



# Injury

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## Objectives:

1. Describe the concepts of injuries, why do they occur and their epidemiology
2. Describe important differences between various types of injuries (intentional and unintentional)
3. Understand principles of injury prevention and control
4. Appreciate the burden of injury in KSA
5. Apply injury epidemiology principles to road traffic accidents

## Done by:

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Important | Extra | Notes

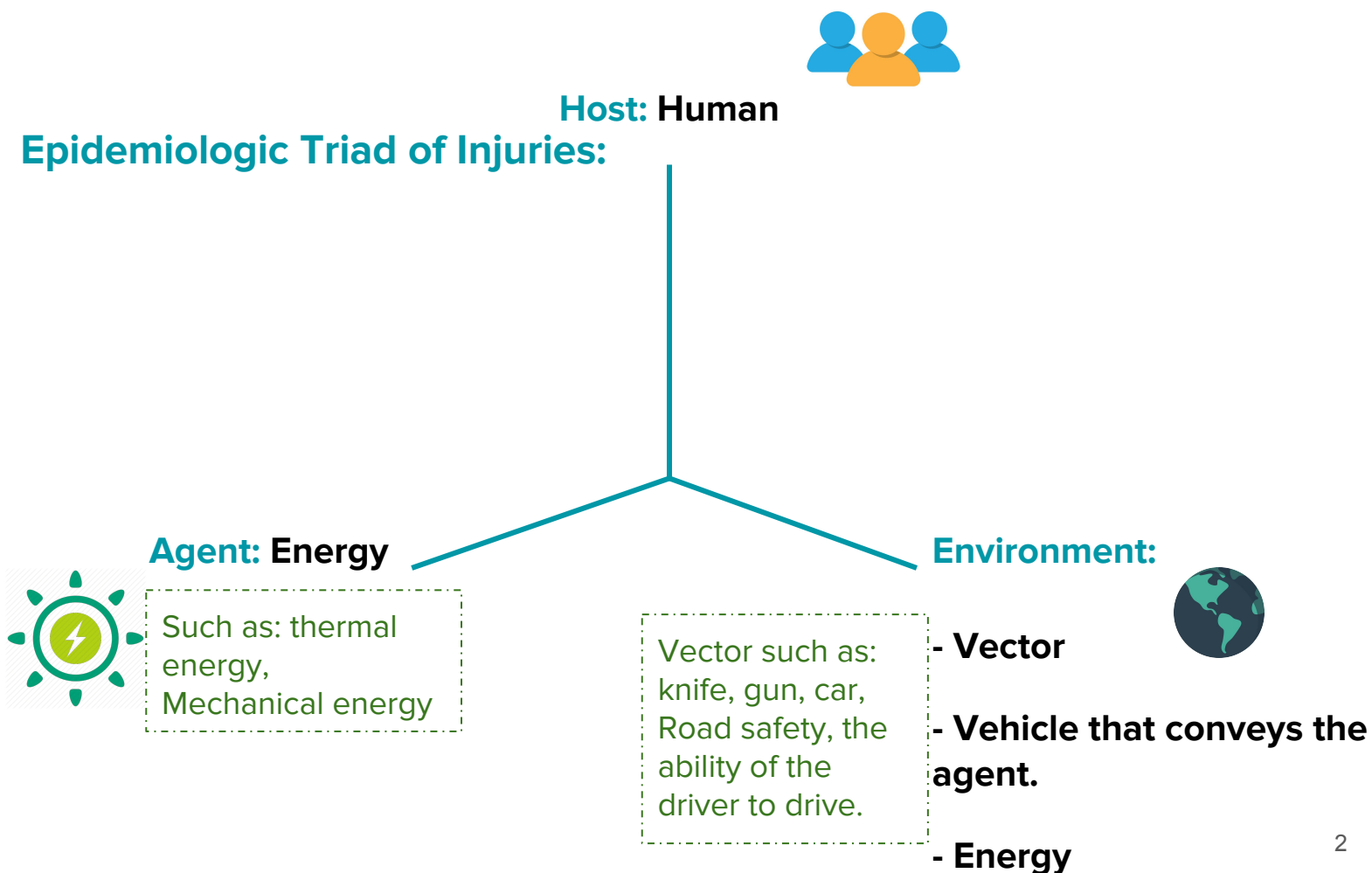
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## Definition of Injury:

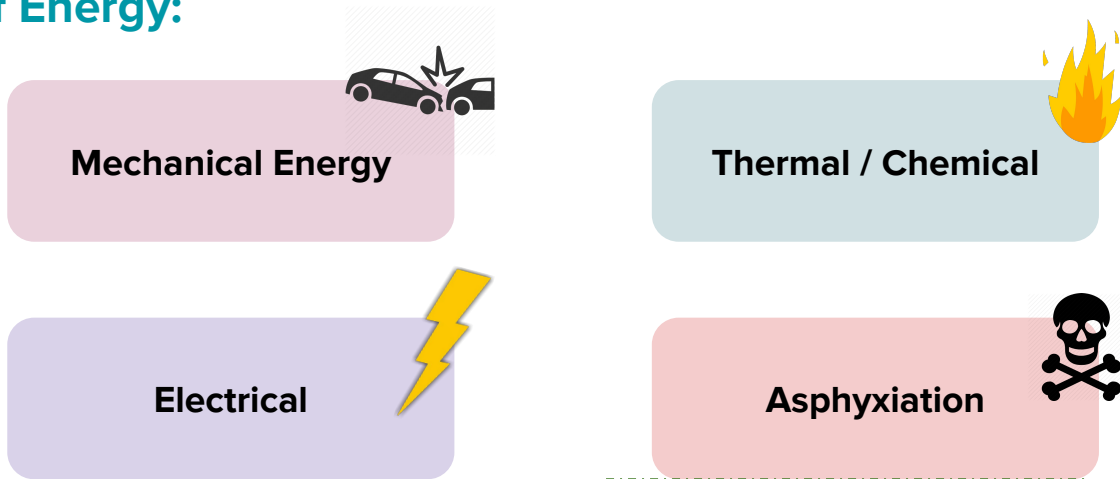
Acute exposure to agents **such as mechanical energy, heat, electricity, chemicals,** and ionising **radiation** interacting with the body in amounts or at rates that exceed the threshold of **human tolerance**. In some cases, injuries result from the **sudden lack of essential agents such as oxygen or heat**. Something is causing harm (damage to the tissues) and in regard of the type of the tissue, there will be a certain cause (we call this cause energy)

## Definition of 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.

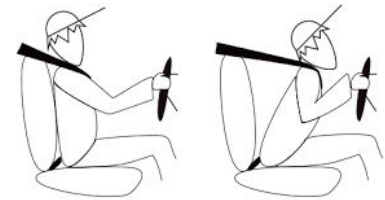


## Nature of Energy:



## Mechanical Energy:

When a vehicle stops suddenly, the occupant will continue to move at the same speed and direction.



**Stresses:** contact with energy source generates forces counter to the load.

**Strain:** extent of deformation, resulting from tension, compression, shear.

The **shape** and **elasticity** of the materials struck will determine the damage to the tissue.

Devices as seat-belts, airbags and child restraints reduce the severity of injury by reducing contact with less flexible structures (second collision).

## Types of force(stress)

### Tension

Something pulled, like if someone is pulling a hand



### Compression

Something is hit, like if you hit the glass or knee hit the front chair. (bruises and fractures occurs)



### Shear

2 object is moving in the same plane but in the opposite side like when a person ejected from a car fell in the road and he is still moving or like air bag and seat belt

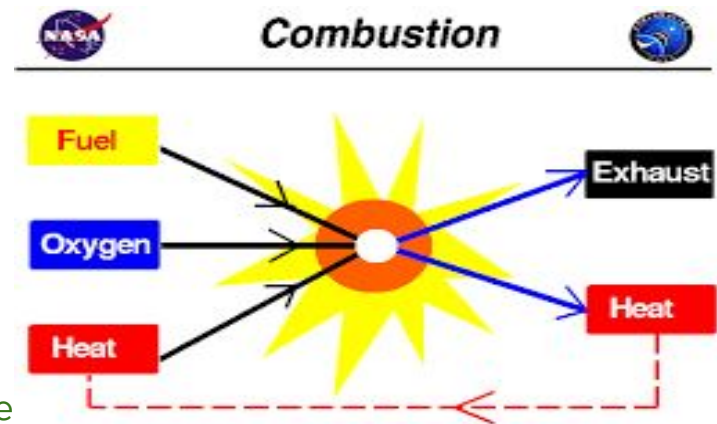


## Thermal and chemical energy:

- Fires, heat & smoke.
- As a result of ignition sources, flammable materials and of the heat and chemical energies.
- 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's absorption through the **organism's membranes**: GIT, lungs' air sacs); **toxo-dynamic** (interaction of chemical with receptors in **target tissues**).

## Combustion varies by: (combustion= اشتعال)

1. Concentration and type of heat source.
2. Shape / size of a combustible.
3. Oxygen concentration.
4. Vaporization of gases.
5. Presence or absence of catalysts.



## Electrical energy: Should be closed circle & humidity or water increase electricity

- The flow of electrons is “electrical current”.
- The extent of damage of human 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).

When the skin is dry then it will have more resistance

## Asphyxiation energy:

**Definition: absence of oxygen** to sustain endogenous energy conversion, which causes essential cells (in brain / heart) to be **damaged** within minutes.

### Causes:

1. Objects blocking nose, mouth, trachea. Like when a kid swallow a Botton and it blocks his airway
2. Mechanical blow to the trachea or constriction of the trachea.
3. Lung obstruction, water in lungs (drowning), ung congestion (endogenous fluids as in pneumonia / congestive heart failure)



## Types of injuries:

1. **Intentional:**
  - a. Violence, Suicide, Homicide, Intentional fire-arm injuries.
2. **Non-intentional (accidental):**
  - a. Road-traffic injuries, fires, falls, poisoning, drowning-asphyxia, burns, sports, accidental fire-arm injuries.

## Measuring the problem of accidents:

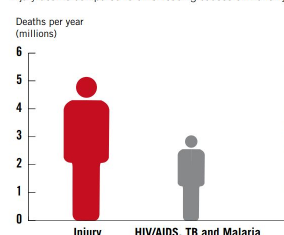
Like Road traffic accidents in Saudi Arabia if we will measure the magnitude of this problem, I'll describe it by: accidents, morbidities, mortalities, disabilities. Accidents might cause direct deaths, it might cause diseases, injuries and hospitalizations, and it might lead to disabilities.

<b>Mortality</b>	<ul style="list-style-type: none"> <li>● Proportionate mortality rate.</li> <li>● Number of deaths per million population.</li> <li>● Death rate per 1000 registered vehicles per year.</li> <li>● Number of accidents or fatalities as a ratio of no. of vehicles per km or passengers per km.</li> </ul>
<b>Morbidity</b>	<p>In terms of:</p> <ul style="list-style-type: none"> <li>● Slight injuries (like: simple fractures)</li> <li>● Serious injuries (lead to disabilities)</li> </ul>
<b>Disability</b>	<ul style="list-style-type: none"> <li>● Temporary or permanent</li> <li>● Partial or total (partial like amputated leg) (total like quadriplegia)</li> <li>● DALY, QALY... (DALY: daily adjusted life years)(QALY: quality adjusted life year) give you an idea of burden on the community. We calculate every person reached 25 years of age and when the accident happens what happens for him, and the quality of certain things that happen to him, how did it affect his community.</li> </ul>

## Magnitude of The Problem:

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

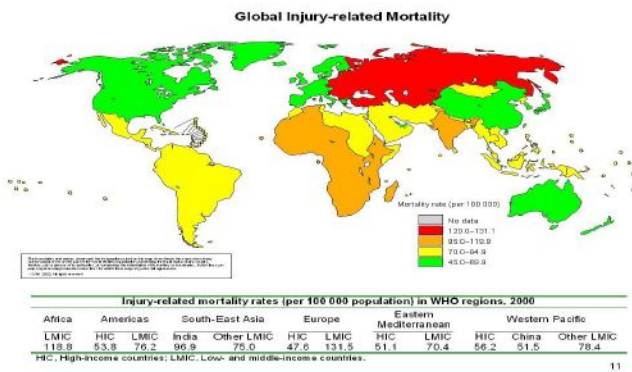
**The scale of the problem**  
Injury deaths compared to other leading causes of mortality, world, 2012.



# Global & Regional Burden:

- 12% of global burden of disease. **Is due to injury**
- The most common cause of death among people 1- 44 years of age.
- In Eastern Mediterranean Region, injury is a leading cause of morbidity and mortality loss of productive years of life and effect on health care cost.
- Road traffic “incidents” are the leading cause of injury deaths worldwide, which strongly applies to GCC/KSA.
- More than 90% of injury deaths occur in low- and middle-income countries. Above 44 accidents are from falls , Young have more road accidents, Less than 15 drowning and falls

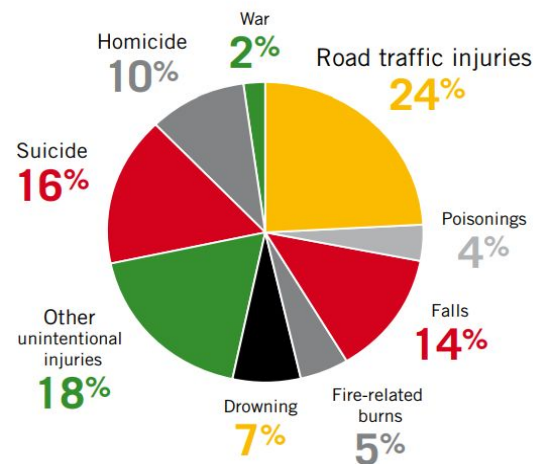
## Injury from a Global Perspective



Each year > 5 million people die of injuries.  
 2/3 are males and the majority are young adults aged 15-44  
 RTA are the largest cause of injury death.

## 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 Road traffic injuries
8 Diabetes mellitus	8 HIV/AIDS
9 Road traffic injuries	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 Suicide	15 Colon and rectum cancer
16 Birth asphyxia and birth trauma	16 Suicide
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/healthinfo/global\_burden\_disease/projections/en/index.html

## Injury pyramid

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

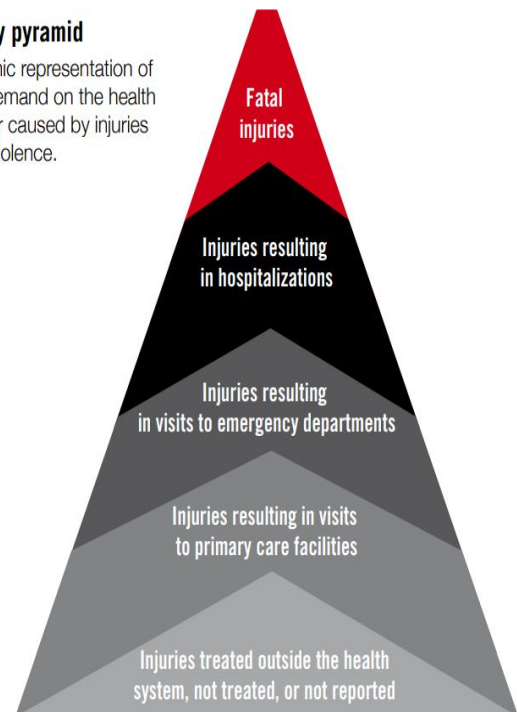
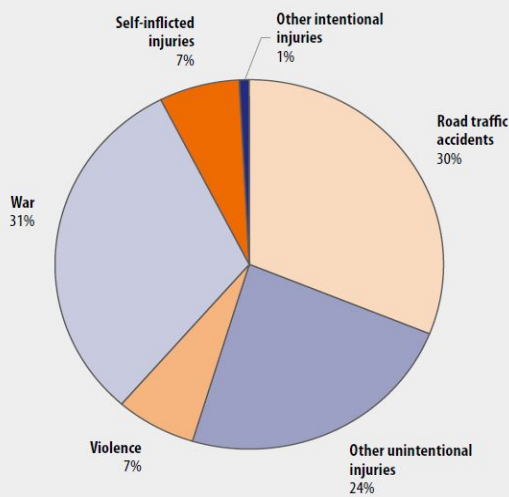
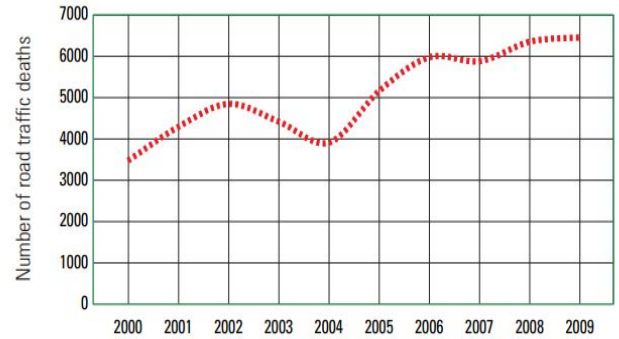




Figure 10: Causes of injury deaths among men aged 15–59 years, Eastern Mediterranean Region, 2004

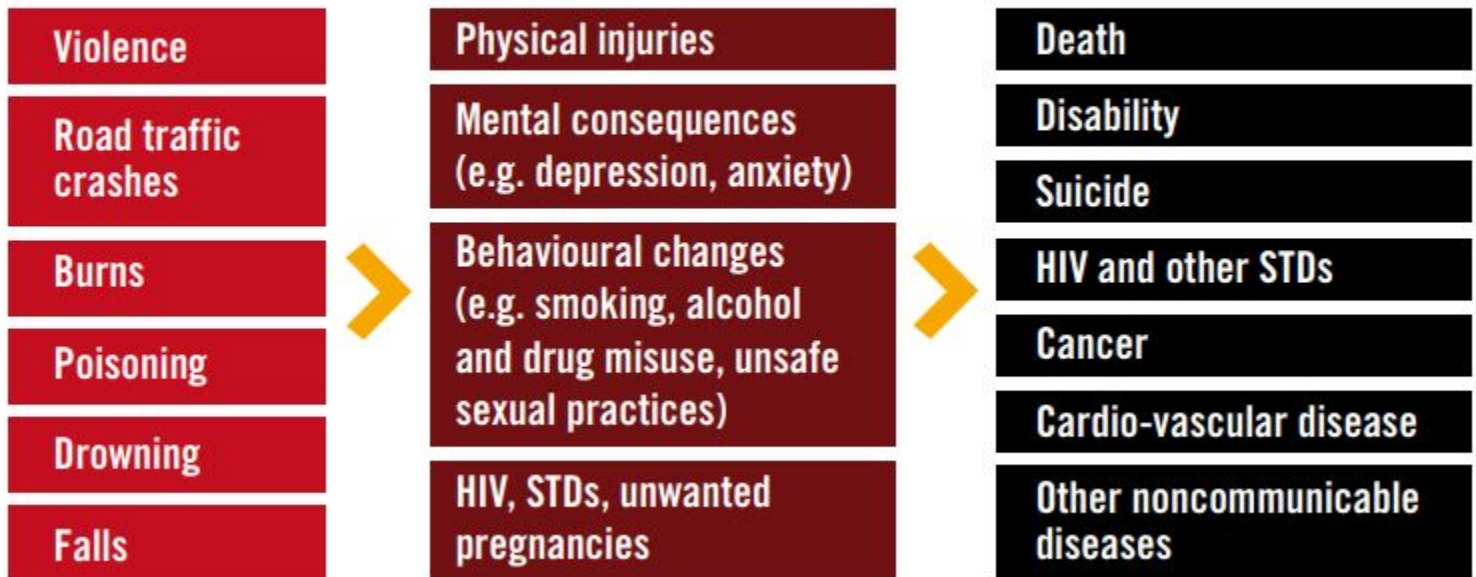


### TRENDS IN ROAD TRAFFIC DEATHS



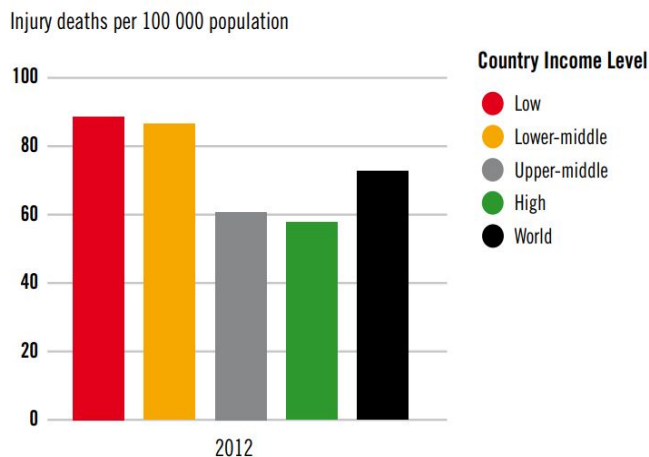
Source: 2010, Annual statistical reports from the General Administration of Traffic (Ministry of Interior)

## Consequences of injuries and violence



### Poorer countries are worst-affected by injuries and violence

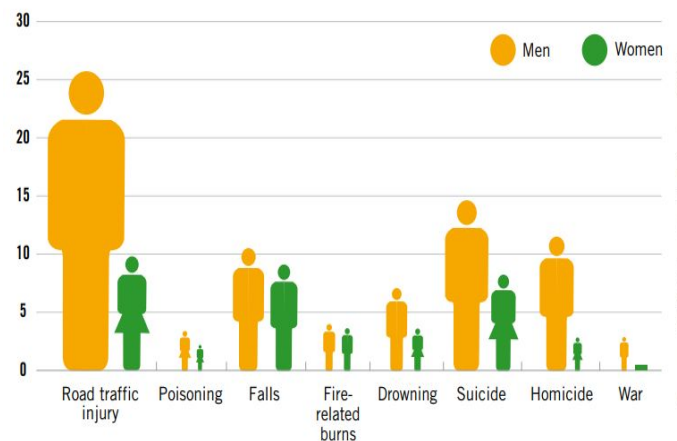
Injury death rates by country income level, world, 2012.



Source: WHO Global Health Estimates, 2014

### Men are more at risk of death from injuries and violence

Death rates per 100 000 population, by cause of injury and sex, world, 2012.



Source: WHO Global Health Estimates, 2014

Low and middle income countries the amounts of fatalities is more

**Haddon Phase-Factor Matrix:** Applies for all injury but more specific for road traffic injuries

Motor vehicle crash				
Phase	Host (Human)	Vector (Vehicle)	Physical environment	Cultural environment
<b>Pre event (primary prevention)</b>	- Alcohol experience - Judgment	- Brake status - Tires	- Nigh - Rain - Icy road	Acceptance of drinking and driving
<b>Event (secondary prevention)</b>	No seat belt	- No air bag - Hardness of surfaces	- Tree too close to road. - No guard rail	- Speed limits - Enforcement of seat belt
<b>Post event (tertiary prevention)</b>	Physical condition	- Fuel system integrity - Cell Phone	Distance of emergency response	- Support for trauma systems. - EMS standard

**Types of Data & Potential Sources of Information:**

<b>Mortality</b>	<ul style="list-style-type: none"> <li>● Death certificates</li> <li>● Reports from mortuaries</li> </ul>
<b>Morbidity and health-related</b>	<ul style="list-style-type: none"> <li>● Hospitals</li> <li>● Medical records</li> </ul>
<b>Self Reported</b>	<ul style="list-style-type: none"> <li>● Surveys</li> <li>● Media</li> </ul>
<b>Community-based</b>	<ul style="list-style-type: none"> <li>● Demographic records</li> <li>● Local government records</li> </ul>
<b>Law enforcement</b>	<ul style="list-style-type: none"> <li>● Police records</li> <li>● Prison records</li> </ul>
<b>Economic-social</b>	<ul style="list-style-type: none"> <li>● Institutional or agency records</li> <li>● Special studies</li> </ul>

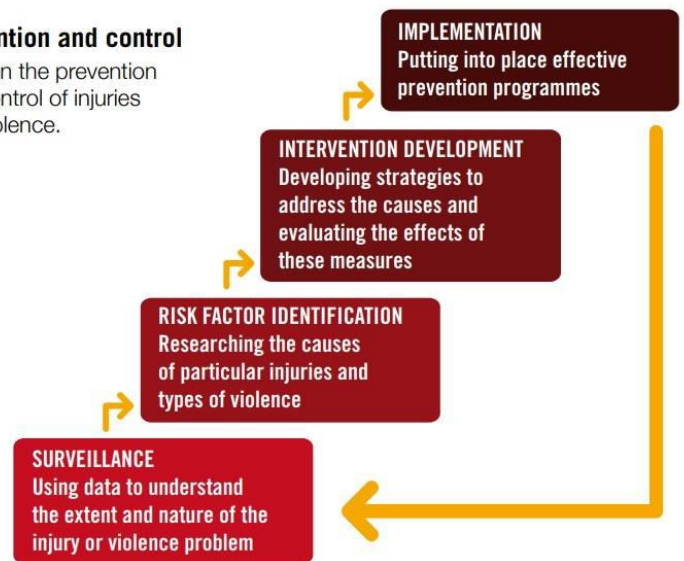


## Prevention & Control:

- **Primary prevention:** (before event)
  - 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 and management)
  - Early detection, proper evaluation and management of injuries at different levels of healthcare delivery (primary, secondary and tertiary facilities).
- **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.
- **Safety education**
- **Promotion of safety measures**
- **Primary care**
- **Elimination of causative factors**
- **Low enforcement**
- **Rehabilitation**
- **Research and data collection**

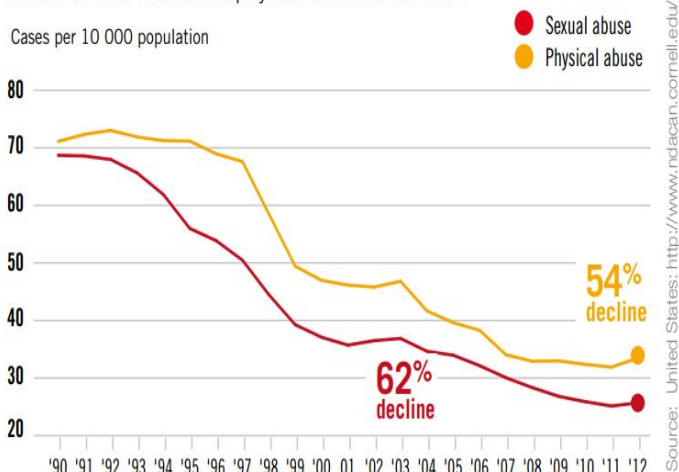
### Prevention and control

Steps in the prevention and control of injuries and violence.



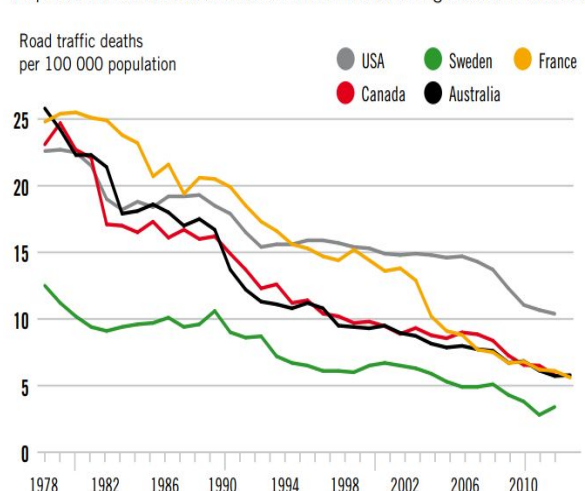
### United States reduces child abuse

Trends in child sexual and physical abuse in the USA.



### Rich countries reduce road traffic deaths

Reported trends in road traffic deaths in selected high-income countries.



## Measures:

- **Road traffic crashes:**
  - Setting and enforcing laws (speeding, drinking and driving, motorcycle helmets, seat-belts, 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.
  - 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 center.
- **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 centers.

- **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
- Reducing violence through victim identification, care and support programs

- **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

## Proven Injury Prevention Interventions:

- Car safety seats and belts
- Air bags
- Motorcycle helmets
- Bicycle helmets
- Child resistant packaging
- Swimming pool fencing
- Smoke detectors
- Self extinguishing cigarettes

## KSA efforts: برنامج الوقاية من الإصابات والحوادث من وزارة الصحة

### 1. Injury and accidents prevention program

- Surveillance System
- Education
- Capacity Building I do training

### 2. Application to Road Traffic Accidents

- **Host: victim:** e.g. driver, passenger, pedestrian, etc
- **Agent:** mechanical / thermal energy
- **Environment:** vehicles 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.
- **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).
- **Strain:** extent of deformation, resulting from tension, compression, shear
- The shape and elasticity of the materials struck will determine the damage to the tissue.
- Devices as seat-belts, airbags and child restraints reduce the severity of injury by reducing contact with less flexible structures (second collision).

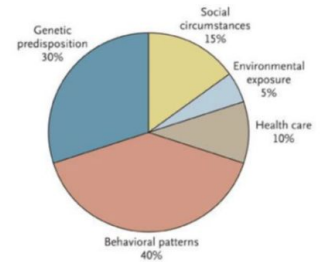
<b>Primary prevention</b>	Raising awareness of the community, at its different levels, as to methods of avoiding RTI. This includes legislations, health promotion activities and applying preventive measures (seat-belts, child restraints, air-bags, good roads, following traffic rules, etc)
<b>Secondary prevention</b>	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)
<b>Tertiary prevention</b>	Management of complications of RTI, especially disabilities, on medical / social / economic levels, including rehabilitative and physiotherapy measures

## National strategic plan to reduce RTI:

**National strategic plan that covers the 4Es:**(we include epidemiology so it became 5 Es)

1. **Education:** annual traffic weeks.
  - a. [Saudi Society Organization for Traffic Safety](#)
2. **Engineering:** road infrastructure and vehicles
3. **Enforcement:** seatbelt rule, speed limit law
4. **Emergency:** Saudi Red Crescent Society (SRCS)
5. **Epidemiology.**

Proportional Contribution to Premature Death



McGinnis, Social Determinants of Health, 2002

### Scenario 1:

Ahmad and Lama spent their one-week vacation in a resort in Egypt with their 3-year old child (Khalid). While they were relaxing by the pool, Khalid fell in the pool. Khalid's parents, the lifeguard and other residents tried to rescue Khalid.

Drawn accident, they tried to rescue hem, they did CPR, get him to the hospital, he might survive completely, or he might have some permanent effects, or they couldn't rescue him. In this case he passed away.

### Scenario 2::

Fatima is a 70-year old diabetic lady who is complaining of peripheral neuropathy and diabetic retinopathy (visual impairment). She was walking in her house and tripped over a loose carpet.

She cant feel while she was walking and she can't see well, when she fell she had hip fracture, she had 3 surgeries. Complicated case with poor healing because she is diabetic

### Scenario 3:

Majid was crossing the road on his way to grocery store. He was hit by a car driving on the wrong side of the road.

He was thrown about 10 feet into the air, landed on the car and suffered a severe brain injury.

Severe brain injury, quadriplegia.



# Summary

<b>Definition of Injury:</b>	Acute exposure to agents such as <b>mechanical energy, heat, electricity, chemicals,</b> and ionising <b>radiation</b> interacting with the body in amounts or at rates that exceed the threshold of human tolerance. In some cases, injuries result from the <b>sudden lack of essential agents such as oxygen or heat</b>
<b>Definition of Violence:</b>	<b>The intentional use</b> 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>
<b>Epidemiologic Triad of Injuries:</b>	<b>1-Host: Human, 2-Agent: Energy, 3-Environment: Vector , Vehicle that conveys the agent., Energy.</b>

## Nature of Energy:

### 1-Mechanical Energy:

When a vehicle stops suddenly, the occupant will continue to move at the same speed and direction.

Stresses: contact with energy source generates forces counter to the load.

Strain: extent of deformation, resulting from tension, compression, shear.

The shape and elasticity of the materials struck will determine the damage to the tissue.

Devices as seat-belts, airbags and child restraints reduce the severity of injury by reducing contact with less flexible structures (second collision).

Types of the force : Tension, compression, shear

### 2-Thermal and chemical energy:

- Fires, heat & smoke.
- As a result of ignition sources, flammable materials and of the heat and chemical energies.
- 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).

## Thermal and chemical energy:

1. **Intentional:** Violence, Suicide, Homicide, Intentional fire-arm injuries.
2. **Non-intentional (accidental):** Road-traffic injuries, fires, falls, poisoning, drowning-asphyxia, burns, sports, accidental firearm injuries.

### Combustion varies by:

1. Concentration and type of heat source.
2. Shape / size of a combustible.
3. Oxygen concentration.
4. Vaporization of gases.
5. Presence or absence of catalysts.

## 3-Electrical energy:

- The flow of electrons is “electrical current”.
- The extent of damage of human contact with electrical energy increases with amperage.
- Skin sensitivity varies 100-fold as a function of wetness

## 4-Asphyxiation energy:

**Definition:** absence of oxygen to sustain endogenous energy conversion, which causes essential cells (in brain / heart) to be damaged within minutes.

**Causes:** 1- Objects blocking nose, mouth, trachea. 2-Mechanical blow to the trachea or constriction of the trachea. 3-Lung obstruction, water in lungs (drowning), lung congestion (endogenous fluids as in pneumonia / congestive heart failure)

### Measuring the problem of accidents:

Mortality	Morbidity	Disability
<ul style="list-style-type: none"><li>• Proportionate mortality rate.</li><li>• Number of deaths per million population.</li><li>• Death rate per 1000 registered vehicles per year.</li><li>• Number of accidents or fatalities as a ratio of no. of vehicles per km or passengers per km.</li></ul>	<ul style="list-style-type: none"><li>• Slight injuries</li><li>• Serious injuries</li></ul>	<ul style="list-style-type: none"><li>• Temporary or permanent</li><li>• Partial or total</li><li>• DALY, QALY...</li></ul>

## Global & Regional Burden:

- The most common cause of death among people 1- 44 years of age.
- More than 90% of injury deaths occur in low- and middle-income countries.

## Haddon Phase-Factor Matrix:

Motor vehicle crash				
Phase	Host (Human)	Vector (Vehicle)	Physical environment	Cultural environment
Pre event	- Alcohol experience - Judgment	- Brake status - Tires	- Nigh - Rain - Icy road	Acceptance of drinking and driving
Event	No seat belt	- No air bag - Hardness of surfaces	- Tree too close to road. - No guard rail	- Speed limits - Enforcement of seat belt
Post event	Physical condition	- Fuel system integrity - Cell Phone	Distance of emergency response	- Support for trauma systems. - EMS standard

### Types of Data & Potential Sources of Information:

**Mortality :** Death certificates, Reports from mortuaries

**Morbidity and health-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 & Control:

- **Primary prevention:** 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).
- **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.
- **Safety education**
- **Promotion of safety measures**
- **Primary care**
- **Elimination of causative factors**
- **Law enforcement**
- **Rehabilitation**
- **Research and data collection**

## Proven Injury Prevention Interventions:

Car safety seats and belts, Air bags, Motorcycle helmets, Bicycle helmets, Child resistant packaging, Swimming pool fencing, Smoke detectors, & Self extinguishing cigarettes.

## KSA efforts:

- **Injury and accidents prevention program:** Surveillance System, Education
- **Application to Road Traffic Accidents**
  - **Host: victim:** e.g. driver, passenger, pedestrian, etc
  - **Agent:** mechanical / thermal energy
  - **Environment:** vehicles of incident
  - **Stresses:** contact with energy source generates forces counter to the load.
  - **Strain:** extent of deformation, resulting from tension, compression, shear
  - The shape and elasticity of the materials struck will determine the damage to the tissue.
  - Devices as seat-belts, airbags and child restraints reduce the severity of injury by reducing contact with less flexible structures (second collision).

## National strategic plan to reduce RTI that covers the 4Es:

- **Education:** annual traffic weeks
- **Engineering:** road infrastructure and vehicles
- **Enforcement:** seatbelt rule, speed limit law
- **Emergency:** Saudi Red Crescent Society (SRCS)
- **Epidemiology.**

## Questions:

**Q1: Which one of the following is the leading causes of road traffic injuries in Saudi Arabia?**

- A. Bad condition of vehicles
- B. Drivers under drugs
- C. Exceeding speed limit
- D. Nonuse if seat belt

**Q2:What is the Primary prevention of injuries?**

- a.Educate the People about how to deal with accidents
- b.Call997
- C .Heavy penalties should be imposed on all thoses who cross speed limits

**Q3: How are road traffic accidents calcified ?**

- 1. communicable disease of public health importance
- 2.intentional injury of public health importance
- 3.non communicable diseases of familial cluster
- 4. Non intentional injury of public health importance

**Q4:Which of the following is a secondary prevention ?**

- A-Early detection
- B-Management of complications
- C-Rehabilitation
- D-Programs to Raise awareness

**Q5:Which of the following is Measuring the problem of accidents mortality ?'**

- A-Temporary or permanent
- B-Serious injuries
- C-Death rate per 1000 registered
- D-Death percentage

**Q6:Injury caused by the flow of electrons?**

- A-Thermal injury
- B-Chemical injury
- C-Mechanical injury
- Electrical injury

Q1:C  
Q2:A  
Q3:D  
Q4:1  
Q5:C  
Q6:4



Good luck!

