

# Injury Epidemiology

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435 Lecture Notes by Sara Alkhalifah

**Original Content** | **Titles** | **Additional Notes** | **Important**

# Learning objectives

- At the end of this lecture, the student should be able to:
  - Describe the concepts of injuries
  - Understand how people get injured in their daily lives
  - Describe important differences between various types of injuries
  - Understand principles of injury prevention and control
  - Apply injury epidemiology principles to road traffic incidents

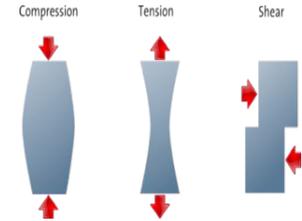
# Definitions

- **Injury:** acute exposure to agents such as mechanical energy, heat, electricity, chemicals, and ionising radiation interacting with the body in amounts or at rates that exceed the threshold of human tolerance. In some cases, injuries result from the sudden lack of essential agents such as oxygen or heat.
- **Violence:** The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation. E.g. homicide, suicide

Epidemiologic triad of injury		
Host	Agent	Environment
Person	That injures (energy)	vector/vehicle that conveys the agent/energy
Road traffic injuries		
victim: e.g. driver, passenger, pedestrian, etc	mechanical / thermal energy	Vehicles of incident (kinetic energy of the car)

# Nature of Energy: Mechanical

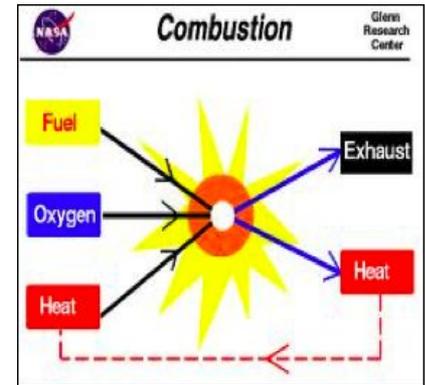
- If a person must stop suddenly, as in a crash of a vehicle, that energy (mechanical energy of the car) must be dissipated in the vehicle, environment, or individual's tissues (Internal organs)
- When the vehicle stops, the occupant will continue to move at the pre-crash speed into interior structures, or into the materials in the exterior environment if ejected.
- Stresses: contact with energy source generates forces counter to the load.
- **Types:**
  - tension (pulling molecules apart)
  - compression (pushing molecules together)
  - shear (from a tangential force) moving in opposite directions e.g. wearing a seatbelt during a car accident
- **Strain:** extent of deformation, resulting from tension, compression, shear (shear injury e.g. falling on the floor) strain e.g. airbags, seatbelts which cause injury but to a lesser extent
- The shape and elasticity of the materials struck will determine the damage to the tissue. E.g. seatbelts
- Devices as seat-belts, airbags and child restraints reduce the severity of injury by reducing contact with less flexible structures (second collision)



# Nature of Energy:

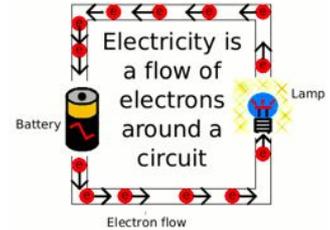
## Thermal and Chemical

- Deaths and injuries associated with fires, heat & smoke are the result of ignition sources, flammable materials and of the heat and chemical energies generated by burning or heating materials (e.g. cigarettes, matches, gas stoves, electrical circuits / appliances)
- Physics/chemistry of combustion vary by:
  - Concentration and type of heat source
  - Shape / size of a combustible
  - Oxygen concentration
  - Vaporization of gases
  - Presence or absence of catalysts
- Chemicals may be breathed / inhaled (as in a fire); ingested; injected; absorbed
- **Harms of chemicals are divided into 3 phases:**
  - exposure (poisoning)
  - toxo-kinetic (chemical absorption through the organism's membranes: GIT, lungs' air sacs)
  - toxo-dynamic (interaction of chemical with receptors in target tissues)
- Most common in children (accidental ingestion) and elderly (drug overdose)
- Smoke inhalation causes both chemical and thermal injury



# Nature of Energy: Electrical

- Atoms are made up of electrons, protons and neutrons
- The flow of electrons is “electrical current”
- The extent of damage of human tissues in contact with electrical energy increases with amperage.
- Skin sensitivity varies 100-fold as a function of wetness (100,000 ohms when dry; 100 ohms when wet)



# Asphyxiation

- Asphyxiation is considered an injury due to lack of energy (oxygen)
- Humans cannot function with too little energy
- **Asphyxiation:** absence of oxygen to sustain endogenous energy conversion, which causes essential cells (in brain / heart) to be damaged within minutes
- Possible causes: objects blocking nose/mouth/trachea; mechanical blow to the trachea; constriction of the trachea; lung obstruction; water in lungs (drowning); lung congestion (endogenous fluids as in pneumonia / congestive heart failure)

# Types and Magnitude

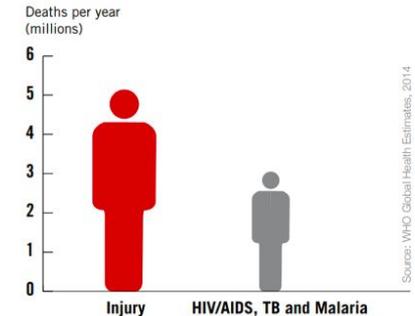
- **Intentional:** e.g. violence, suicide, homicide, intentional firearm injuries, etc
- **Non-intentional (accidental):** e.g. road-traffic injuries, fires, falls, poisoning, drowning-asphyxia, burns, sports, accidental firearm injuries, etc

## Magnitude:

- Every six seconds someone in the world dies as a result of an injury
- Every day more than 14 000 people die as a result of an injury

### The scale of the problem

Injury deaths compared to other leading causes of mortality, world, 2012.



# Burden:

- 12% of global burden of disease
- More than 90% of injury deaths occur in low- and middle-income countries
- Leading causes of morbidity and mortality burden in Eastern Mediterranean Region
- Road traffic “incidents” are the leading cause of injury deaths worldwide, which strongly applies to GCC/KSA

**How injuries and violence claim lives**  
Causes of injury deaths, world, 2012.



Source: WHO Global Health Estimates, 2014

## Injury deaths rise in rank

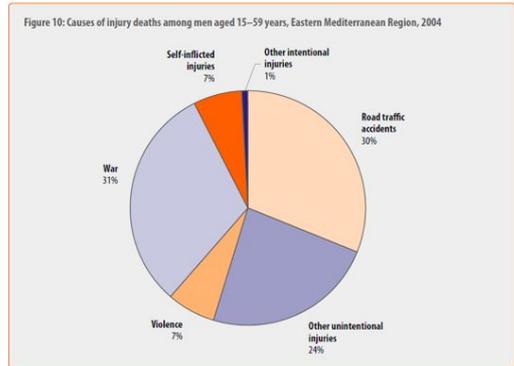
Leading causes of death, 2012 and 2030 compared.

Total 2012	Total 2030
1 Ischaemic heart disease	1 Ischaemic heart disease
2 Stroke	2 Stroke
3 Chronic obstructive pulmonary disease	3 Chronic obstructive pulmonary disease
4 Lower respiratory infections	4 Lower respiratory infections
5 Trachea, bronchus, lung cancers	5 Diabetes mellitus
6 HIV/AIDS	6 Trachea, bronchus, lung cancers
7 Diarrhoeal diseases	7 <b>Road traffic injuries</b>
8 Diabetes mellitus	8 HIV/AIDS
9 <b>Road traffic injuries</b>	9 Diarrhoeal diseases
10 Hypertensive heart disease	10 Hypertensive heart disease
11 Preterm birth complications	11 Cirrhosis of the liver
12 Cirrhosis of the liver	12 Liver cancer
13 Tuberculosis	13 Kidney diseases
14 Kidney diseases	14 Stomach cancer
15 <b>Suicide</b>	15 Colon and rectum cancer
16 Birth asphyxia and birth trauma	16 <b>Suicide</b>
17 Liver cancer	17 Falls
18 Stomach cancer	18 Alzheimer's disease and other dementias
19 Colon and rectum cancers	19 Preterm birth complications
20 Alzheimer's disease and other dementias	20 Breast cancer
21 Falls	21 Endocrine, blood, immune disorders

Source: WHO Global Health Estimates, 2014. [www.who.int/mediacentre/docs/diseases/globalhealthreport2014/index.html](http://www.who.int/mediacentre/docs/diseases/globalhealthreport2014/index.html)

## Injury pyramid

Graphic representation of the demand on the health sector caused by injuries and violence.





# Types of data and sources:

- Mortality
  - Death certificate
  - Reports from mortuaries
- Morbidity and health care related
  - Hospitals
  - Medical records
- Self-reported
  - Surveys
  - Media
- Community-based
  - Demographic records
  - Local government records
- Law enforcement
  - Police records
  - Prison records
- Economic/social
  - Institutional or agency records
  - Special studies

# Prevention:

- **Of injuries:**
  - **Primary prevention:** Fire → smoke detectors
    - Raising awareness of the community, at its different levels, as to methods of avoiding injuries. This includes health promotion / health education activities and applying preventive measures accordingly
  - **Secondary prevention:**
    - Early detection, proper evaluation and management of injuries at different levels of healthcare delivery (primary, secondary and tertiary facilities)
    - Screening children for child abuse and teens for depression
  - **Tertiary prevention:**
    - Management of complications of injuries, especially disabilities, including rehabilitative measures and approaches, improvement of quality of life of injury victims, as well as palliative care, when needed
- **Of RTI:**
  - **Primary prevention:**
    - Raising awareness of the community, at its different levels, as to methods of avoiding RTI. This includes: legislations, health promotion activities and applying preventive measures (seat-belts, child restraints, airbags, good roads, following traffic rules, etc)
  - **Secondary prevention:**
    - Early detection, proper evaluation and management of RTI at different levels of healthcare delivery (especially tertiary facilities: e.g. emergency / trauma facilities and related services)
  - **Tertiary prevention:**
    - Management of complications of RTI, especially disabilities, on medical / social / economic levels, including rehabilitative and physiotherapy measures

# Measures:

- **Road traffic accidents:**
  - Setting and enforcing laws on speeding
  - Setting and enforcing laws on drinking and driving
  - Setting and enforcing laws on motorcycle helmets
  - Setting and enforcing laws on seat-belts
  - Setting and enforcing laws on child restraints
  - Developing safer roadway infrastructure, including engineering measures to reduce speeds in urban areas and separate different types of road users
  - Implementing vehicle and safety equipment standards
  - Setting and enforcing laws on daytime running lights for motorcycles
  - Introducing a graduated driver licensing system for novice drivers
- **Burns**
  - Setting and enforcing laws on smoke detectors *most important*
  - Setting and enforcing laws on hot tap water temperatures
  - Developing and implementing a standard for child-resistant lighters
  - Treating burns patients in a dedicated burns centre

# Measures:

- **Drowning:**
  - Installing barriers controlling access to water
  - Providing capable child care for pre-school children in safe places away from water
  - Teaching school-age children basic swimming, water safety and safe rescue skills
  - Training bystanders in safe rescue and resuscitation
  - Wearing of personal flotation devices
- **Falls:**
  - Setting and enforcing laws requiring window guards for tall buildings
  - Redesigning furniture and other products
  - Establishing standards for playground equipment
- **Poisoning:**
  - Setting and enforcing laws for child resistant packaging of medicines and poisons
  - Removing toxic products
  - Packaging drugs in non-lethal quantities
  - Establishing poison-control centres

# Measures:

- **Interpersonal violence:**
  - Developing safe, stable and nurturing relationships between children and their parents or caregivers
  - Developing life skills in children and adolescents
  - Reducing the availability and harmful use of alcohol
  - Reducing access to guns and knives
  - Changing cultural and social norms that support violence e.g. a few years ago abusing women was considered normal
  - Reducing violence through victim identification, care and support programmes
- **Suicide:**
  - Reducing access to common means, such as firearms, pesticides and certain medications
  - Implementing policies and interventions to reduce the harmful use of alcohol
  - Ensuring early detection and effective treatment of mental disorders, particularly depression and alcohol use disorders
  - Ensuring management of people who have attempted suicide or are at risk, including assessment and appropriate follow-up
  - Training primary health care workers and other 'gatekeepers' who are likely to interact with people at risk of suicide
  - Adoption of responsible reporting of suicide by the media

# KSA Efforts

- **Injury and accident prevention program** “برنامج الوقاية من الإصابات والحوادث”
  - <http://moh-ncd.gov.sa/injury/index.php>
  - Surveillance System
  - Education
  - Capacity Building
- **National strategic plan to reduce RTI:** National strategic plan that covers the 4Es:
  - **Education:** annual traffic weeks.
    - Saudi Society Organization for Traffic Safety
    - <http://www.salamh.org.sa>
  - **Engineering:** road infrastructure and vehicles
  - **Enforcement:** seat belt rule, speed limit law
  - **Emergency:** Saudi Red Crescent Society (SRCS)



# Application to RTI

- **Host: victim:** e.g. driver, passenger, pedestrian, etc
  - **Agent:** mechanical / thermal energy
  - **Environment:** vehicle(s) of incident
- 
- If a person must stop suddenly, as in a crash of a vehicle, that energy must be dissipated in the vehicle, environment, or individual's tissues
  - When the vehicle stops, the occupant will continue to move at the pre-crash speed into interior structures, or into the materials in the exterior environment if ejected.
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