

Road Traffic Injuries: Challenges and Safety Measures

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Introduction:

India is currently experiencing the triple burden of diseases viz. communicable diseases, non-communicable diseases and injuries.^[1] India is having one of the largest networks of roads in the world, which is important indicator of economic development of a country. Rising population, inadequate planning and expenditure contributes to number of road accidents, injuries and fatalities.

A Road Traffic Accident (RTA) can be defined as, an event that occurs on a way or street open to public traffic; resulting in one or more persons being injured or killed, where at least one moving vehicle is involved.' Thus RTA is a collision between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles. Different road transport modes include four wheelers, motorized three wheelers, motorized two wheelers, bicycles and pedestrians.

An "injury" is defined as 'a body lesion at the organic level resulting from acute exposure to energy (mechanical, thermal, electrical, chemical or radiant) interacting with the body in amounts or rates that exceed the threshold of psychological tolerance. Unintentional injuries consist of that subset of injuries, for which there is no evidence of predetermined intent. The cause-specific intentional injuries for which the World Health Organization routinely analyses & publishes data include road traffic injuries (RTI), domestic injuries that include poisonings, falls, burns and drowning.

Road traffic mortality is any death for which a severe road traffic injury is the underlying cause. The "underlying cause" of a death is the disease or injury which initiated the train of events leading directly to death regardless of how long ago the event occurred. Note that there is no time limit between the crash and

the death. There is also no restriction on where the death happens (at crash scene, hospital, home, etc).

RTIs incur a huge burden on economy and on health department in terms of pre-hospital and acute care and rehabilitation with a greater share of hospitalizations, deaths, disabilities and socio-economic losses in young and middle age populations. RTIs are included under unintentional injuries. A road traffic injury is an injury caused in a road traffic crash. "Injury" is the reduction in functional health status due to energy exchanges that have relatively sudden discernible effects.^[2]

Learning objective of this CME is to describe major concepts in road traffic injuries & outline the major global and Indian scenario and its public health implications with highlight on the key risk factors & basic elements of public health approach and Haddon matrix in reference to road traffic injuries.

Burden of RTIs

The Global Burden of Disease (GBD), injury and risk factor study provides global patterns of mortality and disability, the state of the global health. GBD provides largest and most comprehensive systematic epidemiological estimates for 150 major health conditions from 1600 GBD collaborators across 120 countries. GBD minutely examines causes of death, and is unique in its inclusion of disability. It also provides indispensable global and regional data for health planning, research and education. Disability Adjusted Life Years (DALY) assesses overall burden of diseases. Road injury is the ninth leading cause of deaths in the world. Injuries cause over 15 percent of death and disability.^[2]

Worldwide

The worldwide rate of unintentional injuries is 61 per 100,000 populations per year. Overall, road traffic injuries make up the largest proportion of unintentional injury deaths (33%).^[3]

Every year approximately 1.3 million deaths results from road traffic accident, which is more than 3000 deaths per day! In addition, 20-50 million non-fatal injuries results from a collision and these injuries are important causes of disability worldwide. RTIs are among the top three causes of death between 5 to 44 years of age.^[4]

During 2008, RTI ranked fourth among the leading causes of death in the world.^[5] Road traffic injuries are the leading cause of death among young people aged 15-29 years and cost countries 1-3% of the gross domestic product (GDP). Half of those dying on the world's roads are 'vulnerable road users': Pedestrians, cyclists, and motorcyclists.^[6, 7] Only 28 countries, representing 416 million people (7% of the world's population), have adequate laws that address all five behavioral risk factors (speed, drink-driving, helmets, seat-belts, and child restraints). Hence, the goal of the United Nations' Decade of Action for Road Safety 2011- 2020 is to save five million lives. [8] Road injury accounts for 75.5 million DALYS in 2010, up from 56.7 million in 1990.^[9]

India

Based on Global status report on road safety 2013 more than 2, 31,000 people are killed in road traffic accidents (RTAs) in India every year. Nearly half of all deaths on the roads are amongst vulnerable road user's viz., motorcyclists, cyclists and pedestrians.^[10]

In India and South-East Asia, injuries account for an estimated 15% of total deaths and 15% of DALYs. Consequently, an estimated 1.5 million people die, as a result of injuries and 15-20 million are hospitalized with resulting economic losses of 3% of GDP for the country.^[11] Tamil Nadu, Maharashtra and Madhya Pradesh are states showing trend with highest number of road accidents from 2010-13 while Uttar Pradesh, Tamil Nadu and Andhra Pradesh reported maximum number of person killed during the same period. Goa had maximum number of road accidents per lakh population while Lakshadweep had lowest. Two wheelers (28.6%) are the most unprotected road users followed by Car/Jeep/Taxis (22.2%) and Truck / Tempo (21.1%). Time period between 3:00 pm to 6:00 pm shows highest rate of

accidents. Ratio of total accidents during day time (6 am to 6 pm) to night time (6pm to 6 am) is 3:2.^[12]

Reasons for Increasing Burden of Road Traffic Injuries

Road traffic crash occurs as a result of multiplicity of factors and the way they interact, viz. components of the system including roads, vehicles, road users and the environment. While some factors contribute directly to the occurrence of a collision, thus are part of crash causation, the other factors aggravate the severity of the crash and thus contributes to the consequences of trauma. Some factors are indirectly related to road traffic injuries, some causes are immediate, but may remain unnoticed by medium-term and long-term structural causes. Understanding complexities of interrelated risk factors that contribute to road traffic collisions are important in prioritizing interventions that can reduce the risks associated with those factors.^[11]

Identifying transport modes, patterns and needs is essential for ensuring road safety. The overcrowding of vehicles on roads is due to overwhelming growth of the vehicle industry, liberalized government's economic policies, increasing purchasing power of people, easy availability of loans, aggressive media campaigning, and poorly developed and maintained public transport systems have possibly contributed in increasing motorization and a changing transportation scenario.

- Adoption of legislative change is too slow. Countries need to increase pace of adoption of legislation relating to key risk factors for road traffic injuries, if the target of the United Nations General Assembly resolution is to be met (i.e. 50% of countries to have comprehensive legislation on key risk factors by 2020, India is signatory to this).
- Strict enforcement of road safety laws is requisite for users' benefit. Currently enforcement of laws relating to key risk factors is considered poor in most countries; sufficient resources are required for enforcement of road safety laws to obtain their full benefit. Social

marketing campaigns can play big role in increasing public understanding of and support for legislative measures.

- More priority towards the needs of pedestrians, cyclists, and motorcyclists is required for reducing road traffic deaths.

These include setting up of guidelines for pedestrians, cyclists, and motorcyclists to make road infrastructure safer for them, intensifying work to improve the proportion of vehicle fleets that meet international crash testing standards, and improving post-crash care.

Criteria for Assessing and Preventing Road Traffic Injuries

Haddon's Matrix is an analytical tool that combines the epidemiological triad (host, agent and environmental factors) and levels of prevention set against the time sequence of an incident that helps in identifying all factors associated with crash. ^[13, 14] It gives insight about planning for injury interventions and prevention strategies (step 3) by phases in time of the event. William Haddon explained multidisciplinary nature of interventions that address at multiple levels, i.e. involves more than one "event," and/or different boxes of the Haddon's matrix are most effective for injury prevention.

Haddon Matrix is used by filling in the 12 empty boxes, where the two elements intersect with a risk factor or potential intervention strategy. Then we can observe that there are multiple points one could intervene in preventing (pre-event) or reducing (event or post) injuries from an injury event (motor vehicle crash, drowning, fall, etc.).

Components of Haddon Matrix:

1. Host or Human Factors;
2. Agent or Vehicles (such as crashworthiness of a vehicle) & equipment factor
3. Environment e.g. Physical (such as Roadway design or safety features)
4. Environment e.g. Social (such as passage and enforcement of seat belt laws)

Combine with time sequence (phases) of an incident

1. Pre-Event: What factors affect the host before the event occurs?
2. Event: What are factors related to the crash phase?
3. Post-Event: What are factors related to the Post-Event Crash Phase?

| | Host or human (Person Affected) factors | Agent or Vehicle factors | Physical environmental factors | Social environmental factors |
|--|---|---|--|--|
| Pre-crash event (Primary Prevention) | Driving skill: Time pressures (in a rush to get home?): inebriated | Car design & handling: Anti-lock brakes, etc: Maintenance of car | Road design: speed limits | Reliance on private, rather than public transportation raises traffic load: compliance with seatbelt laws |
| During the crash/event (Secondary Prevention) | Wearing seatbelt? | Air bags working? Size of car & crash resistance | Whether conditions; ice on road? | Quality of emergency assistance; Assistance from bystanders |
| Post-crash/event (Tertiary Prevention) | Ability to call for help (phone available?); Knows first aid? | Tendency of car to catch on fire | Emergency vehicle access to collision site | Continued funding for emergency services |

Case scenario - motor vehicle injury where intervention could decrease the problem

1. Pre-crash Event (before the crash took place)
 - Host.... Driver's experience/ training and information
 - Agent.... Speed of vehicle, roadworthiness, and/or lighting
2. During Crash /Event (during the crash)
 - Host... Seat belt use
 - Agent... Safety rating of vehicle
3. Post-crash Event (after the crash)
 - Host..... General health status of victim
 - Environment... Access to trauma care /rescue facilities, congestion

Steps in using the Haddon Matrix

Step 1 : Use community data to determine injury problem that requires an intervention.

Step 2 : Brainstorm potential ideas for interventions and fill them into the cells of Haddon's Matrix.

Step 3 : Make decisions about best intervention options based upon effective strategies and practical to implement in your local situation.

Road Safety

Road safety is a multi-sectoral, multi-dimensional subject and also an issue of national concern. It includes orderly development and management of roads, provision of safer vehicles, legislation and law enforcement, mobility planning, timely provision of health and hospital services, child safety measures, adequate urban land use planning and a comprehensive response to accidents. It depends on improved traffic management systems and practices, adequate safety standards in design, construction, operation and maintenance of roads and production and maintenance of safer vehicles. Owing to unsafe conditions on roads, the rate of accidents in India has been high. Road safety is a shared, multi-sectoral, responsibility of the government and a range of civil society stakeholders. The overall success of road safety strategies globally depends upon a wide support, cooperation and joint action from policy

makers. Thus, its ambit spans engineering aspects of both, roads and vehicles on one hand and the provision of health and medical services for trauma cases (in post-crash scenario) on the other.

Other measures used

Abbreviated Injury Scale (AIS)^[15] – most commonly used for injury severity classification. Its central focus is to measure threat to life. It lacks focus on loss of functional health status that result from non-fatal injuries.

Segui-Gomez and MacKenzie^[16] – focuses on measuring the long-term health impairments due to non-fatal injuries

Disability adjusted life years (DALY)^[17] - developed as part of GBD project, is a time based measure that combines years of life lost due to premature deaths and years of life lost due to life in less than ideal health states. It allows comparing health burden of injuries with that of other diseases.

Worldwide Response

WHO response: Commemorating the Decade of Action for Road Safety across the globe.

In 2010, United Nations General Assembly resolution proclaimed a 'Decade of Action for Road Safety' (2011–2020). The decade was initiated in May 2011 in more than 110 countries, with the aim of saving millions of lives by improving the safety of roads and vehicles; enhancing the behaviour of road users; and improving emergency services.

Adopted Sustainable Development's agenda for 2030 has set an ambitious road safety target of reducing the global number of deaths and injuries from road traffic collision to half by 2020.^[7]

India is one of the signatory amongst ten countries included in the Road safety in 10 countries (RS10) project funded by grant from Bloomberg Philanthropies Global Road Safety programme (2010-2014). National stakeholders implement it with technical support by a consortium of international road safety partners. The partners in India are WHO, the International Injury Research Center from Johns Hopkins University (JHU) and the Global Road Safety Partnership (GRSP). EMBARQ

(The World Resource Center) and the World Bank are also funded through the same grant mechanism to focus on infrastructural issues. The goal of RS10 India is to support the Indian policy makers to implement good practices in road safety in accordance with the national road safety strategy. The focus of the project is to adopt safer practices like helmet wearing, avoiding speeding and drink driving in implementation sites. In addition, the project will provide support to improve trauma care for victims of road traffic injuries.^[18]

Another initiative by WHO is, organized international consultation meeting in 2002 to develop global curriculum for injury prevention and control. The curriculum, known as TEACH-VIP (Training, Educating and Advancing Collaboration in Health on Violence and Injury Prevention), was launched in 2005 and modified in 2007 as TEACH-VIP2.^[19]

Indian Response

Government of India's major concern is growing number of road accidents, injuries and fatalities. Government has taken several initiatives for road safety like raising awareness, campaign about road safety, establishing road safety information database, ensuring safer road infrastructure, ensuring construction of safer vehicles, strengthening system for proper licensing and training of drivers to improve their capability and competence, enactment and enforcement of safety laws, easy access to emergency medical services for road side accidents, promotion of research for road safety, provision of road safety equipment's like interceptors for detection of violation of rules by the road users such as over speeding, drunken driving etc. Government is promoting anti-locking brake system (ABS) for large no of vehicles.^[12]

Existing Institutional Set Up for Road Safety in India

Road safety in the country is managed by the Central Government and the State levels supported by efforts of academia and the private sector including industry and Non-Governmental Organizations (NGOs).^[20]

- Ministry of Shipping, Road Transport and Highways in the GoI (Government of India) is the

administrative ministry responsible for road safety efforts in the country.

- National Road Safety Council (NRSC), it includes the Ministers in-charge of Transport in the State Governments i.e. State Road Safety Council (SRSC).
- The Transport Development Council (TDC) for the formulation of common policies for the development of road transport.
- The Transport Division of the Department of Road Transport and Highways deals with matters relating to safe movement of vehicles on roads and safety awareness among users.
- National Highway Accident relief service scheme (NHARSS) provides cranes and ambulance to states, UT and NGOs for providing relief and rescue measures.

Other organizations :

The other organizations working in the area of road safety are:

- (i) Indian Roads Congress (for laying down standards and guidelines for road and bridge engineering including road safety).
- (ii) Central Road Research Institute, New Delhi (a Laboratory of the Council of Scientific and Industrial Research (CSIR) that carries out research and development in the field of road, road safety and transportation).
- (iii) Automotive testing and research institutions – Central Institute of Road Transport (CIRT), Pune, Automotive Research Association of India (ARAI), Pune, Vehicle Research and Development Establishment (VRDE), Ahmednagar.
- (iv) Universities and academic institutions like Indian Institute of Technology (IIT), National Institute of Technology (NIT), School of Planning and Architecture (SPA), National Institute of Mental Health and Neuro-Sciences (NIMHANS) etc.
- (v) Other NGOs like Institute of Road Traffic Education (IRTE).

Border Roads Organization is involved in the construction of strategically located roads in border areas.

The National Institute for Training of Highway Engineers (NITHE) was established in 1983 under the Ministry of Shipping, Road Transport and Highways, and it organizes in service training programmes for highway engineers of Central/State Governments, consultants and contractors on all areas relating to roads and road transport, including road safety.

There is a gap of specialists in agencies to tackle the issues of road safety. Research issues are not being identified keeping in view the conditions in India and research is not also being funded adequately. Furthermore, crash investigations are not carried out using modern technology and a scientific approach. The data on road accidents, injuries and mortality is both inadequate and scattered. The data is also not analyzed systematically to provide a basis for policy.

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