



Injuries epidemiology and prevention

● 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 injuries in KSA

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● Resources :

Slides.

Doctor's notes.

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.” (Source: Gibson, 1961; Haddon, 1963)

Physical damage due to;

- transfer of energy (kinetic=**movement** , thermal, chemical, electrical, or radiant).
- Absence of oxygen or heat over a period of time, exposure that is either acute or chronic.



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, mal-development or deprivation” (WHO, 1996)



Types of Injuries

● Intentional:

e.g. violence, suicide, homicide, intentional fire-arm injuries.

● Non-intentional (accidental):

e.g. Motor Vehicle Crashes (**RTA**), fires, falls, poisoning, drowning-asphyxia, burns, sports, accidental fire-arm, Occupational Injuries.



Nature of Energy

Mechanical
E.g. RTA

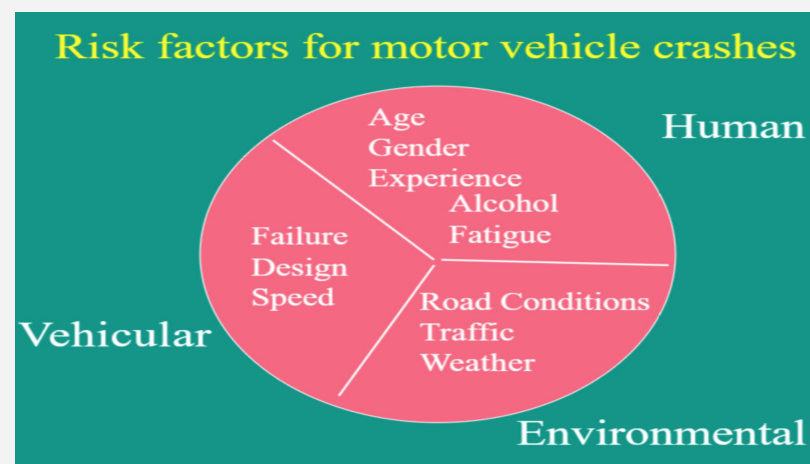
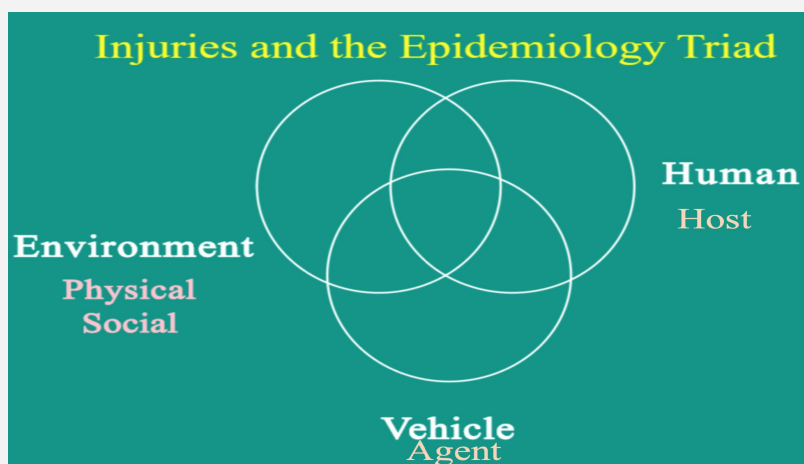
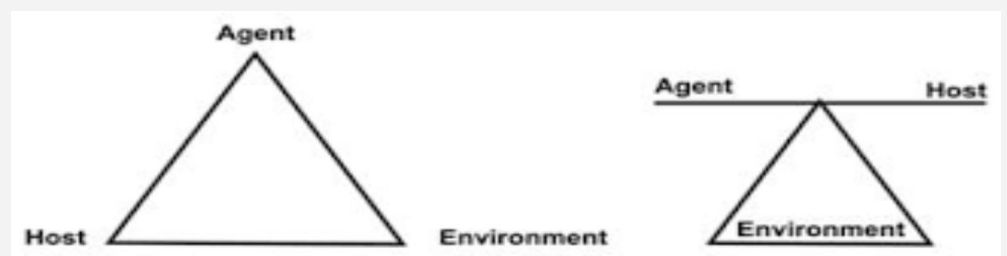
Thermal (burns) /
Chemical e.g. inhalation
of chemical substances

Electrical

Asphyxiation

Epidemiological Triad

- Host (driver)
- Agent (car)
- Environment (road)



Causative factors

Human factors	Vehicle factors	Environmental factors
<ul style="list-style-type: none"> ● Over speeding ● Over taking ● Not wearing helmet ● Drunken driving ● Sudden road crossing ● Driving under the influence 	<ul style="list-style-type: none"> ● Poor safety features ● Faulty design ● Poor condition ● Poor visibility ● Loss of balance ● Brake failure ● Problem with head or tail light ● Overloaded vehicles 	<ul style="list-style-type: none"> ● Absence of reliable public transport system ● Poorly designed roads ● Poor lighting ● Obstacle on road ● Absence of traffic system ● Lack of pedestrian footpath

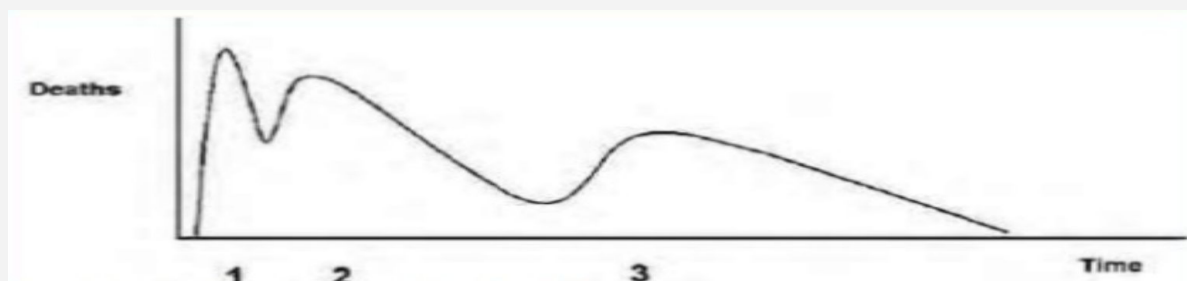
Other risk factors:

Factors influencing exposure to risk	<ul style="list-style-type: none">● Rapid motorization● Demographic factors● Transport, land use and road network planning● Increased need for travel● Choice of less safe forms of travel
Risk factors influencing crash involvement	<ul style="list-style-type: none">● Speed● Pedestrians and cyclists● Young drivers and riders● Alcohol● Medicinal and recreational drugs● Driver fatigue● Handheld mobile telephones● Inadequate visibility
Risk factors influencing Injury severity	<ul style="list-style-type: none">● Lack of in-vehicle crash protection● Non-use of crash helmets by two-wheeled vehicle users● Non-use of seat-belts and child restraints in motor vehicles● Roadside objects
Risk factors influencing Post-crash injury outcome	<ul style="list-style-type: none">● Pre-hospital factors● Hospital care factors

Patterns of death due to trauma

Road death occur in 3 peaks:

1. Early death (within minutes) - primary prevention
 2. Intermediate death (within 1 or 2 days) - secondary prevention
 3. Late death (over days or weeks) - tertiary prevention
- First hour after the accident is the most important hour



Trauma Energy

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

Tension:
pulling molecules
apart

Compression:
pushing molecules
together

Shear:
from tangential force

- Strain: extent of deformation (stresses resultant)

Magnitude of the problem



CDC in Saudi Arabia

The Centers for Disease Control and Prevention (CDC) has worked with the Kingdom of Saudi Arabia for over 20 years. CDC has formed partnerships with the Ministry of Health, WHO, local partners, and other U.S. Government agencies to reduce the impact of emerging diseases, build capacity in laboratory systems and epidemiology, respond to public health emergencies, and conduct surveillance, surveys, and studies.

CDC STAFF
1 U.S. Assignee

AT A GLANCE
Population: 32,938,213 (2017)
Per capita income: \$54,770
Life expectancy at birth: F 76 /M 73 years
Infant mortality rate: 12/1,000 live births

TOP 10 CAUSES OF DEATH

1. Ischemic heart disease
2. Road injuries
3. Stroke
4. Chronic kidney disease
5. Lower respiratory infections
6. Alzheimer's disease
7. Conflict and terror
8. Cirrhosis
9. Neonatal disorders
10. Diabetes

Global Health Protection
To prevent the spread of disease regionally and around the world it is critical that countries respond to public health threats quickly and effectively within their borders. CDC works with the Kingdom of Saudi Arabia to strengthen its public health systems and build capacity for disease outbreak response, surveillance, laboratory systems, and workforce development.

Field Epidemiology Training Program
CDC supports strengthening Saudi Arabia's public health workforce to investigate and respond to disease outbreaks. In 1989 CDC assisted in the establishment of a Field Epidemiology Training Program (FETP) that trains field epidemiologists—or disease detectives—to identify and contain outbreaks before they become epidemics. FETP residents develop skills to gather critical data and use it to make public health program recommendations.

The two-year training program leads to a diploma in Field Epidemiology from King Saud University, which is recognized as equivalent to a Master's Degree by Saudi Council for Health Specialties. Since its establishment, the program has graduated 29 cohorts and 142 residents, many of whom have assumed public health positions in the country.

The Saudi Arabia FETP was the first program in the Middle East. It currently has four residents from Oman and is actively recruiting residents from other countries in the region.

CDC Impact in Saudia Arabia
More than 140 fellows have graduated from Saudi Arabia's Field Epidemiology Training Program, now working across Saudi Arabia to quickly contain outbreaks at their source.

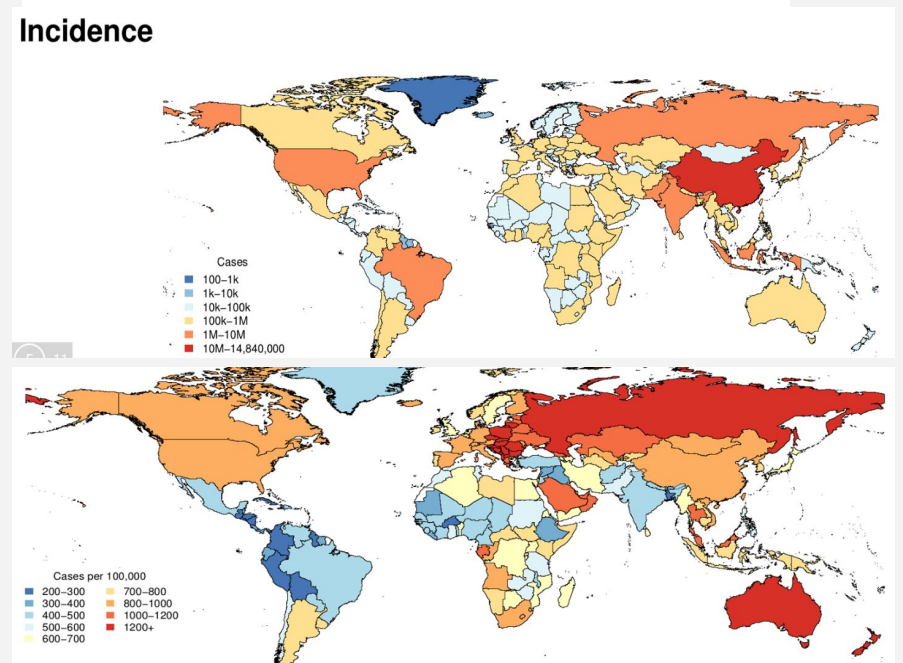
For more country information, visit: www.cdc.gov/globalhealth/countries/saudi Arabia

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

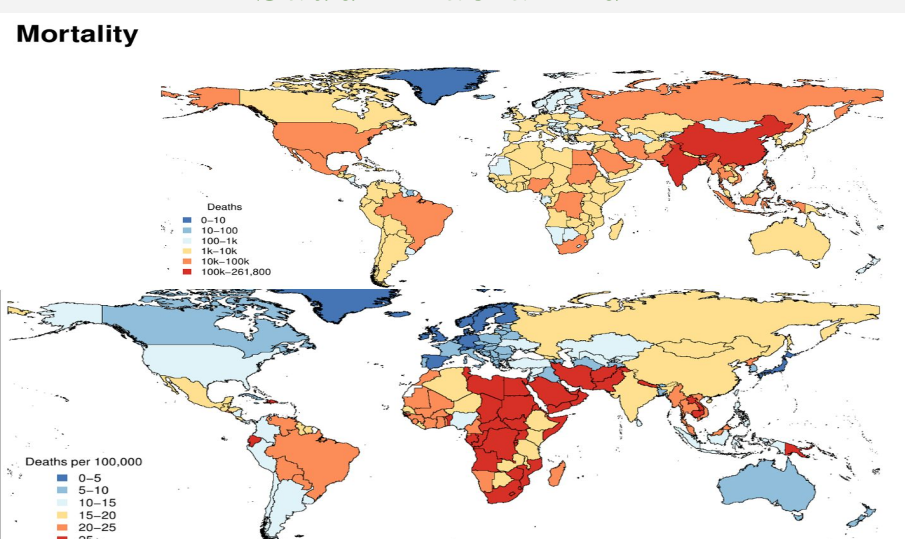
Publication Date October 2019 CS290566-AQ PO

Figure 1 Incident cases, age-standardised incidence rates, and per cent change between 1990 and 2017 by country for road injuries.

James SL, et al. *Inj Prev* 2020;0:1-11. doi:10.1136/injuryprev-2019-043302



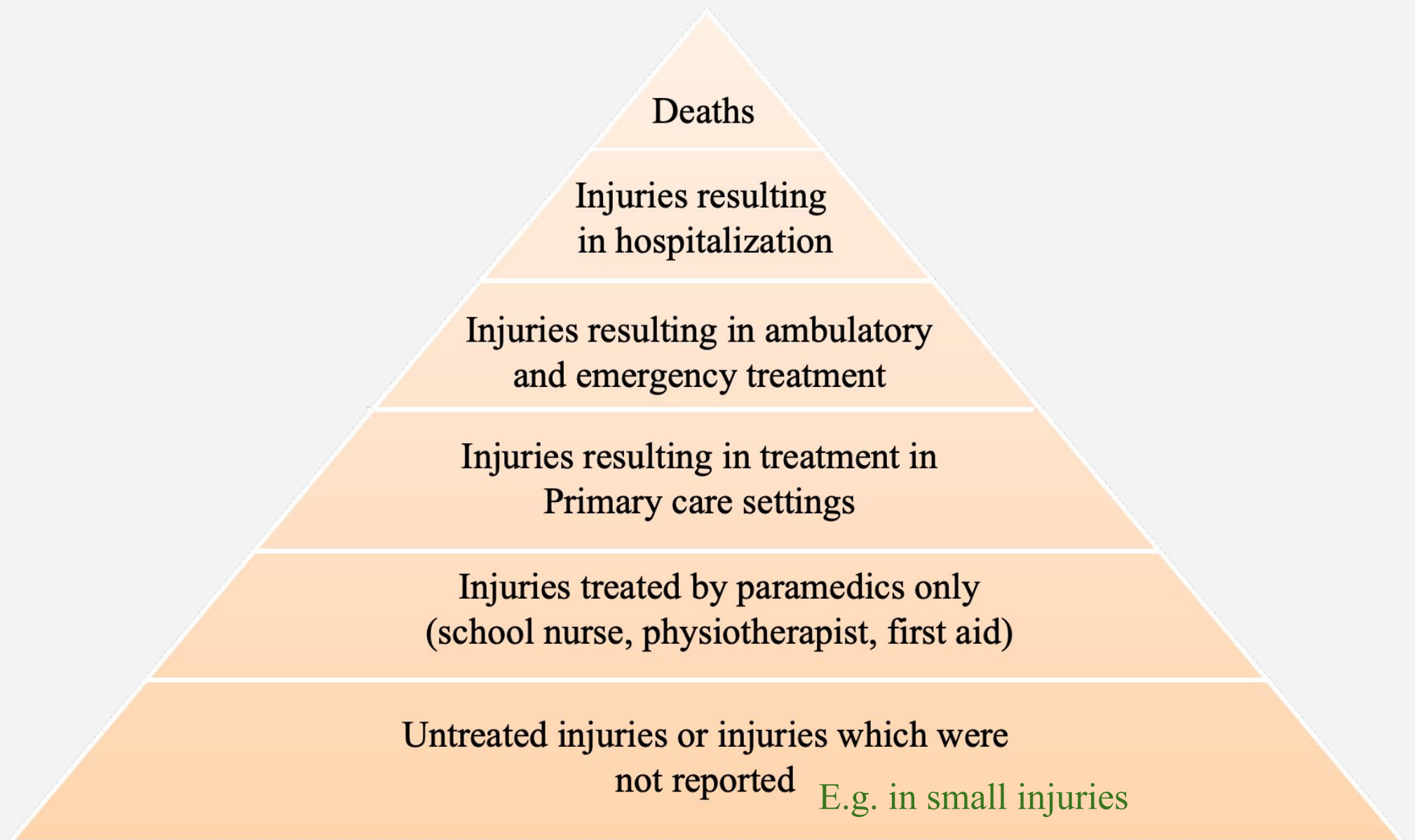
Highest incidence is Russia 1st & Saudi Arabia 2nd



US and Canada share the same incidence rate but the mortality rate is higher in the US bc they don't have a comprehensive national health insurance system, unlike Canada where healthcare is available for all

Road injuries are the 8th cause of death worldwide, and the 2nd cause of death in KSA

Pyramid of Injury



Global & Regional Burden

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

Injury deaths rise in rank

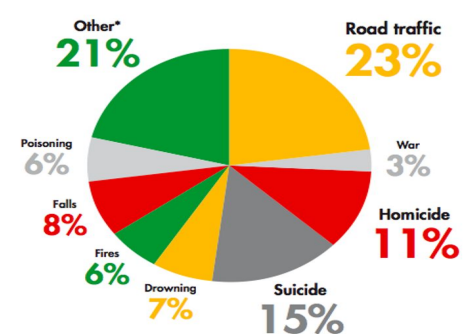
Leading causes of death, 2004 and 2030 compared.

Total 2004	Total 2030
1 Ischaemic heart disease	1 Ischaemic heart disease
2 Cerebrovascular disease	2 Cerebrovascular disease
3 Lower respiratory infections	3 Chronic obstructive pulmonary disease
4 Chronic obstructive pulmonary disease	4 Lower respiratory infections
5 Diarrhoeal diseases	5 Road traffic crashes
6 HIV/AIDS	6 Trachea, bronchus, lung cancers
7 Tuberculosis	7 Diabetes mellitus
8 Trachea, bronchus, lung cancers	8 Hypertensive heart disease
9 Road traffic crashes	9 Stomach cancer
10 Prematurity and low birth weight	10 HIV/AIDS
11 Neonatal infections and other	11 Nephritis and nephrosis
12 Diabetes mellitus	12 Suicide
13 Malaria	13 Liver cancer
14 Hypertensive heart disease	14 Colon and rectum cancer
15 Birth asphyxia and birth trauma	15 Oesophagus cancer
16 Suicide	16 Homicide
17 Stomach cancer	17 Alzheimer and other dementias
18 Cirrhosis of the liver	18 Cirrhosis of the liver
19 Nephritis and nephrosis	19 Breast cancer
20 Colon and rectum cancers	20 Tuberculosis
22 Homicide	

Source: World health statistics 2008 (www.who.int/whosis/whostat/2008/en/index.html)

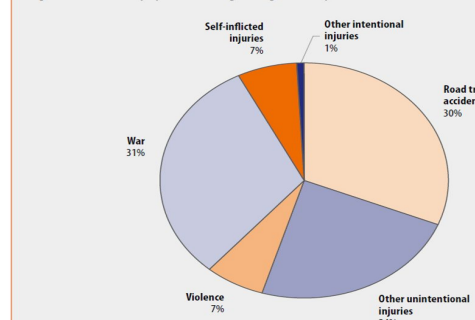
How injuries claim lives

Causes of injury deaths, World, 2004.



Why would RTA move up the list in 2030? Because the healthcare system will become better in dealing with non-communicable diseases

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



Global status report on road safety 2015.

Table 1 - Key features of studies (full text) on road traffic accident (RTA) in the Kingdom of Saudi Arabia (KSA) (n=8).

Study, year of publication	Type, year	Sample size	Place of study	Most common identified cause of RTA	Outcome measure	Preventive strategy proposed
Barrimah et al, 2012 ¹⁶	Both, 2010	835	Hospitals and PHC in Buraydah, Al-Qassim region	High speed	Type of accident, injury, deaths, health versus police records RTA, non-fatal injury rate	Good surveillance, improvement in quality of data
Khan et al, 2010 ²²	Primary, 2005-2006	1513	Armed Forces Hospital Southern Al-Aseer region, KSA	Non use of seat belts	Cause of injuries	Primary prevention of road injuries emphasized
Al-Naami et al, 2010 ²⁰	Secondary	---	-	Driver errors	Magnitude of RTAs	Establishment of trauma care system
Bendak, 2005 ²⁴	Both, 2001	900	Drivers and FSP in Riyadh	NA	Compliance to seat belt law and types of injuries	Trends in use of seat belts
Elshinnawey et al, 2008 ¹³	Secondary, 1997-2002	--	Mortality records of MOH and General Statistics Authority, KSA	NA	PYLL	Health education
Ansari et al, 2000 ⁸	Secondary	--	--	High speed	General and specific causes of RTA economic impact	Use of seat belts, developing RTA database
Qayed, 1998 ²¹	Secondary, 1994-1995	--	Al-Ahsaa Hospitals and Traffic Department	NA	Injury, deaths, no. of vehicles and accidents and causes	Primary, secondary, and tertiary prevention of road injuries
Batouk et al, 1996 ²³	Primary, 1989-1994	303 dead victims	Abha (Al-Aseer region)	NA	Dead on arrival, site of injury, time of accident	Legislation on seat belt and pre-hospital emergency system

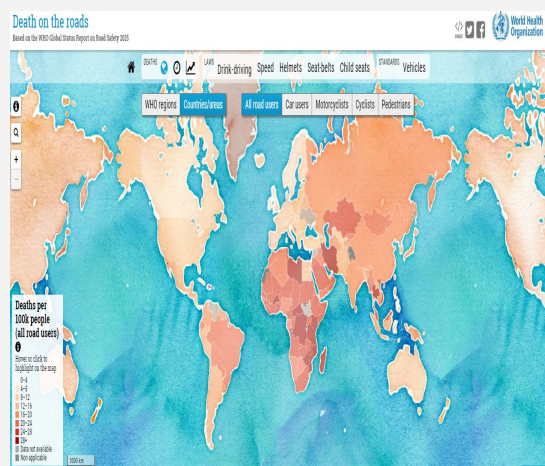
PHC - primary health care, FSP - front seat passenger, MOH - Ministry of Health, PYLL - potential productive years life lost, NA - not available

Table 3 - Causes of road traffic accidents as implicated in various years according to studies from Saudi Arabia.

Study	Drivers' faults					Vehicle's condition	Environmental conditions
	Excess speed	Violation of rules	Non use of seat belts	Substance abuse	Improper turning, or stopping (%)		
Central Department of Statistics and Information ¹⁶	43.1	1.7	-	0.0	42.2	12.2	12.2
Al-Naami et al ²⁰	65.0	50.0	-	-	-	-	-
Kahn et al ²²	29.0	26.6	29.2	-	-	-	-
		had no license					
Bendak ²⁴	-	-	40.0	-	-	-	-
Ansari et al ⁸	65.0	65.0	-	-	-	20.0	20.0
Batoul et al ²³	70.0	12.0	-	-	1.8		

A study done in KSA showing that more than 40% of RTA are because of the drivers' fault

Country/area	General Information			Road traffic deaths			
	Population numbers ^a for 2013	GNI per capita ^b for 2013 in US dollars	Income level ^c	Reported number of road traffic deaths ^d	Modelled number of road traffic deaths ^e		Estimated road traffic death rate per 100 000 population ^f
					Point estimate	95% Confidence Interval	
Qatar	2 168 673	86 790	High	204 ^f	330	—	15.2
Republic of Korea	49 262 698	25 920	High	5 092	5 931	—	12.0
Republic of Moldova	3 487 204	2 470	Middle	302	437	—	12.5
Romania	21 698 585	9 060	Middle	1 861	1 881	—	8.7
Russian Federation	142 833 689	13 850	High	27 025	27 025	—	18.9
Rwanda	11 776 522	630	Low	526	3 782	3 022 – 4 541	32.1
Saint Lucia	182 273	7 060	Middle	30	33	—	18.1
Saint Vincent and the Grenadines	109 373	6 460	Middle	9	9	—	8.2
Samoa	190 372	3 970	Middle	17	30	27 – 33	15.8
San Marino	31 448	51 470	High	1	1	—	3.2
Sao Tome and Principe	192 993	1 470	Middle	33	60	47 – 73	31.1
Saudi Arabia	28 828 870	26 260	High	7 661	7 898	7 002 – 8 795	27.4
Senegal	14 133 280	1 050	Middle	356	3 844	3 214 – 4 474	27.2
Serbia	9 510 506	6 050	Middle	650	735	—	7.7
Seychelles	92 838	13 210	Middle	8	8	—	8.6
Sierra Leone	6 092 075	660	Low	220	1 661	1 334 – 1 988	27.3
Singapore	5 411 737	54 040	High	159	197	—	3.6
Norway	5 042 671	102 610	High	187	192	—	3.8



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

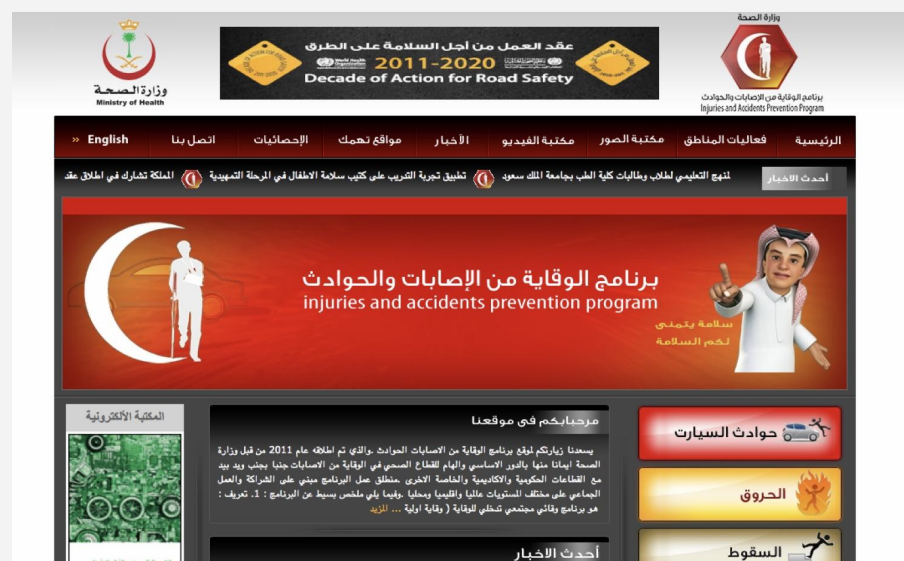


PREVENTION & CONTROL

Levels & Concepts

- **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 e.g. Saudi Red Crescent

KSA Efforts

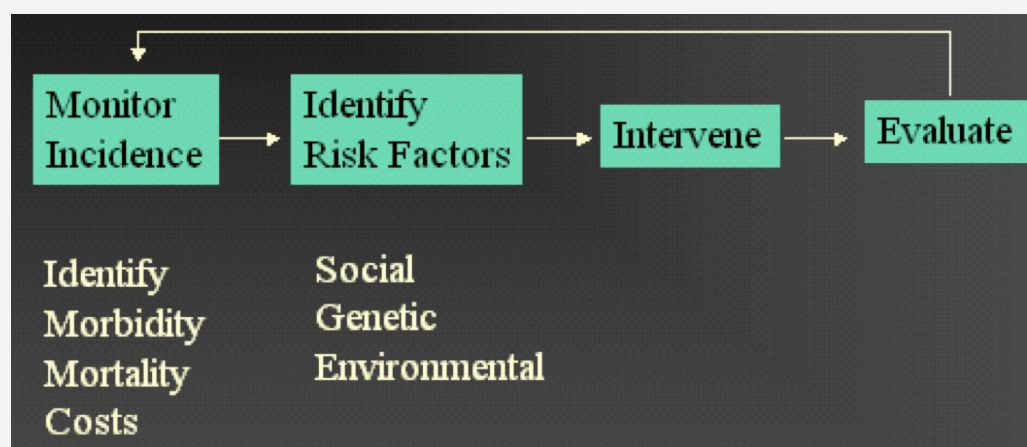


- Surveillance System
- Education
- Capacity Building

<http://moh-ncd.gov.sa/injury/index.php>

Applications

General Model for Injury Control:



Applications

- **Host:** victim: e.g. driver, passenger, pedestrian..
 - **Agent:** mechanical / thermal energy
 - **Environment:** vehicle, road, social
-
- **Primary prevention:** This includes legislations, health promotion activities and applying preventive measures (seat-belts, child restraints, air-bags, 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 rehabilitation and physiotherapy measures

Prevention

Primary Prevention	Secondary Prevention	Tertiary Prevention
<ul style="list-style-type: none">● Road● Vehicle● People● System	<ul style="list-style-type: none">● Pre-trauma care● Acute emergency trauma care system	<ul style="list-style-type: none">● Hospital care● Rehabilitation

The Haddon Matrix

- Added factor of time to previous models to address causes of injury
- The host, agent, and environment interact over time to cause injury and correspond to:
 - Pre-event
 - Event
 - Post-event
- Matrix uses nine components to analyze the injury
 - Encourages creative thinking
- Injury prevention requires broad and innovative thinking to be most successful.

The Haddon Matrix

- Use for planning, resource allocation, strategy identification

	Human	Vehicle	Environment
Pre-event			
Event			
Post-event			

	Human	Vehicle	Environment
Pre-event	Alcohol		Night, rain
Event	No seat belt	No air bag	Tree too close to road
Post-event			Slow emergency response

- Crash injury prevention strategies for the international traveler

	Traveler	Vehicle	Environment
Pre-event	Avoid alcohol	Choose safe cars	Avoid night driving
Event	Use seat belts		
Post-event			Know local medical system

The Haddon Matrix for RTA



- ★ The most important slide in the lecture

Phase	Nature of Intervention	Factors		
		Human	Vehicles & equipment	Environment
Pre-crash	Crash prevention	Information Attitude Impairment Police Enforcement	Road Worthiness Lighting Braking Handling Speed Management	Road Design Road Layout Speed limit Pedestrian Facility
Crash	Injury Prevention during crash	Use of Restraint Impairment	Occupant Restraints Other Safety devices Crash protective Design	Forgiving Roadsides (i.e. Crash Barriers)
Post Crash	Life Sustaining	First Aid Skills Access to	Ease of Access Fire Risk	Rescue Facilities

The Haddon Matrix; cont'

	Pre-Crash	Crash	Post-Crash
Human Factors	<ul style="list-style-type: none">• Education and licensing• Driver impairment• Crash avoidance maneuvers (braking, turning, etc.)	<ul style="list-style-type: none">• Health at time of crash• Sitting properly in restraint• Impairment	<ul style="list-style-type: none">• Response to EMS• Severity of injury• Type of injury
Vehicle/ Equipment Factors	<ul style="list-style-type: none">• Crash avoidance equipment and technology (lights, tires, collision avoidance, etc.)• Vehicle design• Vehicle load	<ul style="list-style-type: none">• Speed of travel• Functioning of safety equipment (seat belts, air bags, child restraints)• Energy absorption of vehicle	<ul style="list-style-type: none">• Ease of extraction from vehicle• Integrity of fuel systems and battery systems
Physical Environment	<ul style="list-style-type: none">• Road hazards• Distractions• Weather conditions	<ul style="list-style-type: none">• Roadside features• Guardrails• Type and size of object struck	<ul style="list-style-type: none">• Distance of EMS personnel• Notification of EMS personnel• Accessibility to crash victims
Social/Economic	<ul style="list-style-type: none">• Enforcement activities• Insurance incentives• Social norming• Ability to use safety equipment appropriately	<ul style="list-style-type: none">• Laws concerning use of safety equipment	<ul style="list-style-type: none">• Trauma system equipment, personnel, training• Information sharing

Special Interventions for Road Safety

- Education
- Drinking & driving
- Helmet
- Seat Belt
- Speed management
- Trauma Care

Education:

Principles:

- Informed people will take necessary action to reduce the risk.
- Educating people decreases the activity that result in injuries, and
- The educator has the means available to provide information and build skills and bring changes regarding emotions and values.

Approaches:

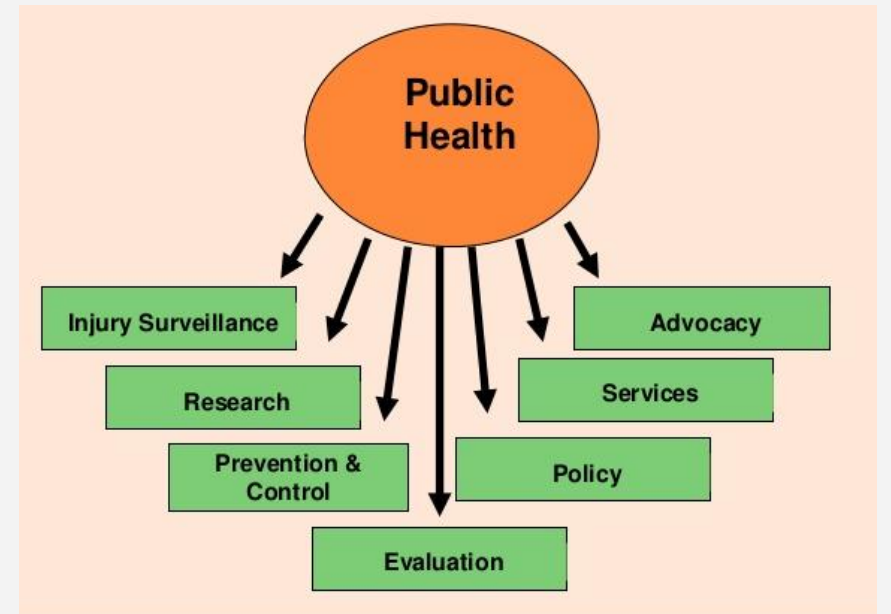
- Banner, posters and slogans
- General education programmer
- Training programmers
- Campaign
- Driver education programme
- School health education

Speed Management

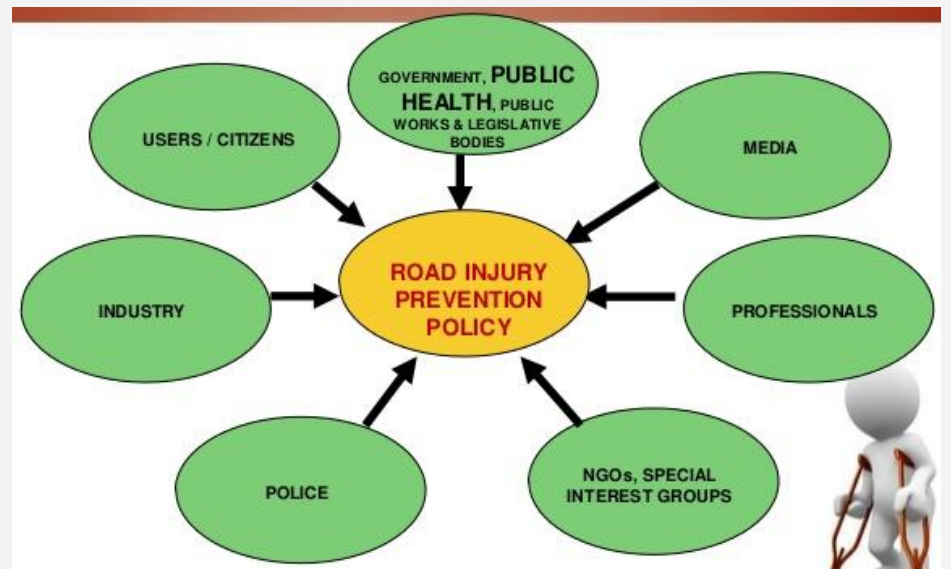
- Excessive and inappropriate speed has been recognized as one of the major contributing factors for increasing road crashes.



- Road traffic accidents: Public health issue



- Conclusion: Road safety; shared societal responsibility



“Prevention is the vaccine for the diseases of injury”

Injury Surveillance

- Assess status
- Program evaluation
- Define priorities
- Stimulate research
- Standard classification to compare data

Surveillance Types:

- **Passive:**
 - Routine data collection for dual (original + surveillance) limited resources, by front-lines HCPs
- **Active:**
 - Seeking injury cases, large resources, by PH services, different data sources
- Nature, trends, size, source, clusters, hazards, risks.
- **Core:**
 - Detection, registration, confirmation, reporting, analytics, feedback.
- **Support:**
 - Communication, training, supervision, resource provision

MCQs

1. 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 is the definition of what?

- A. attack
- B. injury
- C. event
- D. violence

2. Occupational Injuries are example of which of the following?

- A. Intentional
- B. Accidental

3. Poor visibility is which of the following causative factors?

- A. human factors
- B. vehicle factor
- C. environmental factors

4. legislations, health promotion activities are which type of prevention ?

- A. tertiary
- B. secondary
- C. primary
- D. all of the above

5. Routine data collection is which type of surveillance?

- A. passive
- B. active
- C. core
- D. all of the above.