, in theory at least, subscribe to the policy that we should control noxious emissions from smokestacks and vehicles rather than saying people should all put on gas masks whenever they are to breathe the outside air.

In 1961, in pointing out this basic distinction, I coined the term "passive" (in recent years in the case of motor vehicles, often referred to as "automatic") to apply to measures that do not require the person to be protected to do something, and "active" to refer to measures that do (Haddon, 1961; 1974; 1975b; 1980b; Haddon and Baker, 1981; Haddon and Goddard, 1962). These terms, which are in wide use, especially with respect to motor vehicle occupant restraints, actually represent the extremes of a continuum along which all preventive measures can be located, depending on the amount of self-protective action required. Others have further elaborated the basic distinction and discussed its

application (Baker, 1980; Robertson, in press b; Robertson and Heagerty, 1975; Williams, 1982).

Reasoning along similar lines, many of us concerned with motor vehicle injury prevention conclude that the maximum practical protection should be built into vehicles by their manufacturers, in ways that would require their users to do as little as possible. Consider the alternatives in the case of seat belts that the user must fasten; to obtain for all drivers and passengers the protection belts provide would require some 100 billion individual harnessings and unharnessings annually in the United States alone. The alternative would be one-time decisions by a handful of public and private executives to install equivalent "passive restraints" and ancillary passive protection.

Moreover, as the U.S. Department of Transportation's Research Safety Vehicle program demonstrated years ago, it has long been practical to produce attractive, state-of-the-art vehicles that would be relatively small, relatively inexpensive if mass-produced\*, and fuel efficient\*\*; that would produce only low levels of pollutants; and that would be resistant to damage and provide far better human protection than other cars, and do so automatically (Fabian, 1980; Friedman, 1980; Haddon, 1983a).

I believe that the tragedy of the continued absence of vehicles with such preventive characteristics has come about in large part because

---

\* Mass-produced, one of these vehicles would have cost about \$7,000, retail, in 1980 dollars (Friedman, 1980).

\*\* The same vehicle, when driven, gave 32.2 miles per gallon "highway"; 27.5 miles per gallon "combined" (Friedman, 1980).

this aspect of injury prevention, as is true of many others, is not widely known either to the public or, in some cases, to relevant professionals. This meeting, as has been the case with many earlier American Medical Association conferences concerned with other medical challenges, is an important step in correcting this deficiency.

In conclusion, I wish to pay tribute to the many physicians and others whose competent, everyday work and research continue both to prevent and ameliorate injuries of many types, in many contexts, and to point to even greater accomplishments ahead. These workers, who continue the fine work and inquiry begun by the ancient physicians to whom I referred earlier, and who include several participants on this program, deserve far more recognition than they have generally received. I hope that in this respect also, this Conference will have achieved its objective.

## References

- Baker SP (1980): Prevention of childhood injuries. Med J Aust. 1: 466-490.
- Breasted JH, ed. and trans. (1930): "The Edwin Smith Surgical Papyrus (vol 1)." Chicago: University of Chicago Press.
- Damon A, Stouidt HW, McFarland RA (1966): "The Human Body in Equipment Design." Cambridge: Harvard University Press.
- De Haven H (1942): Mechanical analysis of survival in falls from heights of fifty to one hundred and fifty feet. War Med 2: 586-596.
- Fabian GJ (1980): "Calspan/Chrysler Research Safety Vehicle Phase III Final Technical Report. Volume I: Executive Summary." Technical Report DOT HS 805 322. Washington DC: National Highway Traffic Safety Administration.
- Friedman D (1980): The Minicars research safety vehicle. In: "Eighth International Technical Conference on Experimental Safety Vehicles." Technical Report DOT HS 805 555. Washington DC: National Highway Traffic Safety Administration, pp 55-76.
- Gibson JJ (1961): The contribution of experimental psychology to the formulation of the problem of safety -- a brief for basic research. In: "Behavioral Approaches to Accident Research." New York: Association for the Aid of Crippled Children, pp 77-89.
- Gordon JE (1979): The epidemiology of accidents. Am J Public Health 69: 504-515.
- Haddon W Jr (1961): Research with respect to fatal accident causes: implications for vehicle design. Paper 366A presented at the SAE Summer Meeting, St. Louis, June 1961. (Reprinted in: "Highway Vehicle Safety (Collected SAE Papers, 1961-1967." New York: Society of Automotive Engineers, 1968.)

- special reference to motor vehicle accidents. Ann NY Acad Sci 107: 635-646.
- Haddon W Jr (1967): The prevention of accidents. In Clark DW, MacMahon B (eds): "Preventive Medicine." Boston: Little, Brown and Company, pp 591-621.
- Haddon W Jr (1968): The changing approach to the epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based. Am J Public Health 58: 1431-1438.
- Haddon W Jr (1970): On the escape of tigers: an ecologic note. Technol Rev 72: 44-53.
- Haddon W Jr (1972a): Road safety problems and action programmes -- the U.S. approach. In: "Papers presented at the National Road Safety Symposium." Canberra: Australian Government Publishing Service, pp 579-612.
- Haddon W Jr (1972b): A logical framework for categorizing highway phenomena and activity. J Trauma 12: 193-207.
- Haddon W Jr (1973): Energy damage and the ten countermeasure strategies. J Trauma 13: 321-331.
- Haddon W Jr (1974): Strategy in preventive medicine: passive vs. active approaches to reducing human wastage. Newslet Am Coll Prevent Med 15: 23. (Reprinted in J Trauma 14: 353-354, 1974.)
- Haddon W Jr (1975a): Reducing the damage of motor-vehicle use. Technol Rev 77: 53-59.
- Haddon W Jr (1975b): Perspective on a current public health controversy. Am J Public Health 65: 1342-1344.
- Haddon W Jr (1980a): Options for prevention of motor vehicle injury. Isr J Med Sci 16: 45-65.
- Haddon W Jr (1980b): Advances in the epidemiology of injuries as a basis for public policy. Public Health Rep 95: 411-421.

- Haddon W Jr (1980c): The basic strategies for preventing damage from hazards of all kinds. Hazard Prevention 16: 8-12. (Reprinted in: Foresight 6: 16-22, 1981. London: Risk Research Group.)
- Haddon W Jr (1983a): "The Safety of the Automobile: an international perspective." Prepared for presentation at the Nordic Seminar on the Safety of the Automobile, Linköping, Sweden, June 14, 1983. Washington DC: Insurance Institute for Highway Safety.
- Haddon W Jr (1983b): "Automobile Injuries Related to Drug Abuse: an introduction to some of the basic considerations in prevention and research." Prepared for presentation at the Second Binational Symposium, US-Israel, National Institutes of Health, Bethesda, Maryland. Washington DC: Insurance Institute for Highway Safety.
- Haddon W Jr, Goddard JL (1962): An analysis of highway safety strategies. In: "Passenger Car Design and Highway Safety." Proceedings of a conference on research. New York: Association for the Aid of Crippled Children and Consumers Union of U.S. pp 6-11.
- Haddon W Jr, Suchman EA, Klein D (1964): "Accident Research: methods and approaches." New York: Harper and Row, Publishers.
- Haddon W Jr, Baker SP (1981): Injury Control. In Clark DW, MacMahon B (eds): "Preventive and Community Medicine (2nd ed.)." Boston: Little, Brown and Company, pp 109-140.
- Hippocrates (c 400 BC/1939): On injuries of the head. In Adams F (trans.): "The Genuine Works of Hippocrates." Baltimore: Williams and Wilkins Company, pp 142-156.
- Robertson LS (in press a): Trauma. In "Oxford Textbook of Public Health (vol IV)." New York: Oxford University Press.

Robertson LS (in press b): "Injuries: causes, control strategies, and public policy." Lexington, MA: Lexington Books.

Robertson, LS, Heagerty MC (1975): "Medical Sociology: a general systems approach." Chicago: Nelson-Hall, Inc.

Stapp JP (1957): Human tolerance to deceleration. Am J Surg 93: 734-740.

Waller JA (1961): Tic-Tac-Toe burns - the hazard of exposed floor-type room heaters. N Engl J Med 265: 1256-1257.

Williams AF (1982): Passive and active measures for controlling disease and injury: the role of health psychologists. Health Psychol 1: 399-409.