

Moving Towards Competency in Injury Prevention

# History of Injury Epidemiology

Thomas Songer, PhD  
University of Pittsburgh  
Center for Injury Research & Control

History forms the basis for many of the decisions and actions in epidemiology. Much of the current research in injury epidemiology is heavily influenced by the events of the past. This lecture provides a brief overview of the themes that shaped injury research and injury control efforts over the last 100 years.

For those with a serious interest in this topic area, more information can be found from the following sources:

1. Accidents in History; injuries, fatalities, and social relations. Cooter, Luckin (eds). Rodopi, Amsterdam, 1997.
2. Waller JA. Reflections on a half century of injury control. *Amer J Public Health* 84:664-70, 1994.
3. National Safety Council's Safety & Health International Hall of Fame. In <http://www.nsc.org/shhofi.htm>
4. Overview of Landmark Injury Prevention Events in the United States, 1937-1997. In *Injury Prevention and Public Health*. Christoffel, Scavo Gallagher (eds). Aspen Publishing, Gaithersburg, MD, 1999.
5. Rockett IRH. Injury and Violence; a public health perspective. Volume 53, No. 4 (Washington, DC: Population Reference Bureau, Dec 1998.)

## Lecture Objectives

On completion of this lecture, ...  
you as a reader and listener should be able to:

1. Identify the themes which have shaped the development of injury epidemiology
2. Describe how the perception of injury by the professional community has changed over time
3. Describe the biomechanics which underlie how injury occurs
4. Illustrate Haddon's ten principles of limiting energy transfer

## Lecture Objectives

On completion of this lecture, ...  
you as a reader and listener should be able to:

5. Describe the difference between active and passive forms of intervention in the injury context.

# Core Competencies for Injury and Violence Prevention

[www.injured.org](http://www.injured.org)

## Core Competency #1:

Ability to describe and explain injury and/or violence as a major social and health problem.

This lecture is one part of a concerted effort to provide more training to persons interested in injury and violence prevention. The lecture was written with the core competencies for injury and violence prevention in mind. More specifically, the lecture objectives were selected to address the first core competency, as outlined in this slide.

Further details on this and the other core competencies can be found at the following reference:

Songer TJ, Stephens-Stidham S, Peek-Asa C, Bou-Saada I, Hunter W, Lindemer K, Runyan C. Core Competencies for Injury and Violence Prevention. *American Journal of Public Health* 99(4):600-606, 2009. Available online at [www.injured.org](http://www.injured.org).

# Themes Shaping the Study of Injury



@ 1900 - 2005

## Themes Shaping the Study of Injuries

- Shaped by technology
- Shaped by industry
- Spurred by research on biomechanics
- Shaped by history of epidemiology
- Heavily influenced by Haddon
- Shaped by recent success

The themes addressed in this lecture will focus on the areas of technologies and accidents, industrial perspectives to accidents, that natural evolution of epidemiology and it's meaning for injury research, the dynamics learned from biomechanics research, and the ground-breaking work of William Haddon, Jr..

Injury research, in essence, is also relatively new. While injury prevention interventions have been around for centuries, the application of scientific methods to injury control did not occur with any substance until the late 1960s. Thus, the framework for this presentation primarily represents the developments in the last century. Particular emphasis is placed on the role of the injury research with respect to the automobile.

# Injury research has been shaped by technology



The first item for discussion is the view that injury research has been shaped by our responses to and introduction of new technologies. For example, since the early ages of mankind, technologies have been developed to protect against injury in warfare (e.g. body armor).

The industrial revolution and the advent of automatic machinery appears to be a watershed event in the injury realm. Prior to this time, most work was agriculturally oriented. The industrial revolution led to urbanization and the development of factories. The injury risk in this environment increased significantly to the extent that accidents and injuries became an accepted part of ordinary life. Both business and the state accentuated the “normalization of the accident” (Luckin). This means that industry and government accepted that injuries were part of the cost of doing business. Injuries and accidents were one of the consequences of economic development. This perspective is an ongoing issue in the developing countries of the world even today.

This business and government laissez faire approach to safety set the stage for the events of the 20th century, and our initial attitude to the automobile.



1900 - 2000

## The Automobile



Historically, one can view the last 100 years as the century of the automobile. The automobile has dramatically changed the way in which we live our lives. Mobility is much greater now than in any time in the past. There are consequences to this discovery as well. A significant portion of air pollution is attributed to motor vehicles, and traffic-related fatalities are now a large part of life.

The International Red Cross, in the World Disaster Report, has characterized the last 100 years as the “Century of road death”. The first pedestrian death was noted in 1896 and the first driver died in a crash in 1898. The dangers of the automobile and road traffic accidents were regularly featured in the *Lancet* in the beginning of the 20th century.

Source: International Federation of Red Cross and Red Crescent Societies. World Disaster Report, 1998. Oxford University Press, Oxford 1998.

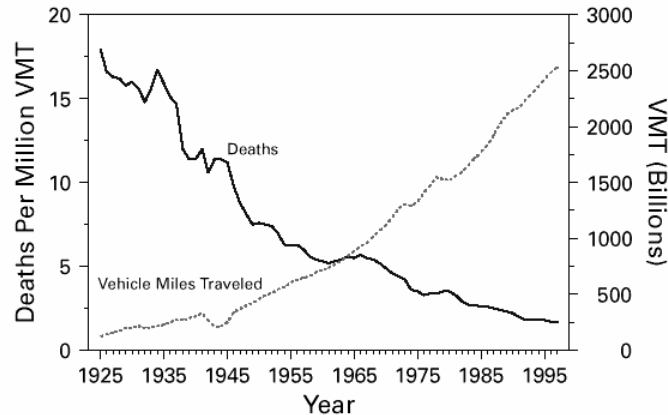
Road Traffic Accidents. *Lancet* 352:1483, Oct 31 1998.





## Top Ten Public Health Achievement

FIGURE 1. Motor-vehicle-related deaths per million vehicle miles traveled (VMT) and annual VMT, by year — United States, 1925–1997



In the developed world, though, the impact of road traffic accidents has been continuously improving.

Indeed, the reduction in the rate of death attributable to motor-vehicle crashes has been called one of the most successful public health responses to a great technologic advance of the 20th century--the motorization of America. Six times as many people drive today as in 1925, and the number of motor vehicles in the country has increased 11-fold since then to approximately 215 million. The number of miles traveled in motor vehicles is 10 times higher than in the mid-1920s. Despite this steep increase in motor-vehicle travel, the annual death rate has declined from 18 per 100 million vehicle miles traveled (VMT) in 1925 to 1.7 per 100 million VMT in 1997--a 90% decrease. Injury control efforts and epidemiology have had a large part in this decline.

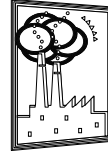
**Achievements in Public Health, 1900-1999 Motor-Vehicle Safety: A 20th Century Public Health Achievement.** MMWR May 14, 1999 / 48(18);369-374

# Injury studies have been shaped by Industry

Automotive



Manufacturing



Insurance



Accidents are rare events that involve a constellation of several factors. However, for the first half of the 20th century, accident and injury research focused mainly and solely on the human aspects of injuries. Reasons for this fact are strongly debated. The events of the 19th century, though, provide a background. Accidents were either viewed as being fatalistic or the cost of doing business. Both government and industry emphasized production over safety.

With respect to road traffic accidents, I argue here that our approach to the prevention of injuries from road traffic accidents was shaped in part by the vested interests of the automotive and insurance industries. Both groups were interested in minimizing the cost of selling their products.

# Highway Safety Emphasis

- Human Factors role (1920s – 1940s)
- Environmental/Vehicular role (1960s - )



The prevailing mood of both the automotive and insurance industries in the beginning of the century was that crashes and the injuries that resulted were due to human behaviors. Initiatives regarding injury research, then, focused on identifying high risk individuals, high risk situations, or high risk behaviors. The concept of the accident proneness of individuals began to emerge. That is the notion that some individuals may be more prone to crash (or multiple crash) than others. The advent of drivers licensing was one response to this research direction. Some vehicular modifications related to safety were made (e.g. safety glass in windscreens), but most prevention initiatives were focused on the individual.

It was not until the 1950s that the focus of injury research began to shift to consider other factors and their contributions to safety. At this time, the study of the role of vehicular design and environmental circumstances in injury began to emerge. New developments in biomechanics and epidemiologic research were the primary factors underlying this change.

# Human Contributions to Injury



The recognition of human contributions to accidents and injury arose from the appalling rate of occupational deaths occurring in the manufacturing industries of the 1880s to 1920s. Observations and quick deductions pointed to human faults underlying many of these deaths.

## “Accident Causation”

- Historically, efforts focused on accident prevention rather than injury prevention
- Shaped by early efforts to reduce industrial accidents
  - If you could understand what led to the accident, then you could intervene to that circumstance and reduce future events.

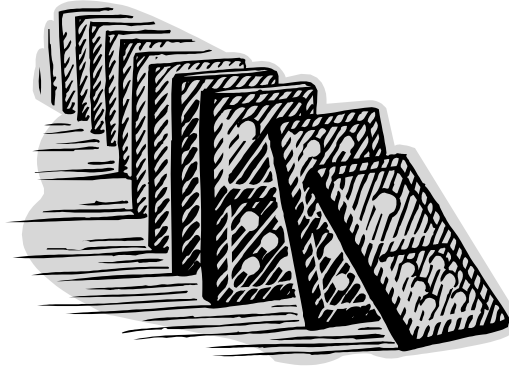
With the institution of occupational safety regulations (in their early form) in the 1900s, industry was being required to pay more attention to occupational accidents and injuries. The primary efforts of industry, in this regard, focused on preventing accidents.... With the view that accident prevention will lead to injury prevention. This led to several models directed at understanding how industrial accidents occurred.

# Domino Theory of Accidents

- HW Heinrich; “accidents are the result of a chain of sequential events”



1940s, 1950s



One of the most widely adopted industrial accident models was the Domino Theory of Heinrich. In this theory, accidents are viewed to result from a chain of sequential events, similar to a line of dominoes falling over. Removing one of the key events prevents the full chain reaction, and the occurrence of an injury.

H. W. Heinrich, “Industrial Accident Prevention: A Scientific Approach” (1950).

# Heinrich Domino Theory



For example, Heinrich postulated that the chain of events might look like the conditions outlined on this slide. According to Heinrich, natural or environmental flaws in the worker's family or life create secondary personal defects in the worker (Sara Stewart). These personal defects (described by Heinrich as character flaws such as bad temper, inconsiderateness, ignorance, and recklessness; Sara Stewart) lead the individual to undertake an unsafe act, which then leads to an accident, and then an injury.

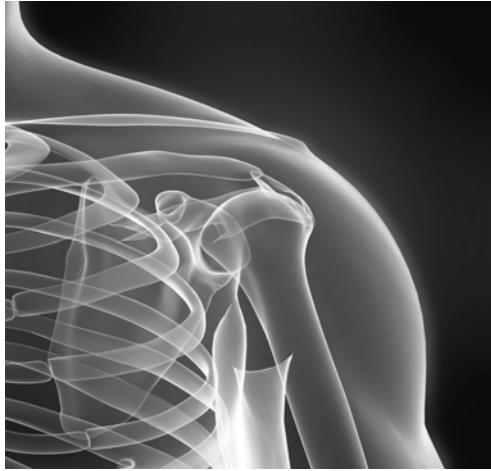
## Personal responsibility as the primary link in the chain of accident causation



An event for which no one, except the victim, was responsible.

In the Domino Theory, the emphasis was placed on the fault of the individual in the development of the accident. To Heinrich, one of the key events of importance regards the personality traits of the individual. "Heinrich explains that inborn or obtained character flaws (from 1) such as bad temper, inconsiderateness, ignorance, and recklessness contribute *at one remove* to accident causation. (Stewart). While other issues are part of the chain, personal responsibility became the overwhelming focus. This reflects the prevailing views for injury causation from the 1920s to the 1950s.





Changes to our understanding of injury, though, began to emerge from biomechanics research

Changes to our understanding of injury, though, began to take place in the 1950s. This was led by two developments; the advent of our understanding of injury biomechanics, and the introduction of epidemiological approaches to injury occurrence. Let's talk about biomechanics first.

# Biomechanics -- What is it?

Bio : LIVING

Mechanics : FORCES & EFFECTS

- The study of the structure and function of biological systems (living structures) by means of the methods of mechanics (statics, dynamics, mechanics of materials)
- The science concerned with the internal and external forces acting on the human body and the effects produced by these forces

What is biomechanics? The definition of biomechanics is presented on this slide. The philosophical focus of biomechanics is the study of forces on the human body and the effects that they have on the body.

## Objectives of Biomechanics

- To determine what kind of forces are acting on musculoskeletal tissue elements
- To understand the mechanical properties of biological tissues; how do they deform and endure the application of forces
- To understand the mechanisms of injury; what kind of loads cause tissues to fail (lose their structural integrity);

Kadlowec

In biomechanics, scientists think and characterize the forces that can impact the human body, and describe the manner in which they impact the body. With regards to injury, this translates to describing what is happening in the body from energy forces and how they impact tissues.

## Current thinking about injuries was influenced by the biomechanical research of

- Hugh DeHaven
- John Stapp
- Cornell Automotive Crash Injury Research



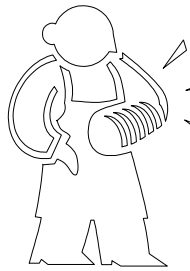
1950s

One of the first investigators to examine the biomechanical aspect of injuries was Hugh DeHaven. His work began to illustrate that the distribution of energy forces could influence or affect the injury and its severity. He studied ways to reduce injuries by changing the environment in which they took place.

Hugh DeHaven's interest in injury work began early. He had survived a plane crash in WWI (while others perished) and sought to understand more fully the reasons why he survived. At the time, he had worn a safety belt and was intrigued by the injuries he received from the belt. His classic work, though, examined survival from falls of 50-150 feet, and noted that injury can be reduced by spreading the transfer of energy forces over time or spatial area.

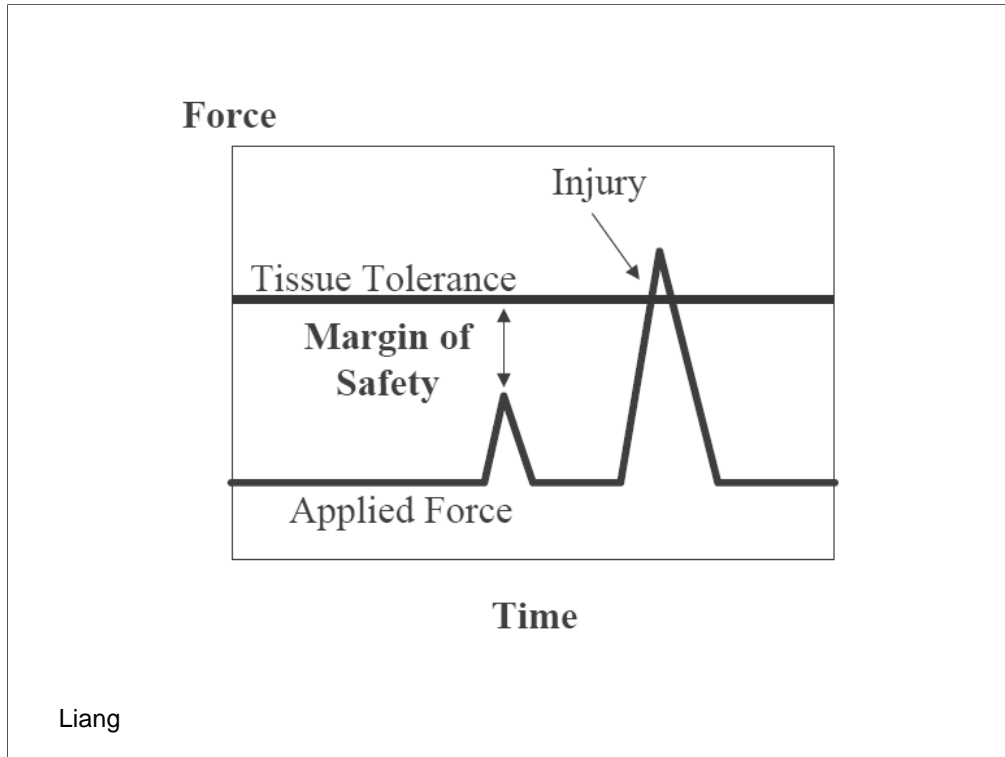
Further work in the area was undertaken by John Stapp. He conducted several experiments for the US Air Force on biomechanical influences at the time of crash events. He is widely known for strapping himself into a rocket sled with a shoulder harness to test the ability of the harness to withstand energy transfer forces on rapid deceleration.

The Cornell Automotive Crash Injury Program examined restraint systems and other vehicular design features, highlighting their role in injuries and injury prevention (Waller).



**Injuries occur as  
the result of  
energy transfer that is  
delivered in excess of  
a threshold**

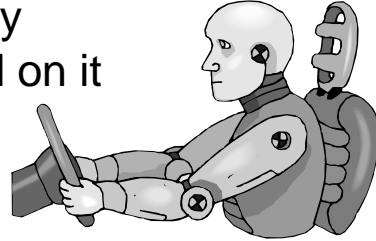
The current definition of injury emerged from this work and the field of biomechanics.



An illustration of the definition is shown in this slide. You can see the two parts of the definition; both energy forces and their transfer to human issue, and the level of energy being “applied”, and if this level attains or exceeds the level of tolerance of the tissue affected. An energy force which does not exceed a tissue tolerance level, for example, will not result in a tissue injury.

# Injury Biomechanics

....study of the human body  
response to forces applied on it



- Identify and define injury mechanisms
- Quantify the responses of different body tissues to a range of impact conditions
- Determine the tissue injury threshold

Today, an entire field of injury biomechanics has emerged. This slide outlines the primary emphasis of current work in the field. Common examples include gaining further understanding of injuries arising from motor vehicle crashes, often through crash testing; where dummies are outfitted with several electronics to document forces and how they change at the time of a crash.

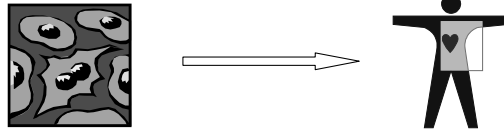
## Energy Forces and Injuries

- Blunt (compression)
- Penetrating
- Deceleration / Acceleration
- Shear
- Blast
- Thermal / Chemical

The important energy forces that can lead to injury are categorized on this slide. The two major energy forces leading to injury are penetrating and blunt forces. Injuries, though, can also arise from other forces.



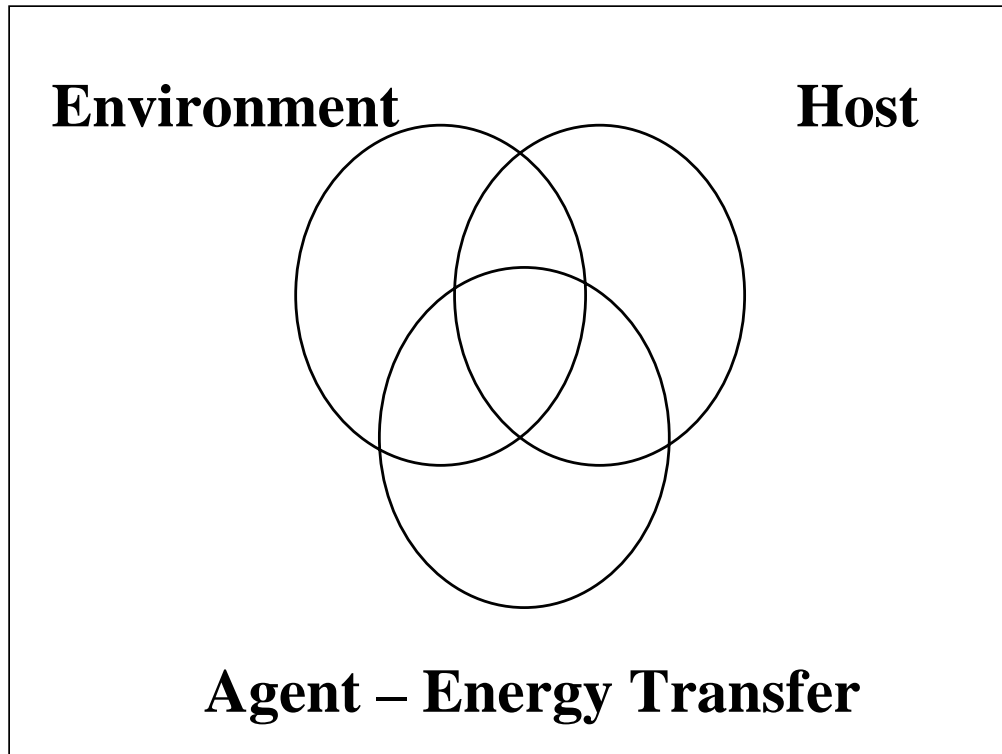
## Injury Epidemiology has been shaped by general developments in epidemiology



- Transition from infectious disease models to chronic disease models
- John Gordon

Changes in epidemiologic research is another them that led to the further development of injury research and our understanding of injuries from a public health context. In the beginning of the 20th century, work in epidemiology focused on reducing the burden of infectious disease. The development of vaccines and antibiotics and their success in reducing infectious diseases led to a shift in emphasis in epidemiology to the investigation of chronic diseases. This shift began to take place in the 1940s and 1950s.

As investigators began to search for new areas in which to conduct research, a few settled onto injuries. Most notably was John Gordon. He was an epidemiologist at Harvard who saw that the study of injuries had many similarities to the study of infectious diseases. He recognized that there were known patterns to injury.



John Gordon was also one of the first investigators to view injuries from the epidemiologic triad of host, agent, environment. Initially, the agent of injury was viewed as the object involved (e.g. the car, the piece of machinery, the knife, etc.). In subsequent years, though, the agent of injury was properly understood to be the energy transfer involved in the event. James Gibson generally receives the credit for this insight. The object involved (such as the automobile), then, came to be seen as the vehicle through which the energy transfer was enabled. William Haddon subsequently refined this aspect of injury control further.

# Injuries are not Accidents



Now, let me diverge a bit to talk briefly about what many injury professionals feel that injuries are not. “Injuries are not Accidents”. This has been a common slogan spoken by injury research professionals.

It originated some time ago to counteract the perception that injuries occurred by chance. In the past, many persons in the lay public and many legislators regarded injuries as accidents; events that you had little control over. This thought probably arose from the publicity that natural disasters receive.

## Injuries Are Not Accidents!

- Accident: An unexpected occurrence, happening by chance... implies a random and uncontrollable event
- Injury: A definable, correctable event, with specific risks for occurrence ... implies something amenable to intervention

© ACS 1999

The slogan, Injuries are not Accidents, is also a simple way to change the public perception of injuries. The term “accident” carries with it a certain connotation from a societal point of view, that is counterintuitive to the current philosophy of injuries.

Accidents, for example, imply randomness or an element of being in the wrong place at the wrong time. It is now well recognized that nearly all injuries are not the result of random events. There are distinct patterns and circumstances that characterize their occurrence. We understand that injuries most often occur to certain risk groups and are fairly predictable (whether it be to certain persons, at certain times, or in common locations).

In this light, many persons in the injury field refer to automobile accidents as “crashes” rather than “accidents”. In reality, it does not matter whether or not crashes or accidents is the most appropriate term. What is important is the recognition that injury events often have identifiable characteristics, and that we may be able to prevent future injuries by intervening on one or more of these characteristics.



William Haddon, Jr.

“Father of Injury  
Epidemiology”

Without a doubt, the father of injury epidemiology and injury control is William Haddon. The former director of the National Highway Traffic Safety Administration and the Insurance Institute for Highway Safety played a leading role in bringing epidemiologic principles to injury research and intervention programs.

## William Haddon, Jr.

- Looked at injury research as a science
- one of the first investigators to characterize energy as the “agent” of injuries
- Phases of crashes
- Link of phases to epidemiologic triad to identify processes of injury prevention

Haddon made several contributions to injury research. In addition to the refinement of Gibson's theory on energy transfer, Haddon saw injury research as a science in which strict methods could transform of understanding of injuries and the processes in which interventions could succeed. Haddon recognized that standard public health methods and epidemiology could be applied to preventing motor-vehicle-related and other injuries.

Haddon is best known for identifying the temporal sequence of a crash and examining this sequence from an epidemiologic perspective.

# The Crash Sequence

- Pre-crash Period
- Crash Period
- Post-crash Period

In this work, William Haddon spoke of the “Crash Sequence” as being meaningful for studying injuries from motor vehicle accidents. This sequence involves events which occur prior to the crash, the circumstances surrounding the crash itself, and the situation that exists after the crash. Haddon argued that there are circumstances in the period of time right before the collision that may dictate whether a crash or injury from a crash happens. The characteristics of the crash itself, (i.e., how energy is transferred) influences the likelihood for and severity of injury. Third, the events which take place after a crash occurs can determine the outcome of a crash. For example, the ability to extricate victims from the car, the response time of EMS (Emergency Medical Services) to the accident scene, and the type of medical care received may all influence the injury outcome of a crash.



## The Haddon Matrix

	Human	Vehicle	Environment
Pre-event			
Event			
Post-event			

To understand the factors underlying injuries from motor vehicle crashes, Haddon proposed that the elements of the epidemiology triad should be considered in unison with the crash sequence. The crash sequence can be examined in terms of three items; the circumstances surrounding the event prior to the crash occurring, the circumstances involved during the crash, and those involved after the crash. There are human, vehicular, and environmental factors involved in each stage of a crash. Understanding how they work together to result in a crash or an injury can help investigators plan prevention strategies.



Phase	Factors			
	Human	(Agent) Vehicles & Equipment	Physical Environment	Socioeconomic environment
Pre-crash (crash prevention)	Is the person predisposed or over- exposed to risk?	Is the agent hazardous?	Is the environment hazardous? Can hazards be reduced?	Does the environment encourage or discourage risk- taking and hazard?
Crash (Injury prevention during the crash)	Is the person able to tolerate force or energy transfer?	Does the agent provide protection?	Does the environment contribute to injury during event?	Does the environment contribute to injury during event?
Post-crash (sustaining life)	Is the person able to tolerate force or energy transfer?	Does the agent contribute to the trauma?	Does the environment add to the trauma after the event?	Does the environment contribute to recovery?

Steffes

The fundamental questions to consider in the Haddon Matrix for any injury are highlighted here. If you can answer “yes” to any of the questions, then you should also consider a follow-up question; and that question is “then, how so?”

## Ten Methods for Limiting Energy Transfer

1. Prevent the development of energy form
2. Reduce the amount of energy
3. Prevent the energy release
4. Alter the rate of energy release from it's source or it's spatial distribution
5. Separate structures from the energy release by space or time

Haddon also provided further elaboration to the role of injury intervention programs by drawing on our first basic principle; that injuries represent energy transfer that exceeds a threshold. Considering that the primary agent involved in injuries is the transfer of energy, Haddon proposed 10 steps to reduce the impact of an energy transfer, and thus, reduce injuries. These steps are outlined here. They focus primarily on altering the environment in which the energy transfer takes place and the degree to which energy can be built up.

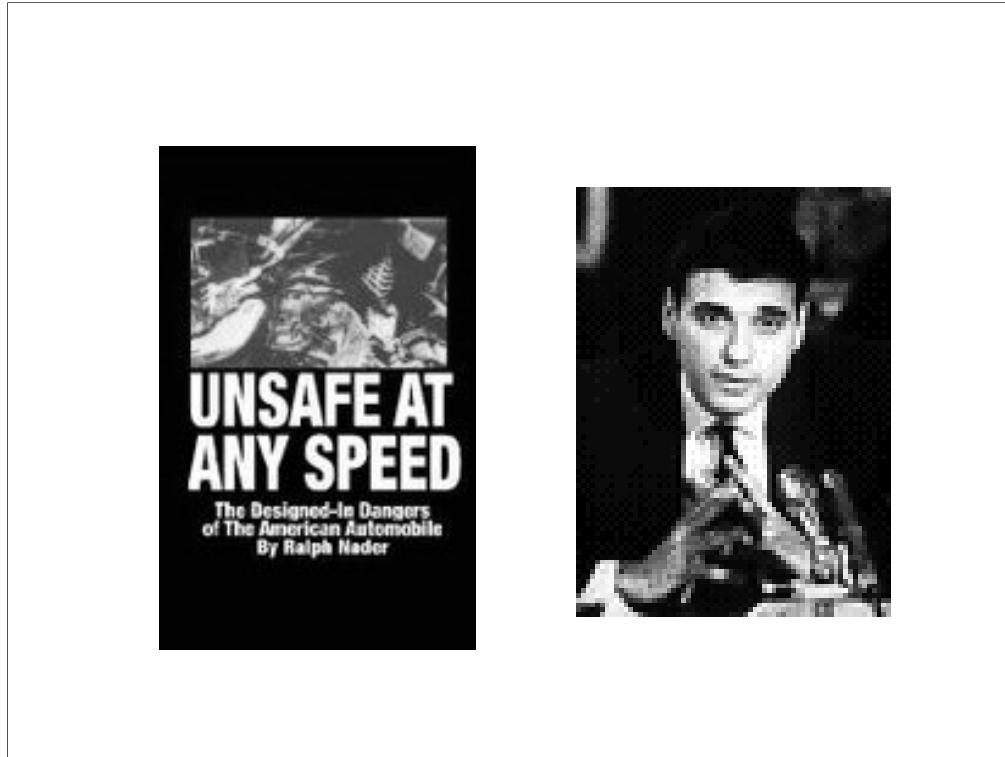
For example, speed limits aid in reducing the degree of energy that can potentially be involved in a crash. Engineering designs and changes in the automobile can affect the time and space in which energy transfer takes place. Overall, these principles transformed injury control efforts.

## Methods to limit energy transfer...

6. Place a barrier between the released energy and susceptible structures
7. Modify surfaces that can be impacted
8. Strengthen structures susceptible to damage from energy transfer
9. Prevent the extension of existing damage
10. Carry out intermediate and long-term repair and rehabilitation

Control programs to limit energy transfer (and thus reduce injuries or their severity) may be “active” or “passive”. Active programs include those in which individuals are encouraged to undertake safer practices to reduce their risk for injury. For example, wearing seat belts or motorcycle helmets.

Passive programs include those in which steps to reduce energy transfer are taken irrespective of an individual’s behavior. For example, the laws mandating air bags in cars are one form of a passive intervention. Many in the injury field prefer passive interventions because promoting changes in individual behavior has proven to be a difficult task in the past.



The work of Haddon was monumental. It also markedly influenced a young Ralph Nader. In the late 1950s, at Harvard, Ralph Nader first explored the engineering design of automobiles. His research resulted in an April 1959 article published in *The Nation*, "The Safe Car You Can't Buy," in which he declared, "It is clear Detroit today is designing automobiles for style, cost, performance and calculated obsolescence, but not -- despite the 5,000,000 reported accidents, nearly 40,000 fatalities, 110,000 permanent disabilities and 1,500,000 injuries yearly -- for safety."

In 1963, Nader moved on to Washington, DC, and acted as an unpaid advisor to a Senate subcommittee, chaired by Connecticut Senator Abraham Ribicoff, which was exploring what role the federal government might play in auto safety. He wrote the book *Unsafe at Any Speed: The Designed-in Dangers of the American Automobile* in November 1965.

The chief target of the book was General Motors' "sporty" Corvair, whose faulty rear suspension system made it possible to skid violently and roll over. More generally, Nader's book documented how Detroit habitually subordinated safety to style and marketing concerns. The main cause of car injuries, Nader demonstrated, was not the "nut behind the wheel" so often blamed by the auto industry, but the inherent engineering and design deficiencies of the motor vehicle that was woefully uncrashworthy. Solutions must focus, accordingly, on the vehicle itself.

Source: David Bollier. Citizen Action and Other Big Ideas:

# Repercussions



**National Highway Traffic Safety Administration**  
Our Mission: Save lives, prevent injuries, reduce vehicle-related crashes

If the public did not immediately appreciate the importance of Nader's book, its chief target, General Motors, did. Worried about litigation challenging the Corvair's safety, GM hired private detectives to tail Nader in an attempt to dig up information that might discredit him, and even had women accost him in an apparent seduction/blackmail scheme. Instead, the story about GM's snooping and dirty tricks came to light, prompting Senator Ribicoff's subcommittee to summon James Roche, president of General Motors, to explain his company's harassment -- and apologize.

This remarkable incident catapulted auto safety into the public spotlight. Systematic motor-vehicle safety efforts thus began during the 1960s. In 1966, the Highway Safety Act created the National Highway Safety Bureau (NHSB), which later became the National Highway Traffic Safety Administration (NHTSA). The systematic approach to motor-vehicle-related injury prevention began with NHSB's first director, Dr. William Haddon.

Source: David Bollier. Citizen Action and Other Big Ideas:  
[http://www.nader.org/history/bollier\\_chapter\\_1.html](http://www.nader.org/history/bollier_chapter_1.html)

# Highway Safety Act

- Created federal highway safety program
- Implementation of program actions at the state level
- Goal was to provide more coordinated and rational public efforts for road safety

The value of the Highway Safety Act, though, was more than just creating NHTSA or the FHWA. The broad vision of the Highway Safety Act was to create a federal response to the growing burden of road traffic injuries. The approach adopted was to use federal agencies (NHTSA, FHWA, FMCSA) to oversee large federal grants made to each of the 50 states. The individual states, would then, use the funds, under coordinated directives from the federal level to address road safety issues. Over time, these issues have included efforts focused on drivers, pedestrians, vehicles, and roads.

See: TRB, Building the Road Safety Profession in the Public Sector, 2007: Chapter 2.

# The Mantra of Injury Prevention

(1970s to present)

- Regulation
- Legislation
- Litigation

Thus began the era of regulation, legislation, and litigation as a means of injury prevention. This era has been tremendously successful in reducing motor vehicle-related injuries and fatalities, and other injuries as well. It shifted the research emphasis from human factors to vehicular, product, and environmental factors in injury. The ability to legislate and enforce standards and environmental modifications have greatly reduced our exposure to injury risks. The advent of product liability has similarly changed product design.

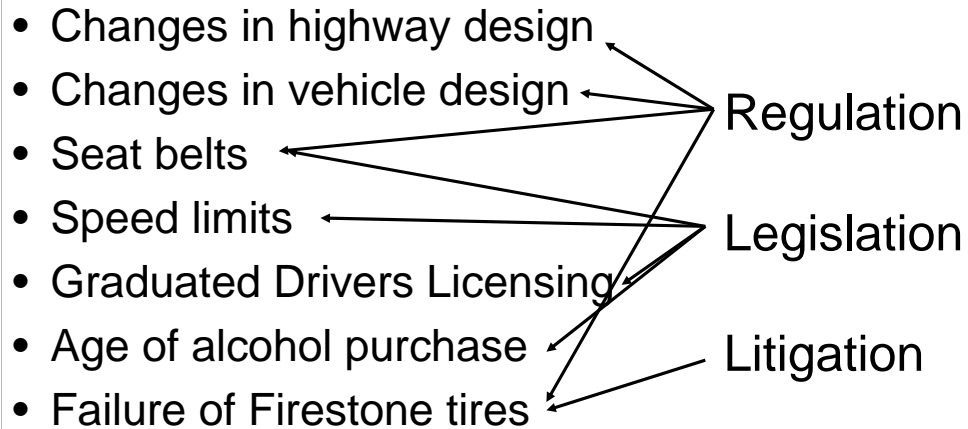
## Match the Highway Safety Measure to the Prevention Action

- Changes in highway design
  - Changes in vehicle design
  - Seat belts
  - Speed limits
  - Graduated Drivers Licensing
  - Age of alcohol purchase
  - Failure of Firestone tires
- Regulation
- Legislation
- Litigation

The injury field is blessed by having had remarkable success in reducing fatalities from traffic accidents. Several initiatives have led the way in this effort. These include better engineering of roads and cars, the implementation of safety devices in cars, and the active enforcement of traffic laws, and litigation efforts. Can you distinguish the type of intervention that these highway safety initiatives represent?



## Match the Highway Safety Measure to the Prevention Action



The links between the types of prevention action and the listed highway safety measures are shown here. Some measures involve more than one action. For example, regulations exist on the type of seat belts that are provided in motor vehicles and their specifications. In addition, legislation has been passed regarding laws for wearing a seat belt when using a motor vehicle. In general, regulations exist to address features of existing products or environments. Legislation and litigation exists to impact corporate and human behaviors.

**‘those who ignore the lessons  
of history are bound to repeat  
them’**

The philosophy of regulation, legislation, and litigation as the primary means of injury prevention still holds strong today. So much so that many injury prevention specialists summarily dismiss the potential impact of human behavior research as not being able to provide the return in injury reduction that regulation, legislation, and litigation can. Given the history of injury research, and the emerging studies on behavior modification in chronic diseases, one could argue that another current theme is that the injury field may be naïve and slow to accept the benefits of human behavior research. The table has turned. Those who ignore the lessons of history are bound to repeat them.

# Strategies for Prevention

Intervention or countermeasures are classified based on requirements for behavior change

- **Active** - rely on actions taken by an individual (e.g. storing meds in locked cabinets, seat belts)
- **Passive** - do not rely on the efforts of an individual to be successful (e.g. child safety caps, airbags)

An example of this argument is provided in the context over the value of two different broad classifications of injury prevention strategies. Broadly speaking, there are two broad strategies; active and passive. Active strategies require an individual to do something in order to receive a benefit. Passive strategies do not rely on human behavior. In passive strategies, individuals are forced into doing something automatically because the environment has been changed.

Passive strategies are preferred by many injury prevention practitioners because they remove much of the human element from the equation. In fact, there is a hard core set of injury prevention professionals who believe that the only good strategies to consider are passive strategies. This seems a bit short-sighted, though, as emerging evidence is suggesting that the best benefits come from a multi-dimensional approach to prevention. Passive approaches also may not always be practical for all injury prevention situations.

# Active vs. Passive Strategies

- **Active Strategies**

- Require repeated action by an individual
- Benefits only those doing the action
- Not uniformly accepted
- Frequently less expensive to implement

- **Passive Strategies**

- No action required by an individual for benefit
- Protects all via a universal application
- Won't decay in efficacy
- Avoids individual-based decisions
- Doesn't have to be perfect fit for all individuals

## Active Strategies

Require continual reinforcement or its effectiveness diminishes

Not uniformly accepted and those who are most at risk are usually least likely to use active intervention

Frequently less expensive to implement

## Passive Strategies

Universal application by protecting all members of the community regardless of the individual's risk values

Passive strategies do not need to constantly reinforced to remain effective

Doesn't have to be perfect fit for all individuals in order for benefits to be obtained

## Match the Prevention Measure to the Type of Intervention Strategy

- |                               |            |
|-------------------------------|------------|
| 1. Alcohol Ignition Locks     |            |
| 2. Side Airbags               |            |
| 3. Warning Labels on Products | A. Active  |
| 4. Smoke Detectors            |            |
| 5. Helmets                    | B. Passive |
| 6. Speed Limit Laws           |            |
| 7. Pool Fencing               |            |
| 8. Locks on Gun Cabinets      |            |

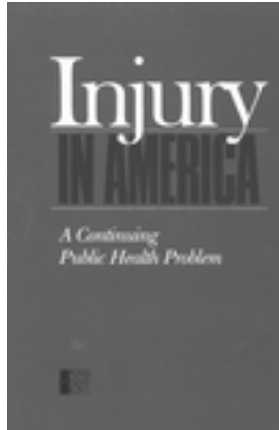
Let's now informally test your ability to distinguish active from passive prevention strategies. Match the listed safety measures to the type of strategy that they represent.

## Match the Prevention Measure to the Type of Intervention Strategy

1. Alcohol Ignition Locks
  2. Side Airbags
  3. Warning Labels on Products
  4. Smoke Detectors
  5. Helmets
  6. Speed Limit Laws
  7. Pool Fencing
  8. Locks on Gun Cabinets
- A. Active
- B. Passive
- 
- ```
graph LR; 1[1. Alcohol Ignition Locks] --> A[A. Active]; 2[2. Side Airbags] --> A; 3[3. Warning Labels on Products] --> A; 4[4. Smoke Detectors] --> A; 5[5. Helmets] --> B[B. Passive]; 6[6. Speed Limit Laws] --> B; 7[7. Pool Fencing] --> B; 8[8. Locks on Gun Cabinets] --> A;
```

The list contains a variety of measures. Five can be described as passive, where an element of the preventive effect is based upon changes in the environment (or product) that are designed to function and provide benefit in all circumstances. The placement of an airbag in a vehicle for example. That air bag will be in the vehicle at all times. Several active strategies are also listed. These strategies, like wearing a helmet, require action by an individual in order for the benefit to be obtained.

## Recent Developments



“The book provides a survey of what is known about injuries, and suggests there is a vast need to know more. It traces findings on the epidemiology of injuries, injury biomechanics and the prevention of impact injury, treatment, rehabilitation, and administration of injury research”.

In the early 1980s, the successes of the regulation, legislation, and litigation movements in the 1960s and 1970s were becoming apparent. At this time, though, new approaches to injury research were facing barriers created in part by the huge successes observed in motor vehicle injury reduction. Of serious concern, was stagnation in biomechanical research, and the training of new investigators in injury research (Waller).

These concerns led to the development of a Committee on Trauma Research panel. Its report, *Injury in America*, helped to redefine the direction of injury research. The report led to the establishment of the injury center at the CDC with the aim of coordinating national injury research programs. The disciplines of injury research, epidemiology, acute care, prevention, and biomechanics, were also recognized and training in these areas was stressed.

Unfortunately, though, injury research programs remain fragmented today. A particularly strong focus on motor vehicle crashes remains at the NHTSA. Most acute care research is funded through the NIH. Prevention efforts have been centered around the CDC. Overall, funding levels are disproportionately low.

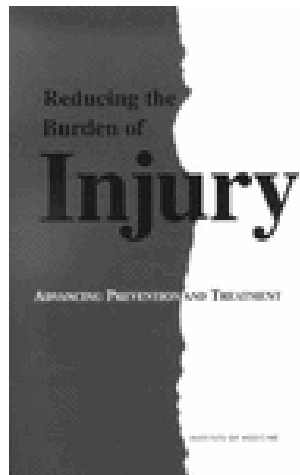
*Injury in America: A Continuing Public Health Problem* Committee on Trauma Research, Institute of Medicine, National Research Council, 1985.  
<http://www.nap.edu/catalog/609.html>



**National Center for Injury Prevention and Control**

One of the developments from this report was the formal institutionalization of an general injury presence in the federal government through the establishment of the National Center for Injury Prevention and Control at the CDC. This action was meant to address the fragmentation of the injury field, and to raise the public health significance of injury and the governments response to them.





**“Reducing the Burden of Injury** describes the cost and magnitude of the injury problem in America and looks critically at the current response by the public and private sectors”.

However, in reality, fragmentation continues to exist in the injury field. Much of this is a nature of the beast, as there are several areas that injury, as a field, can transverse. In response to this fragmentation, the Institute of Medicine convened another committee to explore opportunities to leverage resources and expertise of the numerous parties involved, and discuss issues regarding injury research leadership at the federal level. Published in 1998, the book “Reducing the Burden of Injury” highlighted the fragmentation in injury work and outlined an action plan to guide injury control efforts into the 21st century.

Reducing the Burden of Injury: Advancing Prevention and Treatment Richard J. Bonnie, Carolyn E. Fulco, Catharyn T. Liverman, Editors; Committee on Injury Prevention and Control, Institute of Medicine, 1998.  
<http://www.nap.edu/catalog/6321.html>

## Key Lecture Points

- The current philosophies underlying injury epidemiology practices have been influenced by multiple factors.
- The focus of injury epidemiology has shifted from the individual being at fault to a wider, more complex model of injury causation.
- Injuries are due to energy transfer that exceeds a tissue threshold.

## Key Lecture Points

- William Haddon's work underlies most current actions designed to limit or control energy transfer.
- Many professionals prefer passive interventions for injury prevention, but overlook the strong potential related to active interventions.

## Practice Lecture Review

In this lecture.....

- Material highlighted \_\_\_\_\_ as key themes influencing the study of injuries before 1940.
- These two individuals elevated the field of injury biomechanics. \_\_\_\_\_
- Energy transfer below a tissue tolerance level leads to injury?

TRUE    FALSE

Here are some practice questions to test out in assessing your understanding of the material presented in the lecture.

## Practice Lecture Review II

- Material highlighted \_\_\_\_\_ as key themes influencing the study of injuries in the present day.
- Active interventions are widely viewed as the best means of reducing future injuries?

TRUE      FALSE

Here are some practice questions to test out in assessing your understanding of the material presented in the lecture.