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Injuries

I. Introduction

A. Definition

1. An injury is the physical damage to a person that occurs as a result of exposure to physical or chemical agents at rates greater than the body can tolerate or the absence of such essentials as heat or oxygen. An injury is generally considered to occur acutely after exposure. Injury and trauma are synonymous

- 2. Injuries are often considered separately from diseases, although they are part of the spectrum of disease. The difference between an injury and a disease may be only one of the doses of the causal factor, the time course during which the causal factor operates, or the body's adaptation and response to the causal factor

- a. Injuries and diseases are often caused by the same factors, although the amount or the rate of exposure may differ.
- (1) Radiation can cause a burn (injury) and cancer (disease).
- (2) Carbon monoxide can cause brain damage and encephalopathy (injury) and secondary polycythemia (disease).
- (3) Kinetic energy can cause a fracture (injury) and arthritis (disease).

- b. Although the symptoms of an injury are usually immediately obvious as compared to the symptoms of disease, the duration of latency periods for injuries and diseases overlap.
- (1) Whiplash, an acceleration extension injury of the cervical spine, may not cause symptoms until days after the injury occurred.
- (2) Lead poisoning damage may not be evident until long after the exposure, but once evident, may progress rapidly.


- (3) Food borne *Bacillus cereus* disease has an incubation period as short as 1 hour.
- (4) Altitude decompression sickness, or caisson disease (the "bends"), which is due to nitrogen bubbles forming in the blood and tissues, occurs immediately after a too rapid decompression from a high pressure environment.

B. Accidents

- 1. Injuries, especially unintentional injuries have often been referred to as "accidents". The term "accidents" however, inappropriately implies chance misfortune and lack of predictability, which inaccurately describe the epidemiology of injuries.
- 2. The term "accidents" first used in 1926.
- 3. Although the term "accidents" generally is not used in scientific communication, it continues to be used in some classification and surveillance systems.

International Classification of Diseases (ICD): Supplementary Classification of External Causes of Injury and Poisoning

- Transport accidents
- Accidental poisonings
- Surgical and medical procedures
- Accidental falls
- Accidents caused by fire and flames
- Accidents due to natural and environmental factors
- Accidents caused by submersion, suffocation, and foreign bodies
- Other accidents

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- Late effects of accidental injury
 - Drugs, medicinal biologic substances causing adverse effects in therapeutic use
 - Suicide and self-inflicted injury
 - Homicide and injury purposely inflicted by other individuals
 - Legal intervention
 - Injury undetermined whether accidentally or purposely inflicted
 - Injury resulting from operations of war

C. Injury control and public health

- Public health and preventive and clinical medicine practitioners are applying increasing attention and resources to the field of injury prevention and control:
 1. **The five principal areas of study in injury control are:**
 - a. **Epidemiology** including surveillance
 - b. **Prevention**
 - c. **Injury biomechanics**, which applies the principles of mechanics in studying the physical and functional responses of the human body to the traumatic impact of energy
 - d. **Treatment**, including emergency response
 - e. **Rehabilitation**, the process by which an injured person's functional capacities are restored or developed to the fullest extent possible, consistent with irreversible impairments and environmental limitations

- 2. The public health model of injury prevention and control offers opportunities for decreasing the incidence of injuries using the following approaches:

- a. **Surveillance**, including feedback from those conducting surveillance to those being studied and to those with a need to know
- b. Interdisciplinary **education** and **prevention** programs
- c. **Environmental** modifications
- d. **Regulatory** action
- e. The support of **clinical** interventions

II. Epidemiologic Constructs

- **An injury is a problem of medical ecology. It is a problem in the relationship between one or more individuals and the surrounding environment, related to time. An epidemiologic web consisting of factors related to the host or individual, the physical and social environments, the agent, and the vector**

A. Host

- 1. The host, or **affected individual**, has been the principal focus of the research related to injuries and preventive measures aimed at decreasing injury rates.
- 2. An injury may result when the requirements of a task being performed exceed an individual's performance capacity, which varies with the individual's physical, psychological, and cognitive abilities. **Ergonomics, or human factors**, research focuses on the interface between host's capabilities and the environmental and task

- 3. A **risk factor** is an attribute, determinant, or exposure that is associated with an increased probability of a condition or outcome. **Host factors** that affect the risk of injuries differ according to the type of injury, as do some **risk indicators**.

According to Clark (1981), characteristics that are associated with a condition but are neither causal nor controllable, such as age, sex, and race, is more appropriately called risk indicators, not risk factors.

a. Age

- 1) Young children have less control over their environment. For example, suffocation or asphyxiation is leading cause of fatal infant injuries
- 2) Young adults have less experience in responding to dangerous situations and are more likely to engage in high-risk behaviors. Homicide and motor vehicle related injury rates are highest in young adults.
- (3) Adults 65 years of age or older are most susceptible to complications when injured.
- (a) The case-fatality rate for injuries is increased for older adults, compared to younger persons.
- (b) Older adults have increased mortality rates due to suicide, motor vehicle-related injuries, and falls.

- b. Sex.

- Males are more prone to violent behavior and are at an increased risk of injury.

- c. Race

- (1) American blacks have over a six fold higher rate of homicide (rates are especially high among young adult males) and a lower rate of suicide than whites.
- (2) Native Americans and Alaskan Natives have a threefold higher rate of fatal injuries compared to other Americans (e.g., childhood poisoning, drowning, firearms related injuries, homicide, motor vehicle related injuries).
- (3) Asians Americans have a lower rate of firearms related injuries than other Americans.

- **d. Alcohol use.**

- The use of alcohol increases the risk of injuries.

- (1) **Motor vehicle-related injuries**

- (a) Almost 50% of all motor vehicle-related fatalities are alcohol related in either the driver, pedestrian, or bicyclist (the rate increases during holiday periods).

- (b) **Blood alcohol concentration.** As alcohol consumption increases, the risk of, and severity of, injury increases.

- (2) **Other injuries.** Alcohol use is associated with other injuries, including burns, drowning, falls, firearms related injuries, homicide, hypothermia, occupational injuries, poisonings, suicide, and injuries related to sport and aviation

- e. **Drug use** also can increase the risk of injuries.
- (1) **Medications**, such as tranquilizers and barbiturates, increase the rate of injuries when they interfere with adaptive performance.
- (2) **Illegal drugs**. The use of cocaine and other illegal drugs has been associated with fatal motor vehiclerelated injuries. In addition, these drugs often are used in association with alcohol.

• **f. Physical condition**

• **(1) Chronic medical conditions.**

Some chronic medical conditions, such as poor vision and uncontrolled seizure disorders, increase the risk of injuries.

• **(2) Physiologic status.**

Osteoporosis, which is often related to endocrine status, increases the risk of fall related injuries.

B. Environment

- 1. **Physical environment.**
- Is the location at which the injury occurs. Examples of alterations made in the physical environment that can increase or reduce the risk of injuries include the following:
 - a. **Road design.** It can decrease or increase the risk of injuries. A road barrier can assist an automobile to come to a safe stop or can become a hazard.
 - b. **Homes** can be built or equipped with safety features, such as smoke detectors.
 - c. **Swimming pools** with fences are safer than pools without fences.

- **2. Social environment. Consists of societal attitudes, Laws and regulations that control or tolerate the occurrence of events that can lead to injuries. Example of social environmental factors that increase the risk of injuries include:**
 - **A. Tolerance of violent behavior**
 - **B. Acceptance of the use of alcohol and other drugs**
 - **C. Economic deprivation**
 - **D. Racism**
 - **E. Sexism**

C. Agent

- The injury causing agent is **energy**. A large amount of energy quickly transmitted may result in injury, while a small amount of energy transmitted over a long period of time may result in disease.

- There are five types of energy that cause injuries:
- 1. **Kinetic, or mechanical, energy** is the most common cause of injuries.
 - a. In an automobile crash, the energy transferred by the motor vehicle that injures a person is kinetic energy.
 - b. The energy resulting from a fall that injures a person also is kinetic energy.
- 2. **Thermal energy**, when excessive is the most common cause of burns. A marked lack of thermal energy results in hypothermia and frostbite

- 3. **Electric energy** cause electrocutions and burns
- 4. **Radiation energy** causes burns
- 5. **Chemical energy**, by interfering with the body's energy metabolism, can cause injuries:
 - a. Inhaled water interferes with pulmonary function, which can result in drowning.
 - b. Carbon monoxide interferes with the oxygen-carrying capacity of blood, which can result in acute brain injury.

D. Vector

- The vectors, or vehicle of injury, are the carriers of the energy. The design of the vector markedly alters the amount of energy available to cause an injury. Examples of vector factors that alter the occurrence of injuries follow:
 - 1. **Weapons** are vectors of kinetic energy. Firearm design can decrease or increase the risk of injuries.
 - a. Firearms with safety locks discharge unintentionally less frequently than firearms without safety locks.
 - b. Small, easily concealed firearms can increase the risk of aggravated assault

- **2. Automobiles** are vectors of kinetic energy. Automobile design can decrease or increase the risk of injuries.
 - **a. Safety features.** Automobiles with **air bags** and **automatic safety belts** can protect occupants from many potentially fatal or injury-causing crashes.
 - **b. Small automobiles** are associated with an increased risk of fatal injuries.
- **3. Electric wires** are vectors of electric energy. Insulated electric wire is safer than non-insulated wire.

III. Measures of Impact

- **A. Morbidity.** (USA)
- **a. Incidence.** (1) Injuries account for about 16% of all acute conditions, ranking second after respiratory conditions. (2) Falls are the leading cause of nonfatal injury, causing about 12 million injuries annually and about 800,000 hospitalizations. Falls resulting in hospitalization are especially prevalent among individuals 65 years of age and older.
- **b. Host factors** (1) Age. Overall, the incidence rates of most nonfatal injuries decrease with age. The hospitalization rates increase with age, because the risk of complications resulting from an injury increase with age. (2) Sex. The incidence rate of injuries is greater among males than females, except among individuals 65 years of age and older

- **B. Mortality (USA)**

- **a. Incidence**

(1) Fatal injuries, which constitute the most widely available data base for surveillance, make up only a small percentage of injuries. 156,000 fatal injuries in USA

- 2) Injuries were the third leading cause of death. The three leading causes of death were: 1. Heart diseases 2. Malignant neoplasm's 3. Injuries

- **b. Host factors.** Injury mortality rates vary by host factors. Injury cause about 50% or more of all deaths among people 1-34 years of age. For people 1-44 years of age, injuries are the leading cause of death.

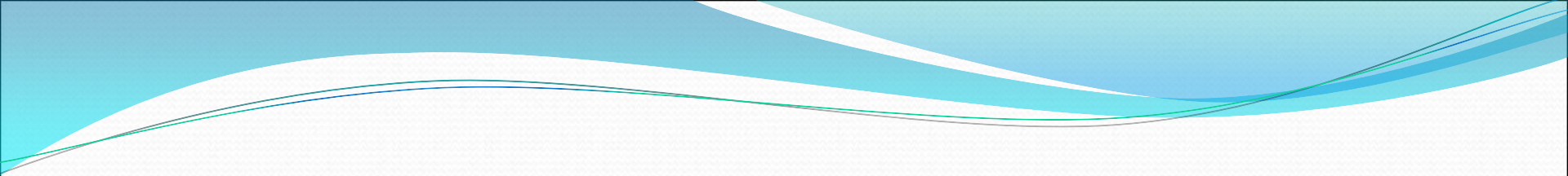
- **c. Environmental factors.** Mortality rates of unintentional injuries are higher in rural areas, and mortality rates of intentional injuries are higher in urban areas.

- **C. Direct and indirect costs**
- 1. **Economic costs** include medical and related expenses, wage losses, insurance administration costs, indirect work losses (e.g. long term disability, premature death), and associates property damage.
- a. **The lifetime economic cost** is the aggregate of the estimated cost due to an injury for the lifetime of each injured person.
 - (1) The lifetime economic costs of injuries in USA were estimated to be \$156 billion.
 - (2) **The cost of injuries** in the actual year of injury is about 75% of the lifetime economic costs.
- b. **Motor vehicle-related injuries** account for the single greatest cost of injuries, approximately \$48 billion annually in USA
- 2. **Pain and emotional sequelae** of injured individuals

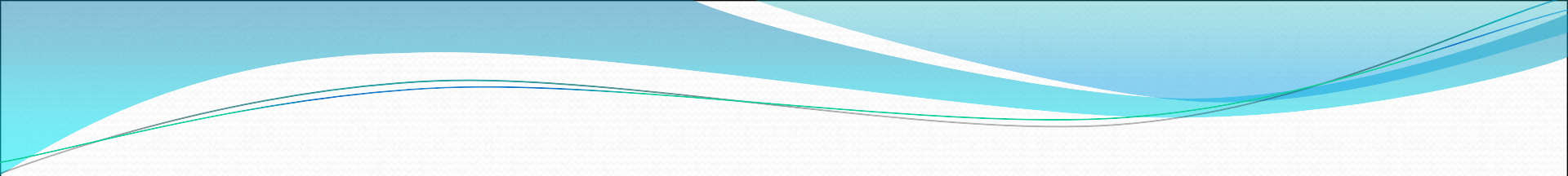
IV. Classifications

- **A. Intent.**
- Injuries are classified by the intent or purposefulness of occurrence:
- **1. Intentional injuries** – that is, injuries that are purposely inflicted and often associated with violence. The injuries can be inflicted by one person on another or can be self directed. **Examples include:**
- **a. Child abuse b. Domestic violence c. Sexual assault d. Aggravated assault e. Homicide and legal intervention** (the tenth leading cause of death- fifth among Hispanics and blacks) **f. Suicide** (the eighth leading cause of death) **g. Abuse of the elderly**

- **2. Unintentional injuries** – that is, injuries that are not purposely inflicted. During the past decade, the death rate due to intentional injuries decreased by about 15%. **The five leading causes of intentional death, in order of frequency are:**
 - **a. Motor vehicle mishaps**
 - **b. Falls**
 - **c. Poisonings**
 - **d. Drowning**
 - **e. Fires and burns**

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- **B. Place of occurrence. There are four principal locations at which injuries occur:**
 - **1. Motor vehicles**
 - **2. Workplace**
 - **3. Home**
 - **4. Public places**

- **D. External cause of injury**
- The most important external causes of injury are:
- a. **Injuries by motor vehicle** are the leading cause of injury mortality.
- b. **Falls** are the leading cause of injury morbidity for all age groups and of injury mortality among people over 75 years of age.
- c. **Suffocation** is the leading cause of injury mortality among children less than 1 year of age,
- d. **Firearms** cause 60% of all homicides and suicides. Almost half of all deaths among young black males are firearms-related

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- **VI. Models of prevention.** The practical approach to the prevention and control of injuries should involve strategies chosen on the basis of their actual effectiveness in reducing injuries. Usually a combination of strategies and interventions are most effective. For example, the safest automobile restraint system incorporates both air bags and seat belts

- **A. Passive and active strategies**
- 1. **Passive strategies** are automatic, require no individual repetitive action to be protective, and are generally most effective. For example, the installation of air bags in motor vehicles is a passive strategy because the occupants of the automobile will be protected in a crash regardless of their individual actions.
- 2. **Active strategies** are voluntary, require repetitive, individual action to be protective, and are generally less effective than passive strategies. For example, seat belts in most motor vehicles must be buckled by the occupant every time the vehicle is used in order to be effective

- **B. The four Es of intervention**
- 1. **Engineering interventions** are aimed at the vectors and physical environments that promote or support the occurrence of injuries. These interventions, which are often passive, are among the most effective in decreasing the occurrence of injuries. For example, medicine containers were redesigned to be child-proof.
- 2. **Economic interventions** are aimed at influencing behavior based on monetary incentives and rewards or penalties. For example, many insurance companies have lower rates for residences equipped with smoke detectors

- **3. Enforcement interventions** are aimed at influencing behavior by laws and regulations that may only be effective when enforced. Every state has made the use of federally approved child safety seats mandatory for children who ride in automobiles. The enforcement of these laws, however, is variable.

- **4. Educational interventions** are aimed at influencing behavior through reasoning and knowledge. These interventions are usually least effective, especially when used alone without other interventions. Educational interventions could be more effective if they were directed toward societal leaders and decision-makers

- C. The **Haddon models**, formulated by Dr. William H. Haddon is useful for determining possible interventions and prevention measures for particular injuries. **The Haddon Matrix**, or multifactorial approach, arranges intervention and prevention strategies by agent, vector, host, and physical and social environmental factors, according to the time at which the strategy would be effective in relation to the occurrence of the injury event.