# Road Safety in India: A Framework for Action

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(opinions expressed in this report are those of the author alone)

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"In 2010, an estimated 1,60,000 persons died due to road crashes in India. Millions were hospitalized and thousands ended up with disabilities. For many of the affected families, loss of a bread earner or a source of support is irreparable. The country also lost huge economic resources due to untimely death of people, damage to property and lost productivity. The psychosocial suffering of people is a mute witness to the impact.

Road deaths and injuries in India are publicly glaring, while road safety is professionally lacking and politically missing. We need to make efforts to change this scenario. Global experience reveals that road crashes are predictable and preventable. Implementing road safety in India needs a change in 'mindset' by moving from 'reactive approaches' to proactive approaches'. It requires developing safe roads, safe vehicles and making people safe in transport environments. It requires developing and implementing strong mechanisms for prevention, trauma care and rehabilitation through institutional approaches. It is time to change."

## 1. Introduction

The health problems confronting Indian society have been changing significantly since economic liberalization and consequent globalization. The epidemiological transition, demographic changes and societal transformation have led to an increase in motorisation during the last two decades. The rapid urbanization, industrialization and migration along with other social changes have resulted in increasing necessity for travel across all age groups in the entire country. With poor public transportation systems and inability of people to afford cars, the personal modes of transport have increased across Indian cities and in rural areas. This increasing reliance on motor vehicles and motorcycles have also started influencing health of people in a significant way.

Transport and mobility are the neural links for growth and productivity. Transportation of people and goods are essential for business, social and leisure time activities. Greater connectivity between places promotes access for health care, education, business and other economic activities. At the same time, this change through unscientific policies is also contributing towards an increase in Non Communicable Diseases (NCDs) and IInjuries. As per recent information, NCDs and injuries account for more than 3/4th of deaths and disabilities in India (Patel et al, 2011). Transportation and it's environment policies are contributing directly and indirectly to the growing number of NCD related deaths and injuries. Greater reliance on motorized travel has reduced walking and cycling, thereby contributing for greater occurrence of obesity and related NCDs. Increasing air pollution has resulted in higher numbers of respiratory diseases and, noise pollution is resulting in more numbers of auditory problems. The larger effects of motorisation are also linked to major environmental changes. The greater stress of driving, especially in urban areas, results in high numbers of stress related disorders like hypertension, diabetes, anxiety, depression and other health conditions. Most importantly, transport patterns are also largely responsible for wide ranging adverse human behaviours that have an impact on family life too.

The heterogeneous traffic environment of India poses unique challenges for both mobility and safety. Amidst poor infrastructural facilities, motor vehicles are in conflict with people and other vehicles on roads. On Indian roads, nearly 30 – 40 types of vehicles of different sizes, shapes and speeds compete for available space and are in a rush to reach their destination. The travel patterns of people also vary in different parts of country, with motorcycles becoming a family vehicle and transporting more than 2 persons at times. The topography and climatic conditions vary across the country and we have roads of different types, width, conditions and characteristics that influence travel patterns of people. The road use patterns are influenced by a variety of social, economic, cultural attitudes and practices. The road user behaviour is always a product of number of factors like age, gender, socioeconomic status, education, occupation, travel needs and others, apart from his/her knowledge, attitudes, beliefs and practices. It is also in large part influenced by the prevailing systems, safety regulations, norms and accompanying requirements along with importance given for safety, and thereby to people's lives. The absence of scientific transport, environmental and safety policies have contributed much over time.

In this conflicting and rather chaotic scenario, the ultimate victims are the general public. Road crashes, deaths and injuries have become an important and leading cause of deaths, hospitalisations, disabilities and socioeconomic losses in India. The death and hospitalisation of a person, whether husband-wife-child-parent, relative, friend or anyone leaves behind a huge suffering for the family. The psychosocial impact after crashes is also a cause for many behavioural and emotional problems and a precursor to some of the NCDs.

## 2. Purpose

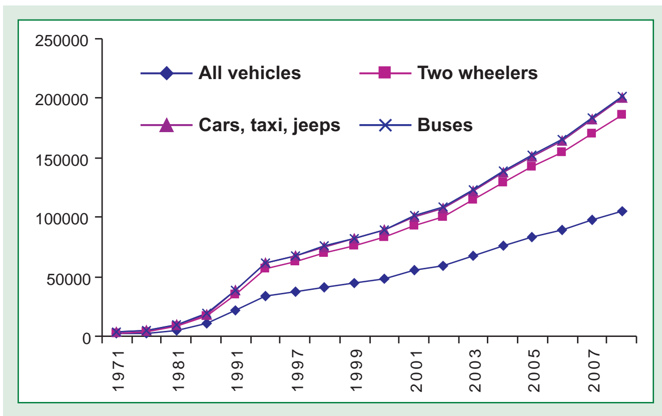
The purpose of the present report is to examine the burden and impact of Road Traffic Injuries (RTIs) on the Indian society, discuss available methodologies to understand road crashes and to develop a framework for implementing road safety in the country. It is hoped that this framework will help policy makers to develop strategies and mechanisms for strengthening and improving road safety in India. The goal is to see a real reduction in crashes and deaths over the next 10 years as measured through scientific methods.

## 3. Changing factors

### 3.1 Motorisation patterns

The economic liberalization of the early 1990's brought in motorisation and industrialisation with an accompanying need for travel. The registered number of vehicles might be at variance with official figures as some of the unused vehicles and those that are not on roads have not been excluded in official statistics(CRRI, 2007). The motorisation pattern across different states vary considerably. The vehicle density on Indian roads has been increasing significantly. The total number of vehicles

**Figure 1: Motor Vehicle growth in India**

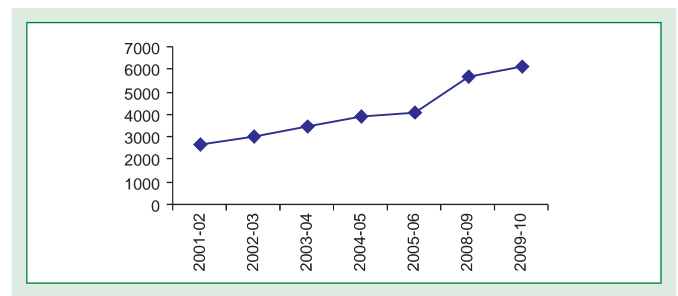



increased from 37 million in 1997 to 89 million by 2009. The annual average growth rate is about 10% each for cars and two wheelers in the country (MORTH, 2008). It is essential to note that the number of two wheelers increased from 25 million in to 64 million by 2006 (MORTH, 2008) (Figure 1). In Bangalore, during 2001 – 10, nearly 15,59,365 two wheelers were added, while public transport buses increased by only 3435 in the same period (Transport department, Government of Karnataka) (Figure 2 & 3). This significant increase in two wheelers across the country is due to a combination of factors like increasing necessity for travel, easy availability, increasing purchasing power, poor public transportation systems and inability to afford cars. Travel by a two wheeler and walking and cycling are still essential modes of travel allover India, even today.

## 3.2. Infrastructure expansion

The available infrastructure to accommodate the growing number of vehicles has been far from satisfactory (Figure 4). The roads in India broadly fall into city roads, rural roads and national/state highways. Each of these are managed separately by independent authorities like local corporations/municipalities, district public works departments and by highway authorities at state and

**Figure 3: Growth of public transport buses in Bangalore**




national levels. In recent years, attempts are being made to improve the infrastructure in cities and on high ways. Some of the major cities have also introduced metro systems recently, even though the oldest metro was started in Kolkata about 30 years back.

The total road length in India is approximately 3.3 million kilometers as on 2008 (MORTH, 2008). The network of national high ways has increased by 18538 kms during the last 10 years. The national highways with a total network of 70,548 kms is only 2% of total road network, but contributes to nearly 40% of transport of goods and traffic (MORTH, 2008). It is most essential to note that large parts of Indian highways pass through thousands of villages that are ill prepared and equipped to handle heavy speeding vehicles. Only recently, bypass roads have begun coming up near major towns on highways. It is well acknowledged that the safety performance of Indian roads has been poor as seen by an increase in road deaths and injuries.

## 3.3. Population growth

The latest information on Indian population and its characteristics is expected by May after completion of the analysis of 2011 census. The country's population increased from 846 miliion to 1167 million inthe last two decades (1990-2010) (http://pib.nic.in/newsite/erelease.aspx?relid=67672) and is spread over 28 states and 7 union territories (Figure 4). Sex ratio is 933 females per 1000

**Figure 2: Vehicular growth in Bangalore**

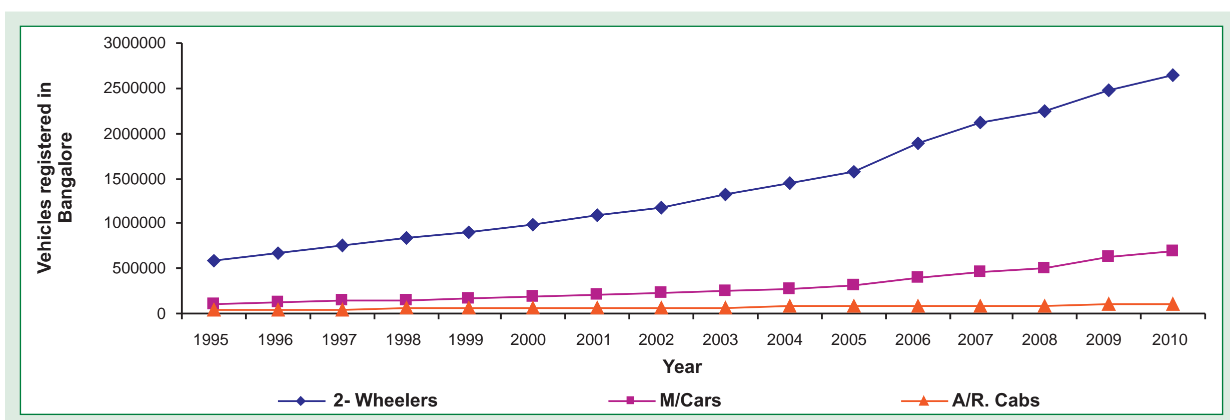
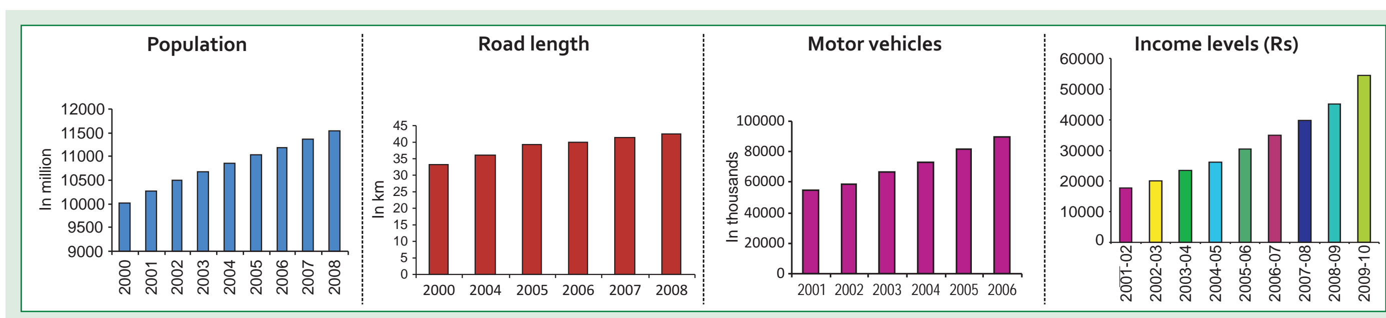


**Figure 4: Changing patterns of population, infrastructure, motor vehicles and income levels in India**




males with minor variations across Indian states. Nearly half of India's population are in the age group of 15-59 years, with children and elderly constituting 42% and 7%, respectively. This huge segment of young and adult population is the national strength as it contributes to an economically productive work force. As per national average, 64% are literate; nearly 70% live in rural India, with a per capita income of 46,492 in 2009 - 10 (*pib.nic.in/archieve/others/2010/feb/r2010020801.pdf*). Despite the impressive economic growth, one third of country's population live below poverty line. In a city like Bangalore, 40% of the population live in disadvantaged and economically deprived settings. In such a scenario, at the population level, 6 out of 1000 individuals own a motor vehicle(www.censusindia.gov.in).

## 3.4. Urbanization

In 2011, nearly 30% of India's population lived in urban areas. This is likely to reach 473 million in 2021 and 820 million by 2051. This shift is also likely to be accompanied with huge increase in the number of motor vehicles, along with limitations on road space that can be provided. The need for easy and sustainable flow of goods and vehicles will be felt more than ever in the coming days. If societal inequalities are not addressed in the coming years, it is likely to have a huge impact on the quality of life, including transport patterns in the society.

## 3.5. Travel and transport patterns

The 1.2 billion population of India is spread over 28 states, 7 union territories, 600 districts and 6,38, 365 villages in a total land area of 3.3 million sq.kms (http://india.gov.in/knowindia/india_at_a_glance.php). The mobility patterns of Indians vary considerably between states; urban to rural areas; residential to business areas; and from plain to hilly areas. It is influenced by number of factors varying from the need for travel to availability of transport modes. Despite this huge variation, walking and cycling remain the dominant mode in both urban and rural areas. It is common to see children commuting long distances by bus and on bicycle in rural areas. Similarly, commuting longer distances is becoming extremely common in urban areas. Travel by two wheelers is phenomenal in urban areas and towns; people in interior rural areas resort to walking and cycling; tempos, cabs and minivans bridge the gap between cities and districts. Transport of goods is primarily through trucks and buses and, these vehicles travel long distances across the length and breadth of the country..

Studies on travel patterns across the country are few and sparse and serve as some examples. A high proportion of travel in India is by walking, cycling or on two wheelers, as still majority cannot afford cars. Nearly 30% of total vehicles ply in Indian cities catering to 11% of Indian population. Personal vehicles were > 90% of total vehicles

in 6 out of 13 sample cities studied, while public transport was <1% of total traffic at peak hours (Mohan D, 2004). In Chennai, walking and travel by bus accounted for 44% and 40% of total trips. Further break up reveals that 30% resort to walking and travel by other modes of transport, with cars and two wheelers accounting for 4% and 14%, respectively (World Bank, 2005). The urban transport study at Bangalore showed that the average pedestrian journey lasted 15 – 45 minutes on the road. In the study, pedestrians, two wheeler riders and cyclists accounted for 80% of total traffic on roads (BATF, 2005). The health determinant study showed that people residing in socially disadvantaged communities covered their daily journey by walking (40%) or by bus (50%) with 10% traveling on bicycles (Gururaj G, 2006a). In Delhi, the proportion of trips undertaken on bicycles range between 15 – 35% during peak hours (Mohan D, 2004).

## 4. The public health burden of RTIs

Globally, RTIs contribute for over 1.2 million deaths and more than 50 million hospitalisations (WHO, 2004). The morbidity as measured by DALYs is estimated to be 38 million for the year 2004. The World Report on Road Traffic Injury Prevention indicate that more than ¾ of these deaths occur in Low and Middle Income countries due to rapid motorisation and absence of road safety policies and programs. RTI deaths in every country are only the tip of the iceberg. For every death, several more are hospitalized and hundreds seek emergency care. The hospitalisations, disabilities, psycho socio impact and economical losses are huge and phenomenal in every country. WHO predicts that RTIs will move from 9th position to 5th position by 2030 (Table 1). The economic losses are estimated to be $ 518 billion per annum and $ 65 billion in low and middle income countries.

### 4.1. RTI deaths

RTIs increased by 61% during the decade and 1.4% in 2009 compared to the previous year. The trend of fatal RTIs in India as per NCRB indicate that RTIs increased from 43,005 in 1990 to 1,26,896 by 2009 (figure 5a & 5b). Between 1970 and 2008, the number of accidents increased by 4 times, with more than 7 fold increase in injuries, 8 fold increase in fatalities against the backdrop of about 64 fold increase in vehicles and 3 fold increase in road length (MORTH, 2008) (Table 2). According to National Crime Records Bureau, 1,52,689 persons died due to road transport accidents in India in 2009 (NCRB, 2009). Among them, 1,26,896 persons died due to road accidents and 1516 persons due to rail road accidents. RTIs accounted for 36% of total accidental deaths in India in 2009. In the same year, 4,70, 941 persons were injured in transport accidents. The RTI mortality rate in India for 2009 was 110 / million population per year. The Million Deaths Study from India reported the RTI mortality rate to be 90/million population per year (RGI, 2009).

Table 1: Leading causes of death, 2004 and 2030

| Rank | Total 2004 | Rank | 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 disease | 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 neophrosis |
| 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 | Oesuphagus cancer |
| 16 | Suicide | 16 | Homicide |
| 17 | Stomach cancer | 17 | Alzeimer and other demantias |
| 18 | Cirrhosis of the liver | 18 | Cirrhosis of the liver |
| 19 | Nephritis and neophrosis | 19 | Breast cancer |
| 20 | Colon and rectum cancers | 20 | Tuberculosis |
| 21 | Homicide | | |

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

**Table 2 : Growth in select accident related parameters: Compounded annual growth rate (CAGR) in per cent**

| Period | Total number | | | | In kilometer |
|---|---|---|---|---|---|
| | Accidents | Injuries | Fatalities | Registered vehicle | Road length |
| 1980/1970 | 3.0 | 4.5 | 5.2 | 12.4 | 2.3 |
| 1990/1980 | 6.3 | 8.4 | 8.5 | 15.5 | 2.9 |
| 2000/1990 | 3.3 | 5.0 | 3.8 | 9.8 | 5.3 |
| 2008/2000 | 2.7 | 3.4 | 5.4 | 10.6* | 2.2@ |

**Note:** * refers to CAGR period 2006/ 2000; @refers to 2004/2000

**Figure 5a: RTI deaths in India, 1980 - 2009**

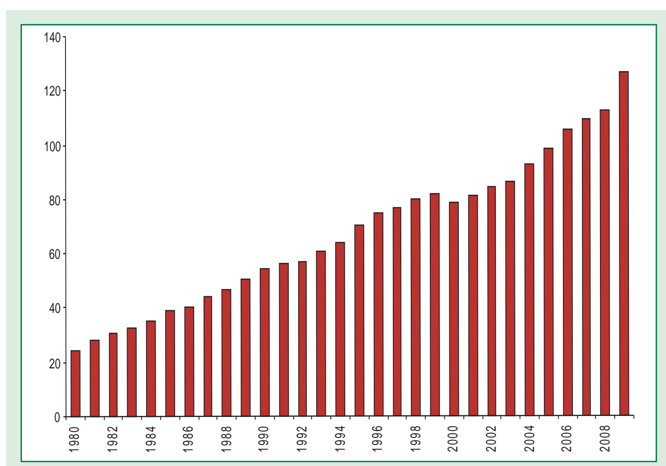
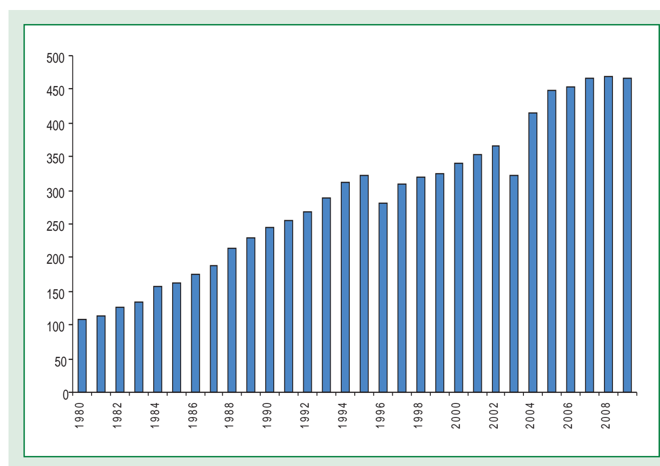



**Figure 5b: RTIs in India, 1980 - 2009**




There has been a gradual increase in RTI deaths and injuries in the last 25 year. RTI deaths increased from 17, 841 in 1980 to 1, 27,000 by 2010. Similarly, the number of non fatal injured persons increased from 1, 09,100 to 46, 66,649 in the same period (NCRB, 1980 & 2009). The actual number of road deaths in India could be much higher due to underreporting. In the area of road safety, it is well acknowledged all over the world that road deaths and injuries are underreported due to a number of reasons. India is no exception to this observation (Panel 1). Three of the studies conducted in India (Bangalore, Hyderabad and in villages of Haryana) have confirmed this observation.

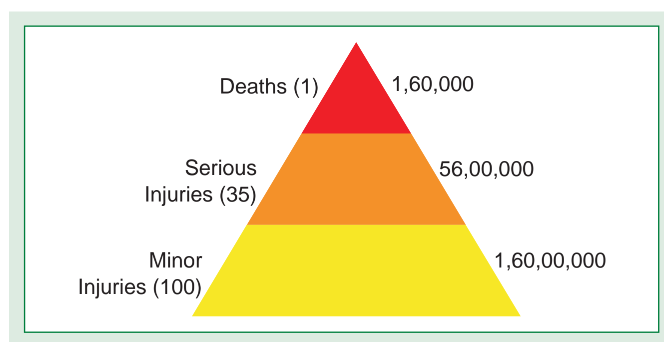
**Panel 1: Causes of Underreporting of Road traffic deaths and injuries**

- Absence of formal reporting agreements and sharing of information between police, hospitals and other agencies.
- Some type of injuries like collisions with fixed and stationary objects, skid and fall, collision between smaller vehicles are not reported to police.
- Agreement between individuals involved in a crash is often found to be a suitable method between the parties, as involving police would lead to additional costs.
- Not all RTIs are reported to police uniformly in all parts of the country.
- Individuals do not feel the need to report to police unless the injury is serious, results in legal proceedings and influence compensation process.
- Even when injured persons go to police, they are not officially registered due to paucity of time or the busy schedule of activities in police stations.
- Individuals provided care by general practitioners; nursing homes and smaller health care institutions are not reported to police to avoid police harassment and legal complications.
- Late hospital deaths due to various complications of road traffic injuries are not recorded as deaths due to traffic injuries, but given other causes. Death certificates are not filled in a systematic and standardized manner in hospitals across the country.
- The immediate procedures of burial or cremation based on local social cultural practices discourage families to get involved with police as this can delay the rituals.
- Limited manpower and facilities among police often make reporting very difficult.
- As there is no reporting practice on all deaths and injuries to any single agency from all health care institutions, information is not totally available within the health sector.

**Source:** Gururaj G, 2006b, Report on Road traffic injury prevention in India.

The study in Bangalore reported that road deaths and injuries are underreported by 5-10% and more than 50%, respectively (Gururaj et al, 2000). A population survey covering 20,000 households and 96,000 individuals from urban and rural Bangalore reported an annual RTI mortality rate of 240/million population, much higher than the figures reported by police statistics (Gururaj and Suryanarayana, 2004). Dandona et al (2008) from Hyderbad city, reported RTIs related mortality rates of 38 / 1,00,000 (95% CI: 17.5-58.8) and observed that RTIs were three times more than the officially reported figures. Varghese and Mohan (2003) reported the ratio between critical, serious and minor injuries to be 1:29:69. Three of the recently completed verbal autopsy injury studies have also indicated the under reporting of injuries (Singh RB et al 2005, Gajalakshmi and Peto, 2007 Joshi R et al, 2006 ). In view of these observations, the actual number of RTI deaths are estimated to be in the range of 1,60,000-1,75,000 (Figure 6).

**Figure 6: India RTI pyramid, 2010**




## 4.2. Non-fatal RTIs

Hospital based studies indicate the huge burden of RTIs and enormous resources spent on care and rehabilitation. The 2010 report of Bangalore Road safety and Injury prevention program showed that 5667 nonfatal injuries were reported to police, while 26,862 persons were registered in just 25 hospitals of the city (Gururaj et al, 2011). Data from 3 years of Bangalore Road Safety and Injury Prevention program has revealed that the ratio of deaths to hospitalisations to minor injuries is 1:35:100 (Gururaj et al, 2008 and 2010). Data from the program showed that injuries accounted for 25% of casualty registrations, 10% of admissions and 20% of deaths. RTIs, in particular, contributed for 8.3% of casualty registrations, 3.5% of admissions and 7.5% of deaths. Few of the other studies have shown that RTIs account for nearly ¼$^{th}$ of Emergency Room (ER) registration. Studies that have focused on brain injuries show that nearly 50 – 60% of RTIs are hospitalized due to injury to brain and spinal cord (Bharti et al, 1993; Gururaj et al, 2005) Dandona et al, (2008) in a study of 10,459 persons belonging to 15-49 years in Hyderabad, estimated the incidence of RTIs to be 207 / 1,000 / year. Sathyasekaran (1996) estimated the incidence to be 160 / 1,000 / year in a survey of 4,333 individuals. In a sample of 30,554 subjects in Delhi, Verma and Tiwari reported (2004) noticed that 31% of injuries were due to RTIs.The numbers of hospitalized could vary between 35 – 40 million and difficult to estimate due to absence of reliable hospital based studies. Numbers of those with minor injuries could be in the range of 15-20 million, many of whom may not reach hospitals.

## 4.3. Impact of RTIs

Disabilities due to RTIs result in poor quality of life and limitations in activities of daily living. With decline of communicable diseases, it is estimated that disabilities due to RTIs and other injuries will increase in the coming years. Available data indicate that nearly 1/3 of disabilities are due to injuries in India and 25 – 30% of these are due to RTIs (Gururaj G, 2005a and 2006b). Two of the studies from Bangalore on Traumatic Brain Injuries have shown that 18% of hospital discharged brain injured persons had different types of disabilities affecting information processing, speech, memory, walking, food intake and other spheres of life at the end of 2 years (Gururaj G et al, 1993 and 2005). Disability rate due to RTI was found to be 35 / 1,00,000 in a study of 10,459 persons in Hyderabad (Dandona et al 2008).

The socioeconomic impact of RTIs is huge and unmeasured. Mohan D, estimated that India loses approximately Rs.55,000 crores every year due to RTIs (Mohan D, 2004). The recent estimates from Ministry of Transport put the estimates at 3% of GDP per year (MORTH, 2008 and Tenth Five year plan Vol II, pg 963). Bhattacharya et al (2007) estimated the cost of a fatal injury to be Rs.1.3 million based on willingness to pay approach. Studies undertaken on ER patients in Bangalore and Delhi show huge costs for managing patients, varying from 1062/ bed/ day to 2152/ day in Delhi and Bangalore (Singh et al, 2006; Gururaj et al, 2005) respectively.

Median expenditure of hospital stay for injury patients admitted to a private medical college hospital in Bangalore was INR 40,000. The study further showed that 68% of inpatients spent Rs.25, 00 – 1,00,000 and 30% between 5,000 – 25,000 and 2% spending upto Rs.2,50,000. (Pallavi, 2010). Reddy et al (2009) from Chandigarh studied economic costs from a sample of 121 crash cases in 2004. Total expenditure incurred was Rs.8,55,644 ($20,000) with medical and non medical costs being 44% and 54% of direct costs. The overall losses to the society was estimated to be Rs.8,06,24,530 (80 million). The smaller size of the study sample precludes its larger extrapolations.

What is difficult to measure is the social, psychological and emotional impact of RTIs. Apart from economic losses,

**Table 2: Associated costs of serious road traffic injuries in Bangalore(Rs) (US $ 1=Rs 47)**

| | Urban | | | Rural | | |
|---|---|---|---|---|---|---|
| | Poor | Non-poor | Sig | Poor | Non-poor | Sig |
| Direct costs | | | | | | |
| Medical costs | 13,760 | 29,012 | – | 7,325 | 15,447 | – |
| Std deviation | 25,380 | 60,291 | 90% sig | 6,620 | 24,268 | Non- sig |
| Damage costs | 11,450 | 6,328 | – | 4,775 | 6,933 | – |
| Std deviation | 26,041 | 15,814 | Non- sig | 10,552 | 17,482 | Non- sig |
| Indirect costs | | | | | | |
| Recovery (no. days) | 87 | 68 | Non- sig | 58 | 60 | Non- sig |
| School missed for under 16 (no. days) | 103 | 47 | Non- sig | n/a | 19 | Non- sig |
| Work days missed (no.days) | 99 | 93 | Non- sig | 93 | 73 | Non- sig |
| Able to return to job | 71% | 84% | Non- sig | 54% | 67% | Non- sig |

families of the deceased and survivors of crashes go through enormous pain and suffering, which are difficult to measure. Children dropout of school, workers miss or loose their job and families have to cancel or postpone social activities like marriage or travel due to RTIs. A study on brain injuries in Bangalore revealed that 14% of children and 18% of workers could not attend school for more than 6 months (Gururaj G et al, 1993). Data from a TBI registry reveal that 10-15% of children missed school and about 1/3rd and 2/3rd of brain injured persons missed work (Gururaj et al, 2005). A population based survey of RTIs showed that on an average, the recovery period from serious injuries was 50-90 days. Children missed school for 20 – 105 days in rural and urban areas, while employed persons lost work for nearly 3 months. Nearly 1/3rd of rural and 20% of urban could not return to their previous jobs as shown in Table 2 (Thomas et al, 2004). Further more, 50% families had to make loans, sell assets or pawn their belongings to meet the crisis.

## 4.4. Inter state comparisons

The number of deaths varies between and within states; across districts and cities in India. States of India and region/areas within states that are motorizing rapidly and with reasonably good economic growth are registering an increase in road deaths. This is obviously due to lack of safety policies and programs that should have accompanied growth and motorisation. Almost all Indian states have registered an increase in road deaths over time particularly during 2000 – 2009 (Figure 7a and b). Further, in 2009, the southern states of India have seen a significant increase (Figure 8a). These are also the states and cities that have picked up momentum in infrastructural growth. The decline in the absolute number of deaths is some of the major metros are more due to rapid and increasing number of vehicles on roads and limited infrastructural facilities, resultant in congestion.

## 4.5. Urban vis-à-vis Rural areas

In 2009, cities with a population of more than 1 million contributed for 15% of total RTI deaths in the country(NCRB 2009a). Delhi with a rate of 140 per million population was the highest with the lowest rate reported from Kolkata at 35 per million in 2009. The unequal distribution of RTIs are evident from figures 8a,b and c. In recent years, there has been an increase of road deaths in grade B and C cities and in district headquarters due to rapid motorization and absence of safety programs. Even as Karnataka has higher number of deaths, three of the districts (Bangalore, Belgaum and Tumkur) have high crashes and fatalities. Data for the years 2000, 2005 and 2009 for a few of the select cities are shown in Figure 9. At the city level, data from BRSIPP showed that peripheral parts of city with new ring roads had the highest number of deaths (Figure 8c). These findings clearly indicate that as economy grows, motor vehicles will increase with an accompanying rise in road deaths in the absence of safety. Similarly, as new roads come up without safety components, road injuries will increase, thus, indicating the need for road safety.

## 4.6. Indian highways

National highways contribute for 2% of total road net work and carry 40% of total traffic and accounts for 1/3 of total road fatalities. National highways accounted for 29% of total crashes and 36% of persons killed in 2008 (MORTH, 2008). Information from MORTH, 2008 revealed that 32-40% of road deaths occured on national highways (Figure 10 & 11). Similarly, state highways contributed for 26% of the total crashes and 28 % of persons killed in the

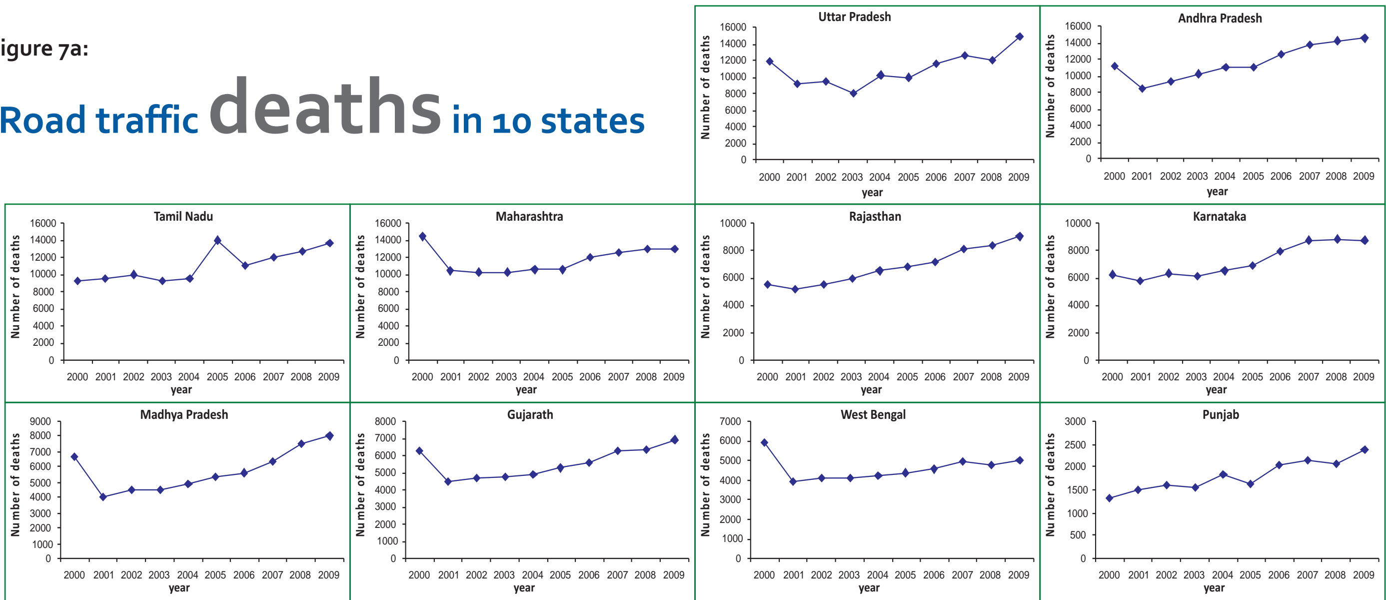


**Figure 8a: State wise distribution of Road deaths in India, 2009**

**Figure 8b: Distribution of road deaths in Karnataka state, 2009**

**Figure 8c: Distribution of road deaths in Bangalore city, 2010**

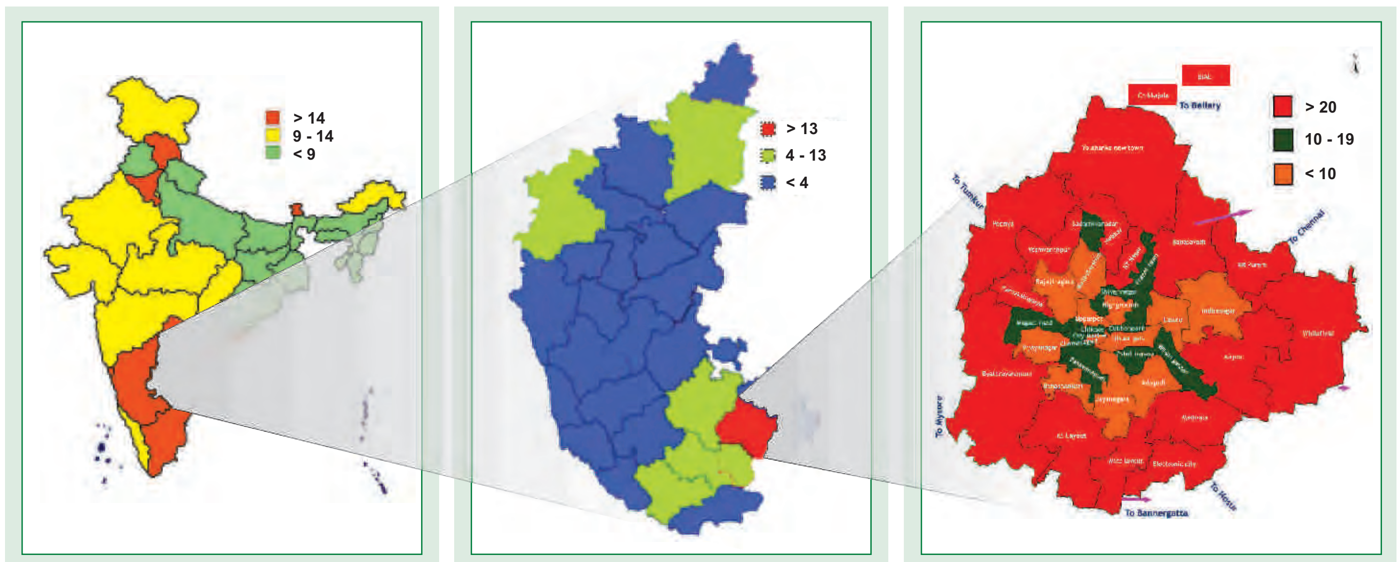


Figure 8b: Road deaths in select major cities of India, 2000 - 2009

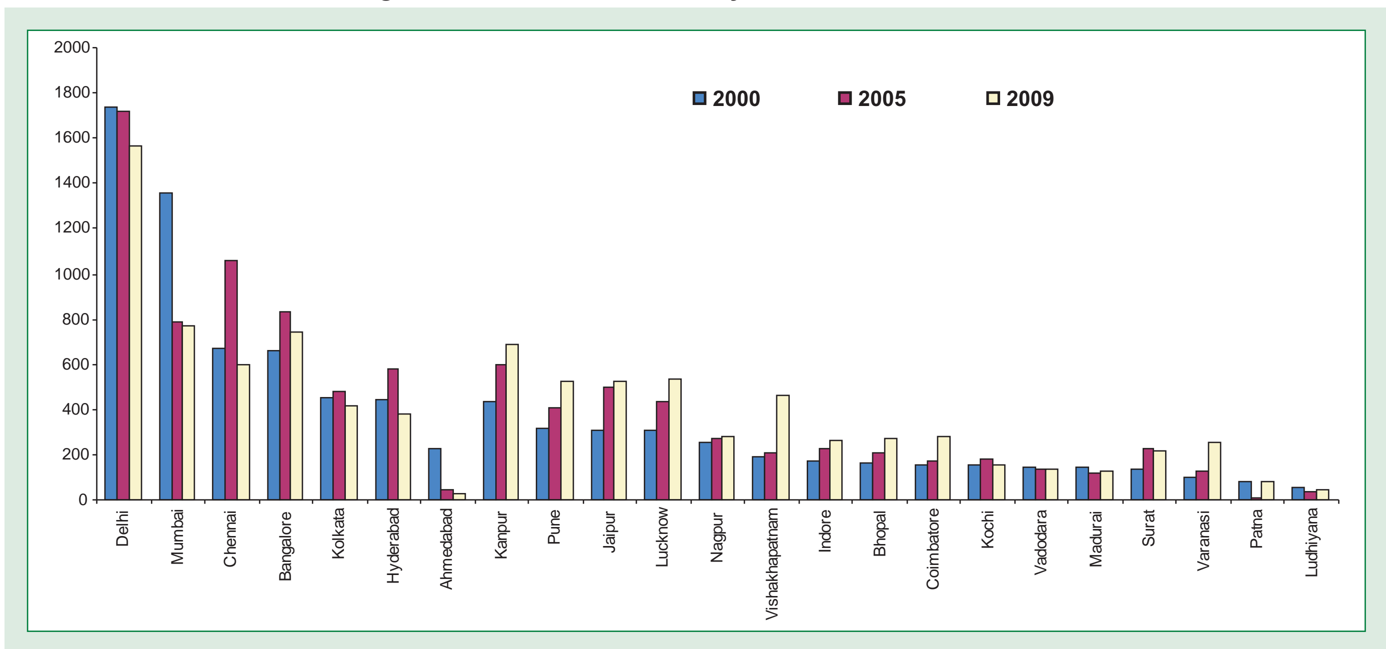



Figure 10: Percent of road deaths on Indian highways

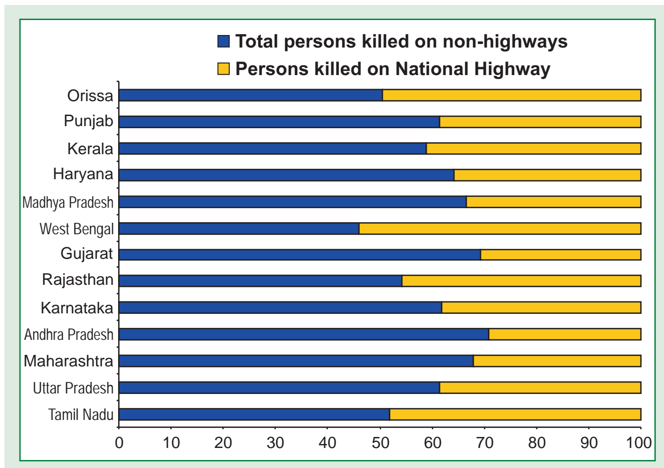
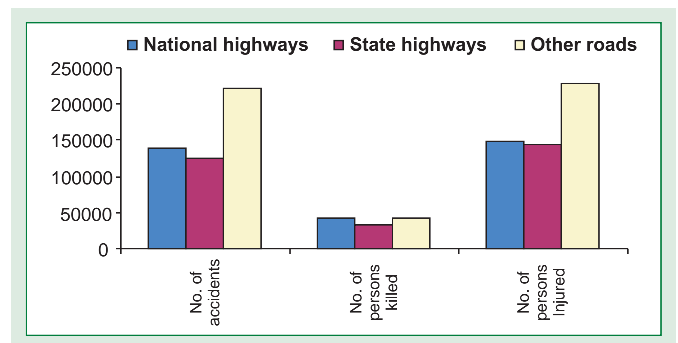



Figure 11: Number of Accidents, persons killed and injured as per road classification (2008)




same year (Table 4). Data from BRSIPP showed that among RTI patients registered in 30 hospitals, 27% were due to crashes on the highways (Gururaj et al, 2010 and 2011). Among RTI deaths, 28% were crashes occurring on highways. The RTI surveillance program from Tumkur near Bangalore district showed that 50% of deaths take place on state highways (Gururaj et al, 2010 and 2011). In India, the national highways are managed by Ministry of Road Transport and Highways, while state highways and other roads are managed by state public works department and the local roads by the local self governments. The nature of vehicles, passing of roads in rural areas, movement of people, presence of traffic generators on the roads and varying speed differentials are some of the factors responsible for high occurrence of crashes on highways.

## 4.7. Age and Gender

All independent studies in India conclusively prove that males out number females in a ratio of 4:1. As per the national statistics, 6% of the fatalities were in children less than 14 years, even though their share in the general population is 40%. The age groups of 15-29 and 30-44 years were 30.1% and 35.2%, respectively (NCRB 2009). Studies from different parts of the country show that age group of 15-44 years contribute for 60- 70% of deaths and injuries respectively. Analysis of death records from the city vital registration division, fatal and non-fatal RTIs under BRSIPP for 2010 shows that traffic crashes are the leading causes of deaths and hospitalizations in 15–44 years (Figure 12 & 13)

## 4.8. Vulnerable road users

The official reports in India do not include fatality by road user categories, as only impacting vehicle is included. Data from few of the studies undertaken in Delhi, Bangalore, Hyderabad, Pune, Pondicherry and other places indicate that pedestrians, two wheeler riders and

**Table 4: Number of Accidents and number of persons killed and injured as per type of roads**

| Year | National highways (% share in) | | | State highways (% share in) | | |
|---|---|---|---|---|---|---|
| | Total number of road accidents | Number of persons killed | Number of persons injured | Total number of road accidents | Number of persons killed | Number of persons injured |
| 2001 | 28.6 | 39.7 | 29.5 | 22.5 | 27.6 | 25.6 |
| 2002 | 32.3 | 39.7 | 32.4 | 23.5 | 27.2 | 25.4 |
| 2003 | 31.4 | 38.6 | 30.1 | 22.4 | 28.2 | 26.7 |
| 2004 | 30.3 | 37.5 | 30.8 | 23.5 | 26.9 | 24.9 |
| 2005 | 29.6 | 37.3 | 31.3 | 23.6 | 27.2 | 25.7 |
| 2006 | 30.4 | 37.7 | 30.8 | 18.5 | 26.8 | 24.9 |
| 2007 | 29.0 | 35.5 | 30.2 | 24.4 | 27.7 | 26.2 |
| 2008 (P) | 28.5 | 35.6 | 28.6 | 25.6 | 28.4 | 27.5 |

(P): Provisional

Source: MORTH, 2008

**Figure 12: Age Sex distribution of Road deaths in Bangalore, 2010**

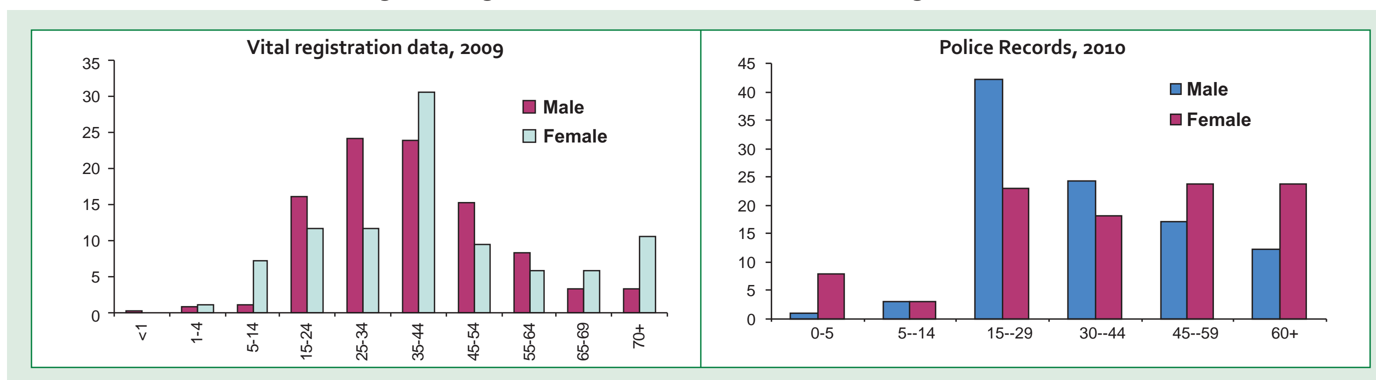



**Figure 13: Age Sex distribution of Non Fatal RTIs, BRSIPP, 2010**

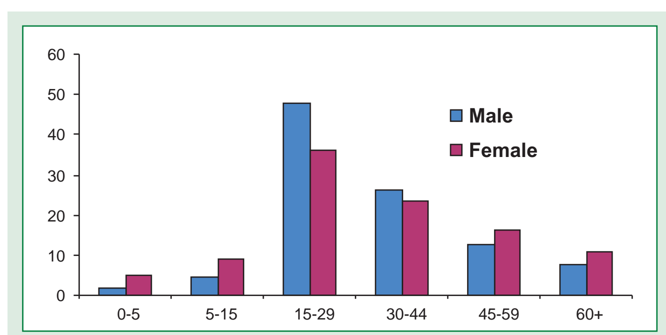
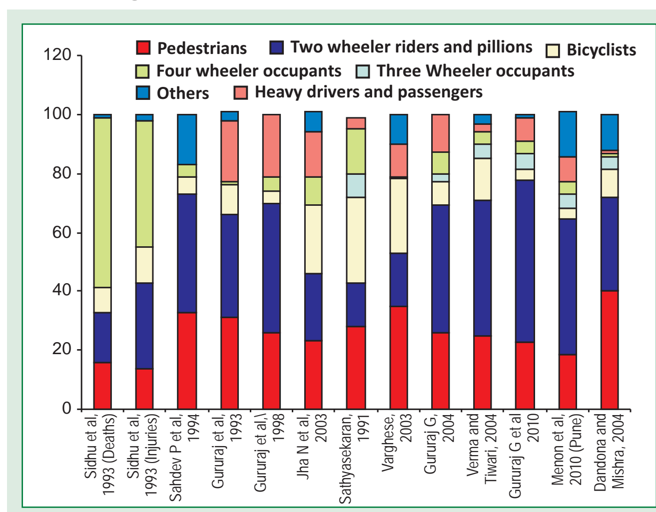



**Figure 14: Burden of RTIs in different studies**




pillions and cyclists(Vulnerable Road Users) constitute more than three-fourth of those killed and injured in India (Figure 14). The vulnerable road users accounted for 84% of deaths in Delhi and for nearly 67% on highways (Mohan D, 2010). Data from the three years of BRSIPP has shown that vulnerable road users were 75-85% as shown in figure 15. Data for the first time from a rural injury surveillance program in Tumkur shows the high involvement of VRUs in rural areas. Unlike the situation in high income countries where motor vehicle occupants are affected more, people outside mot vehicles are involved greater extent in India.

Detailed information on other aspects of RTIs in terms of distribution, causes, risk factors and other aspects are extremely limited in India due to absence of research from health and related fields of engineering, transport and others. However, pooled information from NCRB, research from TRIPP, New Delhi (www.iitd.ac.in/tripp) and NIMHANS, Bangalore (http://www.nimhans.kar.nic.in/

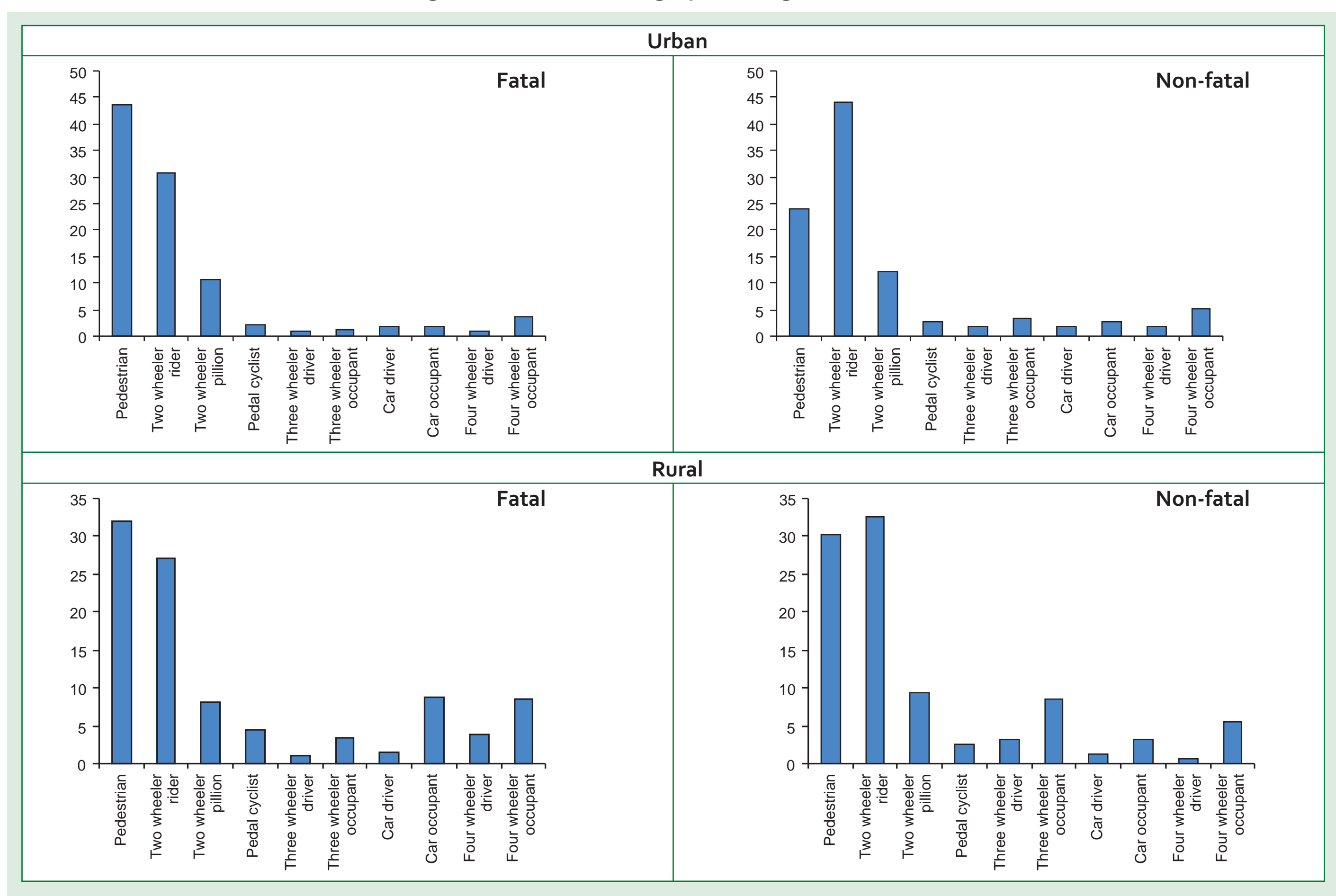



**Figure 15: Road user category involving in road crashes**

epidemiology/ default.htm) alongwith findings from few independent studies provides some insights into these aspects.

### 4.9. Crash patterns

Data from BRSIPP, 2010 revealed that pedestrians were hit by various types of vehicles and majority included crashes with two wheelers. Collission between two wheelers was also common. Collision between heavy vehicles and VRUs result in higher number of deaths and serious injuries. Mohan et al in a review of crash patterns in Delhi, Mumbai and Kolkata observed that pedestrian's, bicycles and motorized two wheelers represented 67 to 86% of total crashes (Mohan D, 2010). The heterogeneous traffic environment, differing speed patterns, non separation of pedestrians and two wheelers from other vehicles contribute for increasing occurrence of fatalities among VRUs.

## 5. Causes of road crashes

Unlike many communicable diseases where the role of agent, host and environment are more defined and risk factors delineated, road crashes are complex events, involving multiple interactions between vehicles, roads and human beings. The complexity of this interaction differs from setting to setting and the probability of a crash is higher in certain situations. Increased risk means the greater probability of an event in the presence of a risk factor or absence of protective factors. Many risk factors have been identified over time that contribute to greater crashes and poor outcomes.

Research in road safety on risk factor analyses in India has been extremely limited. The official reports from NCRB do not provide details of risk factors. The official agencies document only the type of impacting vehicles. The report 'Road accidents in India 2008' by the Transport Research Wing of the Ministry of Road transport and Highways , Government of India shows that "driver fault" is the single most important factor and accounted for 81% of total accidents. Accidents due to a fault of the vehicles was about 2% of total crashes and no environmental factors were cited in the report (MORTH, 2008).

The World Report on Road Traffic Injury Prevention outlines causes of road crashes at 4 levels (Panel 2). These are factors that influence exposure to risk, crash

Panel 2: Understanding risk factors

**Exposure to road traffic**
- Economic Factors - economic development
- Demographic factors - age, gender and migration
- Infrastructure modes - Road design and layout
- Travel modes - how long people travel and by which means
- Mix of vulnerable road users and high speed motorized traffic

**Being involved in a crash**
- Younger age and being male
- Risk taking behaviours – speed, alcohol and drugs
- Failure to consider physiological factors - fatigue
- Neglect of safety practices – helmets, seat belts, child restraints
- Being vulnerable road user in an urban or residential area
- Visibility factors
- Fast moving vehicles
- Poor vehicle maintenance
- Road design, layout and maintenance defects

**Severity of a crash**
- Individual characteristics
- Tolerance of the human body
- Inappropriate and excessive speed
- Non use of seat belts and child restraints by vehicle users
- Non use of crash helmets by two-wheeler riders & pillions
- Unforgiving roadside objects such as concrete pillars
- Insufficient vehicle crash protection such as air bags for occupants and vehicle soft fronts for those who may be struck by vehicles

**Consequences of injuries as a result of crash**
- Trauma care availability and affordability
- Rescue and evacuation
- Lack of appropriate care prior to arriving at a health facility
- Rehabilitation issues

environment, determine severity and those influencing severity of post crash injuries (panel 2).

Several factors like economic development, living standards or social deprivation, demographics, design and development of the transport systems, presence of heterogeneous traffic environments and standards of road development and manufacture of vehicles contribute both directly and indirectly to road crashes. These factors influence the exposure of people to different risk situations. Addressing these risk factors require some basic and fundamental changes in the way transport environments are built.

Factors that influence the crash environment are several and are directly related to crash mechanisms. These include varying speeds and its influencing factors, presence of alcohol and drugs, fatigue and sleeplessness, distracted driving through use of cell phones, visibility issues, road and vehicle related factors.

The impact of crash severity varies between road users and the environment, and is influenced by presence or absence of certain protective mechanisms. Use of helmets, seat belts, and child restraints decrease the severity and impact of crashes. Safer interior and exteriors of motor vehicles and heavy vehicles can reduce crash severity.

In the event of individuals surviving a crash, availability and affordability of appropriate emergency and acute trauma care and good rehabilitation practices can influence post crash injury outcomes. Trauma care is a continuum of activities starting from the crash site till the person is returned to an optimal state of functioning. Several components need to be integrated to deliver efficient trauma care.

An examination of risk as outlined above clearly indicates that there is no one single risk factor that either contributes for crash occurrence or for negative outcomes following a crash. Thus, understanding road safety involves identification of several risk situations and risk factors, developing appropriate general and specific interventions, implementing the same in the given socio political context and evaluating whether it made any change in reducing deaths and injuries. Research over the past few years has clearly identified a few possible interventions that are likely to yield positive results.

Few studies across different parts of India have identified some important risk factors that contribute for an increase of road deaths and serious injuries and these are discussed below.

- **Road designs and standards**

  The precise contribution of different road types and conditions that contribute for road crashes in India is not clearly known. It is generally acknowledged that roads that promote higher speeds contribute for higher deaths. Data from BRSIPP, though not specific, indicate >50% of deaths occurred in areas with new, well developed roads, where speeding and overtaking is extremely common. Road designs and standards should be formulated based on research that involve study of traffic patterns and crash analysis. Mohan D (2004) points out that "standards should be initiated on a demonstrated need based approach with scientific documentation of the problem that needs to be addressed". Further, he adds that, "establishment of future standards will need a great deal of background work, research and

experimentation as many of the safety needs will have to be specially tailored for our needs". Despite recent attempts to improve roads, especially on highways and within cities, crashes have been on the increase. As we continue to make roads that focus on only rapid mobility and relegate safety to the periphery, crashes will rise continuously.

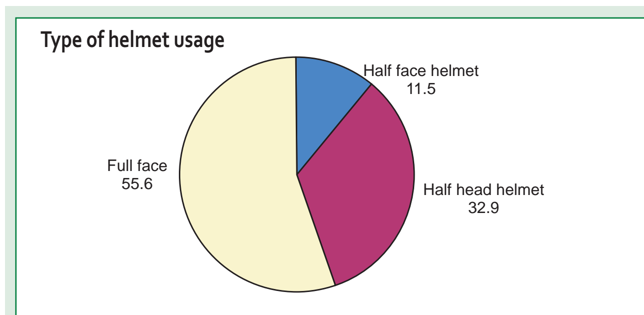
- **Excessive and inappropriate speeds**

Speed is a major contributor for road crashes all over the world, more so in countries like India, that are building and expanding roads. Studies undertaken by TRIPP, New Delhi have shown that excessive speeds are a major factor for crashes on intercity and inner-city roads (Mohan D, 2004). Observations from BRSIPP during 2010 indicate that majority of fatal crashes occurred on outer ring roads, straight roads, during day times and speed was the cause, often documented as driver carelessness in official reports. Studies undertaken in 2009 and 2010 indicate that as speeds in central parts of cities reduced due to traffic congestion, crashes only shifted to peripheral areas where speeds predominated (Figure 8c) (Gururaj et al, 2008 and 2010). Connecting roads to highways had greater speeds, greater crashes, and higher number of deaths. In crashes that occured at high speed involving heavy vehicles and vulnerable road users, VRUs were killed and severely injured due to crash impact and greater transfer of energy. In a qualitative study of 1500 hospitalized RTIs due to brain injuries, more than 80% of injured persons attributed their crash to travelling at higher speeds (Gururaj G, 2005). A study from Delhi also attributed most of crashes to travelling at high speeds (Verma and Tiwari, 2004).

- **Low use of helmets among two wheeler riders and pillions**

Despite the proven effectiveness of helmets all over the world and its inclusion in Indian Motor Vehicles Act of 1988 and 2002, many Indian states are yet to notify helmet legislation. In a country where more than 70% of vehicles are motorized two wheelers, use of appropriate helmets is highly essential. It is known that helmets reduce deaths, serious brain injuries, consequent disabilities, hospitalisations and economic costs (Gururaj G 2005b). Despite this understanding, helmet use in many states is abysmally low or totally absent. Data from Bangalore, where helmet laws were notified in Nov 2006, indicate that only 50% of riders wear proper helmets and 10% of pillions wear them (Figure 16). Even though knowledge levels are high,

**Figure 16: Use of helmets among two wheeler riders (%)**

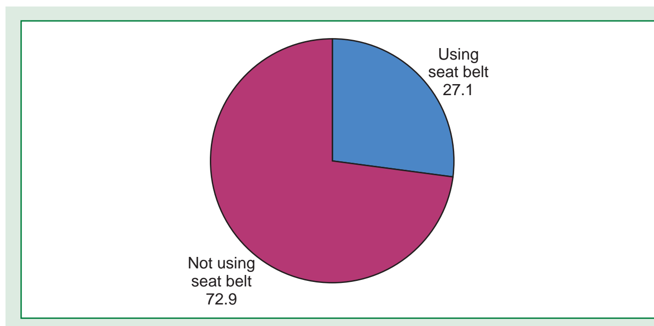



helmet use remains far from satisfactory indicating the need for strict enforcement (Gururaj & Suryanarayana 2006). Data from Hyderabad (Dandona et al, 2006)and Pune (Shah B et al, 2007) also support these findings. Even in states and cities with helmet laws, repeal and reintroduction are common features.

- **Failure to use seat belts and child restraints**

Seat belts and child restraints are known to reduce deaths and injuries among car occupants, latter among children. Seat belt laws are included in Indian Motor Vehicles Act of 1988 with amendments in 2002. Today, most of the cars are fitted with seat belts at the time of manufacture. Despite this, usage rates are pitifully low. Data from Bangalore through observational surveys show that only 27% of drivers wear seat belts (Figure 17). Even though there is an effort to make child restraints mandatory in cars, it is yet to come up as legislation.

**Figure 17: Seat belt use among Car drivers in Bangalore city (%)**




- **Increasing role of alcohol**

Driving under the influence of alcohol is commonly known and seen in India. Consumption of alcohol increases the risk of deaths and injuries as it affects vision, coordination, reflexes, judgement and coordination. Nearly one third of crashes occur during night time, and a third of these are linked to alcohol. As early as 1984, Mishra et al (1984) studied a small sample of 87 persons and observed that 29% were positive for alcohol. In 2008, Milito et al (2008) studied

500 patients and reported that 34% were positive for alcohol in crashes. Several other studies (Jha et al, 2004: Sharma et al 2007: Supriya 2008) have documented alcohol presence in RTIs varying from 15-30%. Studies by NIMHANS, over time, have shown that 20–30% of patients brought to hospitals between 7 pm – 7 am tested positive for alcohol (Figure 18). Recent data from BRSIPP has shown that among fatal crashes, 20% of deceased were positive for alcohol. In the absence of blood and breath tests to confirm alcohol, this has been a neglected issue. The recent increase in penalty levels appears to have made a change as there is slightly better awareness and more fear in public (Figure 19).

**Figure 18: Presence of alcohol in road crash victims (%)**

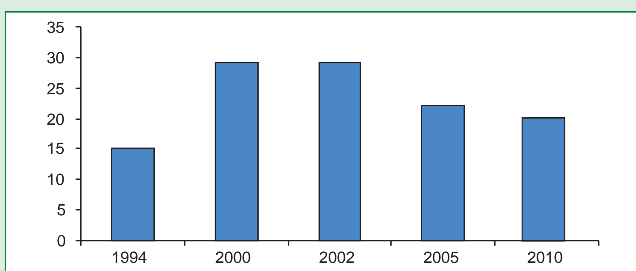
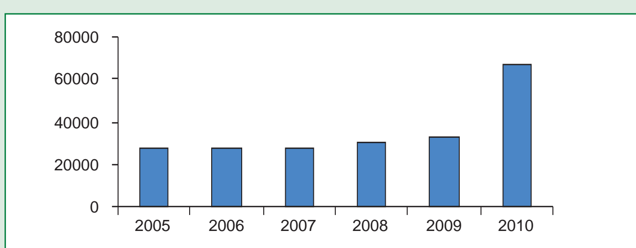



**Figure 19: Trend of drink driving cases booked by the Bangalore City police**




## Visibility issues

With nearly one third of the crashes occurring during night times, visibility of people, vehicles and dangers on roads are important issues. Data is not available in this regard from India.

## Pedestrian practices

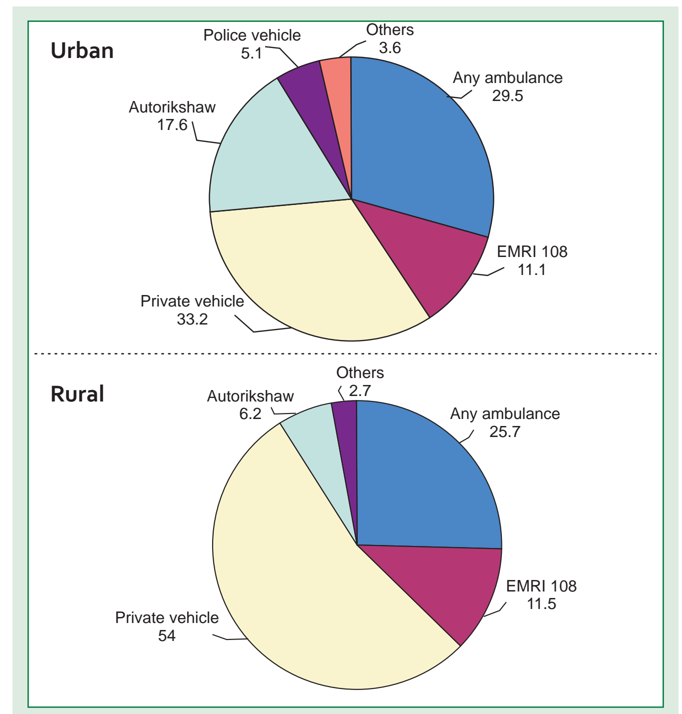
Nearly 30–40% of injured and killed in RTIs in India are pedestrians. The presence of large numbers of pedestrians, their relatively small size and poor visibility makes them highly vulnerable for road crashes. Collision of pedestrians with heavy vehicles results in more deaths due to transfer of large amounts of energy. While pedestrian facilities are shrinking in urban areas, their needs are not considered on highways and in rural areas. Even where facilities are available, pedestrians often do not use these facilities.

In a recent observational survey in Bangalore at 82 traffic intersections, only 40% were using zebra crossing facilities appropriately (Gururaj and BISCG, 2011). A previous study showed that while a majority in urban areas are aware of safety issues, they often do not practice them while they are on the road (Gururaj and Suryanarayana, 2006).

## Poor status of trauma care

Availability and affordability of good trauma care is an important determinant for survival and outcome in road crashes. In India, trauma care is more of an urban phenomenon and large parts of rural India does not have access to quality care. Data from BRSIPP for 2008 – 10 has shown that a majority of survivors (>90%) do not receive care at injury site and have to reach a nearest hospital, are referred from hospital to hospital, time interval between injury and reaching a hospital is high and are transported in private vehicles or the three wheeled auto rickshaws (Gururaj et al, 2011) (Figure 20). Facilities in public hospitals are poor and costs of care are high in private sector hospitals.

**Figure 20: Mode of transportation in Non-fatal injury cases (%)**




## Deficient rehabilitation services

Nearly half the patients discharged alive from hospitals require short term or long term rehabilitation services. In India, this area has not developed over time and manpower, facilities and data are woefully lacking, especially in rural areas.

## 6. Future predictions

With current rates of motorisation and neglect of road safety, the number of deaths and injuries are likely to increase in the coming years. With an annual increase of 8 – 10% every year, the numbers are likely to reach significant proportions. In 2006, we estimated that India will lose about 135,000 – 150,000 persons due to road crashes by 2010 and this is almost true. Estimates indicate that by 2015, there will be nearly 2,00,000 road deaths every year. Kopits and Cropper estimate that road fatalities in India will reach about 1,98,000 deaths before halting and beginning a decline (2003). Mohan, estimates that India will register about 2,60,000 deaths by 2030, if the present scenario continues (Mohan, 2010).

## 7. Current scenario

Road safety in India is a shared responsibility of different ministries at both national and state levels. As health, transport, enforcement are all state subjects the implementation power lies with these states. The Ministries of Transport, Finance, Home affairs, Health, Judiciary, Welfare and several other ministries are involved directly or indirectly for road safety management in India. In addition, several other agencies like National and State Highway authorities, Planning Commission, Central Road Research Institute, vehicle manufacturers, insurance companies, automobile manufacturers association and small number of NGOs are also involved in road safety. The Indian motor vehicle act of 1988 with amendments in 2002 sets the guidelines for implementation of several rules for road safety. However, the implementation of road safety programs takes places at the state and local level as it is mainly a state subject. The Government of India can formulate guidelines and directives for implementation of programs along with allocation of funds. The primary responsibility of implementing road safety lies with individual states and union territories.

Road safety has begun to receive some importance in recent years due to interest shown by national government, increasing motorisation, attention by the media, involvement of automobile industry and concerns from public. As news of road crashes are beginning to become day to day news stories, concerns are being raised, that are still resulting in crisis management approaches. Despite this, Road traffic injuries and other injuries are not on the public health agenda at national or state levels.

There have been some efforts in recent times to address road safety in India, though much more needs to be done. Road traffic injury surveillance programs in Bangalore and Pune have shown the strengths and limitations of a surveillance approach. (Shah B et al,2007). Injury surveillance across trauma care centres in India is under consideration of the Ministry of Health, Government of India. After nearly 4 years of preparatory work, "The National Road Safety and Traffic Management Board Bill, 2010 (Bill no. 59 of 2010)" is under the consideration of parliament and it is hoped this will be approved soon. Based on the "Sundar committee report", this bill will be a strong beginning for road safety in India (http://morth.nic.in/writereaddata/sublinkimages/Road_Safety_sundar_report4006852610.pdf, accessed on 19th march 2011). The National Highway Authority of India has recognized road safety on national highways as an important component of building and operating highways and has established a "Road safety Cell" (http://www.nhai.org/). The proposed revision of the Indian Motor Vehicle Act has opened up new avenues to change the age old motor vehicles act of India (http://www.morth.nic.in/index2.asp?langid=2&sublinkid=460). The compensation for injured has seen an increase and is expected to be available (!) for the timely treatment of individuals. Many states are beginning to address road safety through their own policies. The sporadic public education programs and media voices need to become stronger for establishing road safety in India.

The transport development policy (http://www.urbanindia.nic.in/policies/transport policy.pdf), Urban development Policy (Ministry of Urban Development, 2010), environment policy (http://www.envfor.nic.in/nep/nep 2006.htm) have a mention of road safety in their policies and programs. The Golden Quadrilateral project, High way expansion and improvement projects, infrastructure expansion projects of World Bank, Asian Development Bank and other multilateral funding agencies are beginning to address road safety issues. Road safety audits are becoming an integral component of road safety projects. The National Trauma Care program by the Ministry of Health and Family Welfare has been focusing on strengthening trauma care facilities on the Golden Quadrilateral route and other high ways (www. mohfw.nic.in). The massive expansion of trauma care by private sector in urban areas has helped some, while unaffordable to majority. Other initiatives like helmet legislation and enforcement, reducing drinking and driving, speed control measures, pedestrian safety are all being discussed by several experts, but the real impact is yet to be seen.

Few institutions in India like Central Road Research Institute in Mehrauli (http://www.crridom.gov.in), Automobile Research Institute in Pune

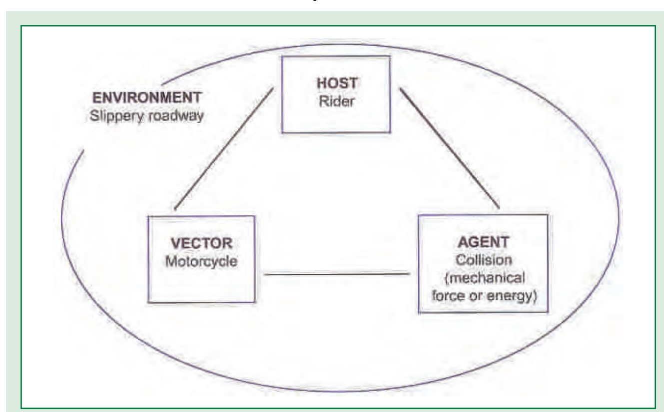
(www.araiindia.com), Transportation Research and Injury Prevention Program of Indian Institute of Technology, New Delhi (www.iitd.ac.in/tripp), National Institute of Mental Health and Neuro Sciences, Bangalore (http://www.nimhans.kar.nic.in/ epidemiology/ default.htm), engineering departments of Indian Institute of Technology and Indian Institute of Science, Institute for Road Transport education, New Delhi, also work independently in road safety along with national and state governments. NGOs, though few in numbers are involved in road safety mainly in advocacy and public education activities. However, it is clear as of now that India does not have scientific, structured, focused and coordinated programs in road safety.

## 8. Understanding road crashes

Road crashes are complex events that occur due to interaction of human beings, vehicles and the road environment. Since these interactions occur at any time and any place, it is crucial to identify the determinants of such crashes. Understanding these issues is critical and requires in-depth research and scientific data along with proper interpretation. As there could be many factors that contribute, these should be separated as those that can be modified (eg. speed, vehicle factors, etc.,) and those that cannot be modified (eg. weather). As the goal is to reduce crashes, the focus should be on preventable deaths and modifiable risk factors. The field of road safety has grown over time and several frame works have evolved which are briefly discussed below.

The classical epidemiological approach examines road crashes from the agent, host and environment perspective. This classical approach has been used in the understanding of communicable diseases for a long period of time. As road traffic injuries are like any other public health problem, this was being used earlier. The agent is the mechanical energy

**Figure 21: Epidemiological model of an injury caused by a motorcycle collision**




**Source:** WHO Injury Surveillance Guidelines

generated in a crash, vector being the vehicle involved and responsible for a crash, the host is the individual and the environment is the situation – context – and circumstances of a crash. As shown in figure 22, the host is the rider, the vector is the motor cycle and the environment is the slippery road way. This approach has some limitation as merely identifying the 3 components will not help prevention and control in a big way and more details are required due to the complexity of events.

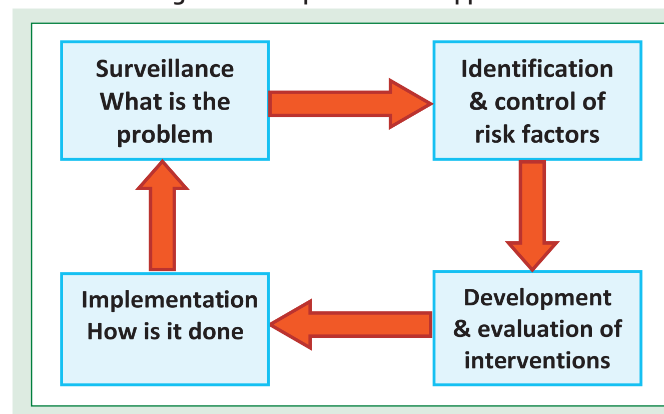
The Haddon matrix developed in 1970's, revolutionized the understanding of road crashes and injuries and has contributed enormously since then for reducing crashes. The matrix provides a framework for understanding the role and involvement of several factors that could have contributed before, during and after the crash in relation to the person, vehicle and the environment(Table 5) (Haddon, 1968). It is possible to systematically understand road traffic injuries on this broad platform and to develop specific counter measures for implementation. The pre crash phase aims at primary prevention, while during and after crash phases focus on secondary and tertiary prevention. Applying this matrix in different settings, especially in countries like India, requires a major investment in road safety research and also involvement of multiple partners.

**Table 5: Example of Haddon matrix as applied to two wheeler road traffic injury**

| | Human | Vehicle | Environment |
|---|---|---|---|
| **Pre-event** | Increase awareness about helmet wearing, drink driving, safe driving, etc. | Increase visibility of vehicle | Implement safety features on roads |
| **Event** | Early transfer to hospital and required care | Better braking systems of two wheelers | Crash protective road side stationary objects |
| **Post-event** | Rehabilitate and improve health care services | Improve safety technologies and components | Facilities for early rescue of injured persons |

The public health approach helps in understanding the magnitude of the problem, identification of risk factors, guiding development of appropriate interventions and examining whether the implemented interventions work effectively (Mohan et al, 2006). Analysis of risk factors is crucial to develop appropriate interventions. This approach essentially guides in responding to the problem over time through systematic approaches. Determining the magnitude of the problem should move beyond counting heads and include delineating mortality, morbidity, disability, impact and risk behaviours. It should also include the characteristics of the population from where road traffic injuries originate. The second component focuses on identification of risk factors to understand the possible broad causation patterns of RTIs. It would be appropriate to focus in-depth on certain risk factors that are modifiable. The third component of identifying what works is a process of designing and implementing interventions. The 4th component highlights the efficacy and effectiveness of the implemented interventions to see the change in the nature and characteristics of the problem (Figure 22).

**Figure 22: The public health approach**

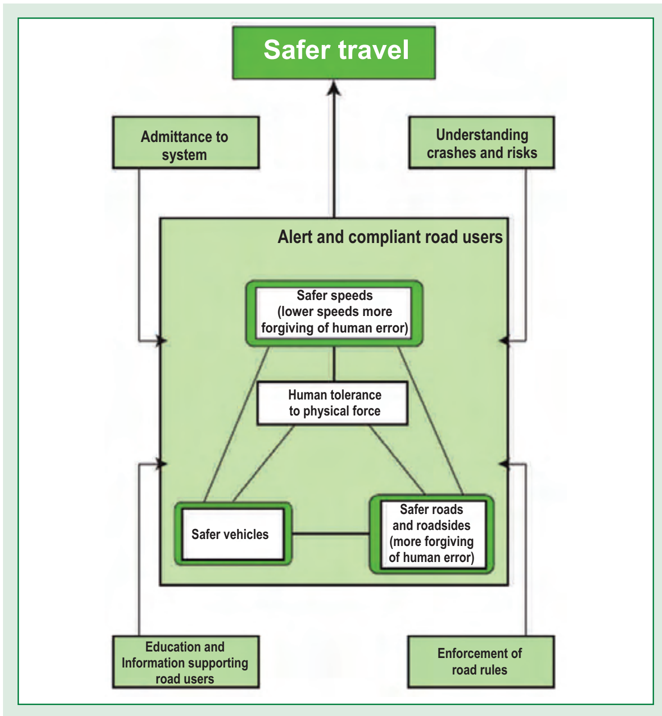



It is essential to note that surveillance data is a guiding step and may not specifically be able to delineate the required interventions. Hence, it would be ideal to combine findings from more focused research to develop interventions. Several quantitative and qualitative research designs are employed in this broad framework to address specific questions. The actual impact of any intervention should be measured in real reduction of deaths and injuries at local and national level.

## 9. Towards a systems approach

As road traffic injuries are multifactorial in nature, the solutions need to be multiple and intersectoral in nature. The safe systems approach recognizes that in any traffic environment people are likely to make mistakes for a number of reasons. These mistakes can lead to crashes and as human body is vulnerable to injury, it can lead to damage to various body parts. Hence, the emphasis in road safety has shifted from addressing individual components to developing safe systems that accommodate human vulnerability and fallibility. Based on the principles of human tolerance, systems need to be developed to see that crashes do not occur, and even if it occurs, results in no or minimal damage. Developing this safe systems approach requires involvement and participation of all sectors towards a common goal with a unified vision

Figure 23: Systems approach




Source: WHO, 2010

(WHO 2009).This approach considers the multiple interactions in an environment and identifies several factors that need to be addressed for reducing the crashes. The primary focus of this approach is to make the traffic environment less hazardous and identifying different potentials for interventions (Figure 23). The focus is on safe roads, safe vehicles and safe people.

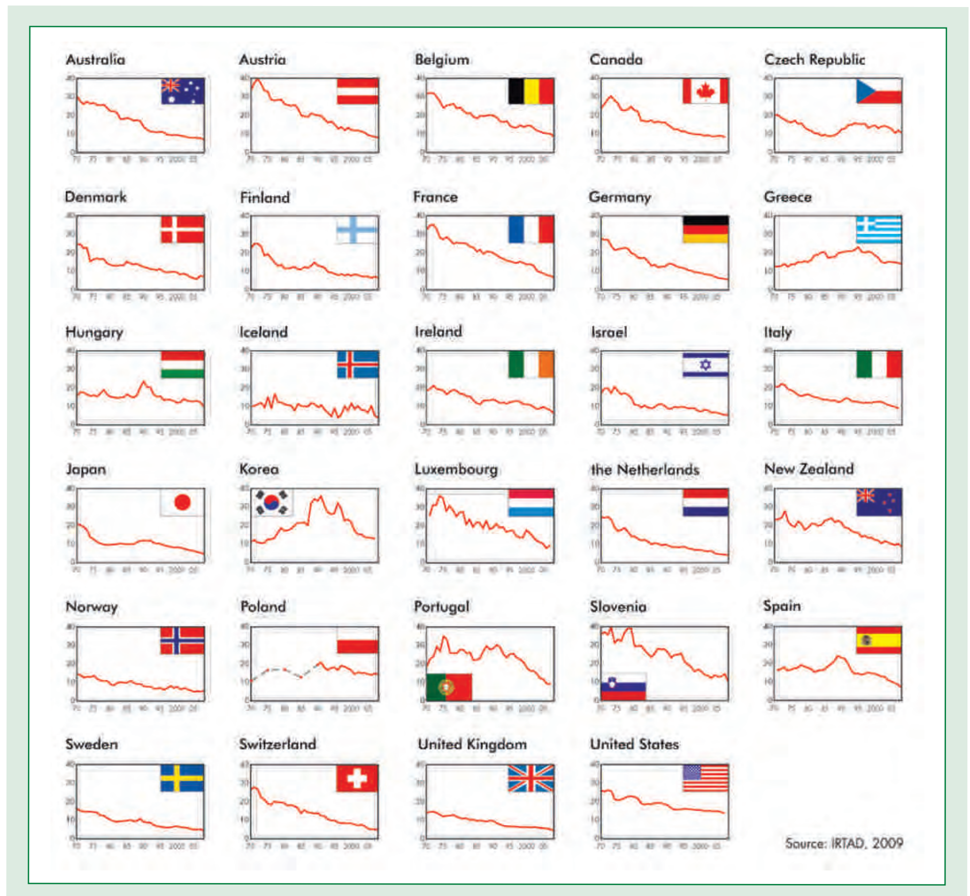
While these broad frameworks provide a platform for understanding the burden and causation of RTIs it also brings to the fore, the contribution and involvement of various sectors at different levels. Integrating these sectors through policies and programs is crucial for reducing road deaths.

## 10. Road crashes are predictable and preventable

Figure 24 shows that road crashes are declining in many high income countries of the world. This has been possible due to number of factors like greater political commitment, development of institutional mechanisms, presence of strong policies and programs, high levels of implementation of road safety regulation and laws, greater funding allocated for road safety, capability of different ministries and partners to work together through strong intersectoral mechanisms, implementing integrated strategies and a strong community involvement that demands safety (European Road safety Observatory, 2007). Further, emphasis is laid on implementing passive countermeasures (like making road environments and vehicles safer) than active countermeasures (where people have to make efforts every time they are on road).

Over time, understanding the multifactorial causation of RTIs and risk exposures has been possible due to an investment in science and research and growth of road safety professionals in transport, engineering, health and other branches. Understanding road crashes has moved from 'human errors and driver's mistakes' to 'making safe systems'. The concepts of energy production – transfer – absorption – and consequent protection of people has helped in moving from just educating people to implementing integrated approaches on roads and vehicles. Most significantly, monitoring and evaluation has remained major pillars of learning in improving safety on a continuous manner. Despite these developments,

Figure 24: Traffic deaths per 100,000 population 1970 - 2009




Source: IRTAD, 2009

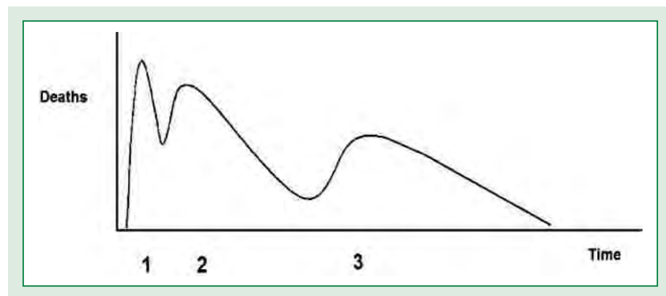
addressing human behaviours still remains an important issue (Gielen et al, 2006). Efforts are in progress in many countries to reduce crashes further as road safety is an evolving and continuous process.

## 11. Towards solutions in India

India is a diverse country with a population of more than a billion with variety of vehicles operating in a heterogeneous traffic environment. Till date, no systematic interventions have been implemented to reduce the burden of crashes either at the national or the state level. In India, always, people are blamed for their mistakes, and consequently, some sporadic attempts are made to give them knowledge with the hope that they will become safe.

As outlined in earlier sections of this report, RTI surveillance, reporting systems, crash analysis and investigations, research on roads and vehicles are yet to be established. International research shows that road deaths occur in 3 peaks of early deaths (within minutes after crash), intermediate deaths (within one or two days) and late deaths (over days or weeks) (Figure 25). The number of deaths in each peak varies between and within countries.

**Figure 25: Pattern of deaths due to trauma.**




Source: Trunkey, 1983

Data from 3 years of Bangalore Road safety and injury Prevention Program has shown that 30-35% of deaths occur at crash site, 10-20% en-route to hospital and >50% in the hospital. Some percent of deaths occur after discharge from hospital due to late complications (Figure 26a-26c). Many of the survivors with moderate to severe injuries get hospitalized in public and / or private hospitals. Minor injuries receive care at local levels and may or may not reach health care institutions. Data is required from more centres and at the national level on this aspect.

A broader approach to road safety in India should focus on making safe roads, safe vehicles and safe environments with people being protected both inside and outside their vehicles. As there is no single solution, a range of programs need to be implemented that will reduce the occurrence of crashes. Deaths at crash site can only be reduced with a wide rage of primary prevention activities

**Figure 26a: Place of deaths in fatal RTIs in 2008, 2009 and 2010**

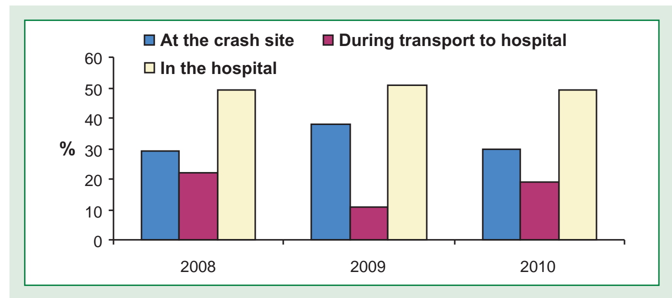



**Figure 26b: Time interval between injury and registration in the hospital for non-fatal injury cases (%)**

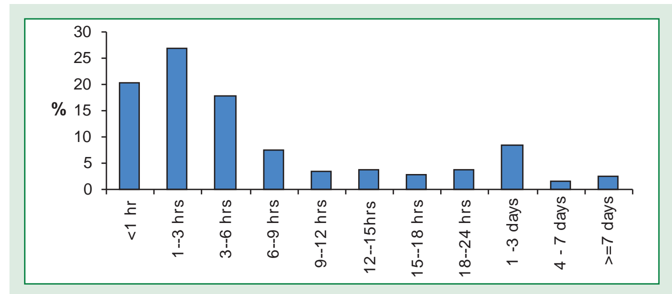
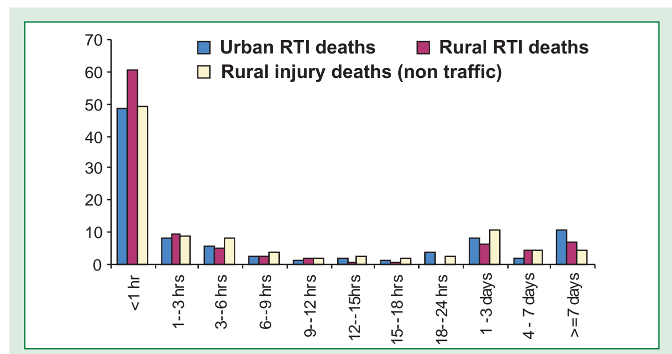



**Figure 26c: Time interval between injury and deaths in fatal injuries**




(safe roads, vehicles, greater implementation of road safety regulations, increased awareness etc.,), while second peak can be reduced through a combination of primary prevention and efficient prehospital care systems. The third wave of deaths can be minimized with good trauma care practices across hospitals. Trauma care includes both prehospital and in hospital practices and work in a continuum.

## 12. Strategic approaches for Road safety

Implementing road safety programs needs a vision, mission and focus. Political commitment is crucial in this process as national and state governments should make a determined effort to address the problem. Like any other programs (Cancer control or malaria control), road safety also requires a policy, program, structure, funding, mechanism, monitoring, evaluation and several other components. It requires a defined mechanism with setting up of goals and targets along with several managerial

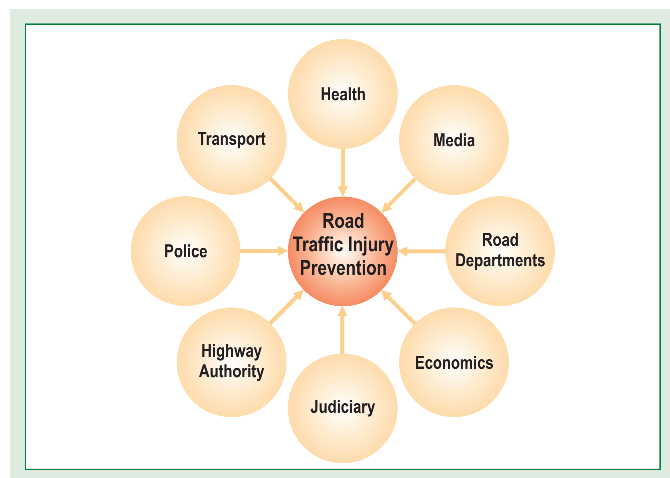
components. Capacity strengthening of all involved policy makers and professionals is esential. In total, it requires a scientific, systematic and programmatic approach to develop – implement – monitor and evaluate road safety in the country.

## 12.1. Road safety management

India has a long standing experience in prevention and control of public health problems. Even complex problems involving human behaviour like HIV / AIDS have been addressed through programatic approaches. A road safety management system is required in India to reduce the rising toll of road deaths and injuries, control the increasing economic costs, develop better systems and mechanisms to address road safety. This is also required based on the understanding that RTIs are largely preventable and better results can be achieved even with existing knowledge. Road safety management has three major components of developing institutional mechanisms and approaches, implementing interventions and measuring results (European Road safety Observatory, 2007).

Road safety is complex and challenging. Road safety in India is the shared responsibility of several ministries and departments at national, state and district/city levels. It requires the total and active participation of many sectors like transport, police, health, finance, law and justice, education, welfare, town and city planning, Public road works department, highway authorities, media, civil society and many other agencies (Figure 27). In India, each ministry is confined to its own activities(Public works department – building roads, transport – traffic laws / certification of vehicles, Police – enforcement, health – trauma care, etc.,) and this pattern will continue in the absence of a unified vision. Equal commitments from all are hard to come by in the absence of a common and shared vision and program. Coordination is required both across and within ministries for effective road safety

**Figure 28: Ministries and organisation influencing road safety**




management. Further, the budgetary allocation for each ministry is specific and there is no funding for road safety at central or state levels.

The management system should bring in ownership of the program, accountability, neutrality, consider present and future developments, limitations of existing systems, current and projected road – vehicle – and land use patterns, financial arrangements and other aspects. Moving ahead from the earlier concepts of educating road users to safe roads, safe vehicles and safe people, it places emphasis on a "Safe Systems Approach" where road environment is used as reference (Bliss and Breen 2008). Global experience has clearly demonstrated the effectiveness of such lead agencies in many HICs and several examples can be found across the world.

## 12.2. Institutional mechanisms for road safety

In India, there is no single agency to guide, formulate, develop, implement, monitor and evaluate road safety activities. No information is available on the functioning and contributions of road safety councils at national, state, district and city levels that were established long time back. These bodies, though limited in their knowledge, capacity, powers and funding have not shaped the road safety scenario in India. There has been no defined goals, objectives, budget, direction and implementation powers for these councils, except a set of guidelines. The individual committees set up by independent ministries serve specific roles and responsibilities as per their terms of reference. This scenario has resulted in absence of a unified vision, resources, trained manpower, professional and technical inputs to policies and programs.

To deliver road safety in India, a lead coordinating agency at both national and state level is essential to coordinate all road safety activities. Such an agency in HICs, is a guiding, coordinating body constituted by professionals and plays a catalytic role and is always result oriented (European Road Safety Observatory, 2007). Its major focus should be on establishing strong

- horizontal coordination with different ministries and agencies
- vertical coordination within ministries at national and regional levels
- legislative framework
- Resource mobilization and allocation
- Funding mechanisms
- delivery of interventions
- mechanisms for achieving results
- systems for monitoring and evaluation
- involvement of civil society and professionals
- research and technical base

**Panel 3: Road Traffic Injury Prevention and Control - The New Understanding**

- Road crash injury is largely preventable and predictable; it is human – made problem amenable to rational analysis and counter measure.
- Road safety is a multi sectoral issue and a public health issue- all sectors, including health, need to be fully engaged in responsibility, activity and advocacy for road crash injury prevention.
- Common driving errors and common pedestrian behavior should not lead to deaths and serious injury – the traffic system should help users to cope with increasingly demanding conditions.
- The vulnerability of human body should be a limiting design parameter for traffic system and speed management is central.
- Road traffic crash injury is a social equity issue – equal protection to all road users should be aimed for since non- motor vehicle users bear a disproportionate share of road injury and risk.
- Technology transfer from high income to low income countries needs to fit local conditions and should address research – based local needs.
- Local knowledge needs to inform the implementation of local solutions.

**Source:** WHO/ World Bank Report on Road traffic Injury Prevention, 2004

## Evidence for Interventions… … …

- Improving visibility of vehicles on roads has been found to be an effective strategy. Day time running lights by motorcycles increases visibility and has been found to reduce crashes by 10-20% (Yuan, 2000; Umar et al, 1996). Use of bright reflector sing colours on motorcycles, bicycles, autorickshaws and even on helmets, increasing peripheral lighting on buses and trucks have been found to be effective solutions (Mohan and Tiwari, 1998). Visibility aids have the potential to increase visibility and help drivers to detect pedestrians and cyclists (Kwan, 2002).
- Improved vehicle crash protection, referred as secondary safety has resulted in significant reduction of deaths, specially for car occupants. Mohan (2004a) has observed that this important measure reduced deaths and injuries among car occupants by more than 30% WHO (2004a) has recommended that such crash protective vehicle designs with suitable standards should be adapted globally.
- The role of seat belts, airbags and child restraints in cars have been proven beyond doubt (Zara et al, 2001; Dinh - Zaar et al, 2001). Seat belts have been shown to reduce serious and fatal injury by 40-65% (WHO, 2004a). Airbags combined with seat belts add incrementally in reducing injuries (some controversy still exists with regard to certain types of airbags). Once again this requires active participation be drivers to wear seat belts and properly use child restraints, which can be achieved by proper legislation and enforcement along with education programs.
- Speed control has occupied centre stage of road safety in all HICs by combined methods. Setting speed limits as per road design and hierarchy, installation of speed cameras, placement of traffic lights, road engineering methods like scientifically designed speed breakers, traffic calming methods, others have all been tried extensively and has shown positive results. A combination of road engineering and enforcement has yielded better results. Speed enforcement on rural roads by automatic and/or enforcement reduced fatal crashes by 14% and injury crashes 6% (Keall, 2001; Mountain, 2005; WHO 2004a; Regan 2004). Red light cameras are found to be effective in reducing total casualty crashes as manual enforcement methods are resource intensive (Aeron Thomas, 2005)
- Several road design changes to reduce speeds, separate traffic, traffic calming measures, use of roundabouts, provision of dedicated cycle lanes and walking paths, development of medians, crash protective road side barriers have all been developed, experimented and evaluated in HICs. Area wide traffic calming measures have been shown to be effective in reducing crashes by 10-30% (Elvik, 2001; Bunn, 2004; Peek-Asa,2003; Mohan 2004a; WHO, 2004a)
- With drinking and driving being a major risk factor, several combined approaches have been tried in HICs (Stewart, 2000). Strict enforcement of drink drive laws through random checking of blood alcohol levels in drivers and setting appropriate blood alcohol limits has had a major success all over world. A systematic review found that reduction of Blood Alcohol Concentration Levels from 0.10g/dl to 0.08g/dl resulted in decline of crashes by 7% across 16 states of USA. Integrated alcohol control measures like lower blood alcohol limits, minimum drinking age laws, random breath testing and sobriety check points, higher penalties for offenders have helped in reducing alcohol related crashes by 30-40% (Shults et al 2001; Sweedler BM, 2003; Lowenfells and Lyan, 1992).

- Helmets for motorcyclists have provided maximum protection by reducing brain injury related deaths, serious injuries, incidence of skull fractures, consequent neurological disabilities, extent of hospitalization and consequent medical costs. A recent Cochrane review has revealed that helmets for motorcyclists reduce the risk of head injury by 72% (OR 0.28; 95% CI 0.23-0.35) and subsequently mortality and severe injuries (Liu, 2004). Another Cochrane review has found helmets to reduce head and fall injuries among bicyclists (Thompson, 2004). Based on this experience many HICs have introduced helmet laws for bicyclists also. This strategy has proved to be the single most cost effective approach, if properly enforced among motorcyclists and bicyclists (Channabasavanna and Gururaj, 1994; Kraus et al, 1992; Sosin et al, 1990; Ichikawa et al, 2003; Servadie, 2003). Even bicycle helmet laws and its proper implementation have been shown to decrease brain injuries by about 63-88% (195-196) and a recent meta analysis revealed the decline to be 25% among cyclists (Thompson et al, 2004)
- As per recent Cochrane review, Specific interventions like early fluid resuscitation in bleeding trauma patients, hypertonic versus isotonic saline in fluid resuscitation, spinal immobilization of patients and advanced versus basic life support training have not shown to be effective and some (1 and 3) can even increase the harm (Bunn, 2001). This indicates that many high technology solutions lack scientific evidence and need for well designed research before putting such techniques in practice.
- Four of the recent Cochrane review have showed that (i) there is no evidence of post license driver education in preventing road traffic injuries or crashes (Ker, 2004), (ii) pedestrian safety education of children can result in improvement of knowledge and can change road crossing behaviour; however, whether this would lead to reduction of injury occurrence is yet to be proven (Duperrex, 2004), (iii) school based driver education leading to early licensing does not reduce road crash involvement (Roberts, 2004) and (iv) graduated driver licensing might be effective in reducing crash rates (Harting et al, 2004)
- Mock et al (1998) have shown that basic first aid training of commercial drivers will be of help in saving some lives at the site of injury. With training in basic aspects of first aid care for first responders along with improving basic supplies and equipment, the mortality rate was reduced from 40% to 9% as demonstrated by injury Surveillance system in Cambodia and Iraq. Even though this was demonstrated for landmines, it also applies to strengthening prehospital care for other injuries (Husum, 2003). Training for first respondence like police, lay public and drivers have been tried and results have been promising.
- Low cost interventions and implementations of prehospital trauma life support resulted in decline of mortality from 8.2% to 4.7% in Mexico. Interventions included training in basic first aid aspects of maintenance of airway, breathing and circulation, skill, improvement in specific areas and increase in ambulance dispatch sites (Nathens, 2000; Risa, 2000 & 2004).
- Data based on population based studies and trauma registries show a consistent reduction of 15-20% or more of deaths in countries with better organized trauma systems over a period of time. After adjusting for secular trends in crash mortality, age, traffic safety laws and others, Nathens (2000) demonstrated that injury mortality was reduced by 8% during 1979-1995 in USA. During the period 1989-95, 16% reduction in hospital mortality from injury was reported among those <25 yrs with severe injuries due to improved assessment and management, and integrated management in UK (Royal College of Surgeons, 2000). Development of regional trauma systems in USA resulted in decline of deaths from 34% to 15% (Sethi et al, 2000). Many more examples of successful interventions, evaluator results and promising interventions can be accessed from " WHO/World Bank Report on Road Traffic Injury Prevention", " The Road Ahead: Traffic injuries and fatalities in India" by Mohan D of TRIPP, IIT, New Delhi and in scientific literature. As some of them cannot be merely implanted in India it requires careful assessment for technological feasibility, cost effectiveness, resource availability and people's acceptance. Combined measures are known to provide large benefits.

**Source:** Gururaj G, 2006, Road traffic injury prevention in India

The major functions of this lead agency will be to

- Establish coordination between ministries and agencies,
- Formulate and develop road safety policies, programs and action plans
- Set up national goals, targets, guidelines, standards for roads, vehicles and all other products
- Decide on funding and resource allocation for different ministries and activities using a program framework
- Communicate to all stake holder's on their roles and responsibilities
- Guide and coordinate interventions, policies and programs for implementation
- Enact and strengthen appropriate legislation at different levels
- Monitor and evaluate all activities in an impartial basis
- Strengthen and promote research that are relevant for national needs, and
- Share and disseminate knowledge for learning by all

The precise mechanisms for such an agency should be evolved. To achieve long term sustainability, it is important that this agency is established through parliamentary approvals, appropriate legislative mechanisms, with adequate funding and comprising of professionals.

The National Road Safety and Traffic Management bill of 2010 has been recently formulated and is under the approval of the parliment. This bill aims at establishment of a lead agency with appropriate manpower, budget and authority. It is hoped that this agency will change the way road safety is delivered in India.

## 12.3. Road safety Policy

*A policy is typically described as a principle or rule to guide decisions and achieve rational outcome(s). A Policy can be considered as a "Statement of Intent" or a "Commitment". Policies can be understood as political, management, financial, and administrative mechanisms arranged to reach explicit goals (en.wikipedia.org/ wiki/Policy).*

Policies and programs set the vision, mission and focus and decide on the chosen path of the country over time. India needs a National Road Safety Policy to achieve the desired reductions in road deaths and injuries and to develop a safe traffic environment. A road safety policy framework defines goals based on population health burden (and status) of RTIs and lays down a road map for future activities covering vision and mission, goals and objectives, involvement of stake holders, financing and organizational arrangements, capacity development of key partners, delivery mechanisms and guidance for prioritizing expenditure along with decision making issues. It also outlines priorities, identifies partners, availability and need for resources, promote consensus among involved partners and generates political will. To put the policy framework into action, a defined policy - program and a plan of action are required. Essential to note that a policy stays for a long time, irrespective of political and administrative changes.

A national road safety policy is a written document providing basis for action to be taken by governments. This policy and its framework is essential to raise awareness, guide action, generate consensus, provide framework for action, define roles and responsibilities of various ministries, engage partners, identify components likely to

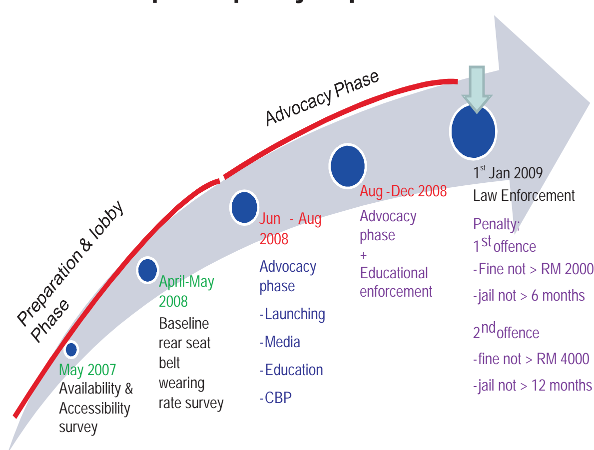
**What governments can do**

- Institutional development
  - Make road safety a political priority.
  - Appoint a lead agency for road safety, give it adequate resources, and make it publicly accountable.
  - Develop a multidisciplinary approach to road safety.
  - Set appropriate road safety targets and establish national road safety plans to achieve them.
  - Support the creation of safety advocacy groups.
  - Create budgets for road safety and increase investment in demonstrably effective road safety activities.
- Policy, legislation and enforcement
  - Enact and enforce legislation requiring the use of seat-belts and child restraints, and the wearing of motorcycle helmets and bicycle helmets.
  - Enact and enforce legislation to prevent alcohol-impaired driving.
  - Set and enforce appropriate speed limits.
  - Set and enforce strong and uniform vehicle safety standards.
  - Ensure that road safety considerations are embedded in environmental and other assessments for new projects and in the evaluation of transport policies and plans.
  - Establish data collection systems designed to collect and analyse data and use the data to improve safety.
  - Set appropriate design standards for roads that promote safety for all.
  - Manage infrastructure to promote safety for all.
  - Provide efficient, safe and affordable public transport services.

**Source:** World Report on Road Traffic Injury Prevention, 2004

The example of introduction of rear seat belt program for car occupants in Malaysia shows that a systematic process helps in promotion, use, acceptance and enforcement of an intervention. Based on data and surveys the problem was defined, advocacy activities were undertaken, public education was carried and enforcement was put in place. All activities were monitored and future evaluations will show the likely changes of this intervention.

**A stepwise policy implementation**




**Source:** Personal communication: Mohammed N Miros, 2010

produce results and monitor results (Schopper et al 2006). India also has policies in transport, urban and rural development, environment and many others apart from health that will have a bearing on road deaths and injuries. While there is need for such individual policies within individual sectors, convergence and integration of these to road safety is crucial. For example, transport policy need not focus only on motorisation, but can have elements of strengthening public transportation that will reduce road deaths. A policy should lead to development of an action plan with roles and responsibilities, financial arrangements, chosen activities, mode of implementation and expected outcomes.

## 12.4. Resources for road safety

Both human and financial resources are essential to promote road safety in India. As there is no allocated budget for this particular activity in India, it needs to be provided by both central and state governments. Currently, some activities are carried out within the available budget of independent ministries along with allocations made for independent activities. Even in the ministry of health, the allocated budget in health is largely spent for acute hospital based trauma care and these are utilized for construction of new hospitals and purchase of hi-tech equipments. The national policy should specify the source and allocation of funds, while the program should highlight utilization mechanisms. Inbuilt mechanisms should be developed for monitoring activities with regard to utilization of funds.

A central national fund is essential for defined road safety activities and this budget should be earmarked in the planning cycles and the national budget. This should be separate from the allocation towards regular activities of the respective departments. The source of this fund can vary and can be generated through national allocation, cess on fuel, revenues from fines and penalty, etc. Apart from funds, there is also need to develop human resources within different sectors for effective implementation of road safety activities.

## 12.5. Advocacy for Road safety

*Advocacy by an individual or by an advocacy group normally aims to influence public-policy and resource allocation decisions within political, economic, and social systems and institutions; it may be motivated from moral, ethical or faith principles and can include many activities that a person or organization undertakes including media campaigns, public speaking, commissioning and publishing research (en.wikipedia.org/wiki/Advocacy).*

Advocacy is a combination of individual and social actions designed to gain political commitment, policy support, social acceptance, and developing systems for road safety and injury prevention and control programs. The overall goal of advocacy is to bring policy change and direction along with social change. Advocacy is an overall strategy employed to influence an issue or cause, which are carried out in a variety of settings by all involved partners. This will have a larger impact if it is driven by evidence and data at national and local levels. Sustained and strong advocacy strategy and activities are required and should be aimed at political leadership and policymakers for

- Placing road safety on the public health agenda
- Mobilizing governments and policy makers to take action
- Influencing agenda setting, policy design and implementation and resource mobilization
- Lobbying with the governments at national and local levels to take all possible actions.

Even though advocacy is a broad and general term, advocacy activities need to be developed for individual groups, has to be undertaken by professionals (especially health) and civil society members and through number of ways. It also requires developing suitable materials relevant to governments and policy makers that would catch their attention and bring in their participation.

## 12.6. Information for road safety

Road safety activities require strong and robust data at national and local levels. Activities, especially at the local level, are not driven by data and decisions made are adhoc and crisis driven in nature. Road safety data systems in India are very weak and problems exist in data availability, collection, analysis, interpretation and utilisation. Essentially, data with regard to modifiable risk factors and preventable deaths are required to develop general and specific programs. As such data is not readily available, improved data collection mechanisms are crucial, should drive all activities, and are urgently required to formulate and strengthen road safety programs in India.

For road safety activities, data is required on real numbers of deaths and injuries, geographical distribution, population characteristics of those involved in crashes and those exposed, disability levels and types, adverse health consequences and also data on risk factors like helmets, speed, seat belts, drinking and driving, use of child restraints and others. Often, data has to be collected from different sources, even though hospitals and police remain primary sources. Data is also required from engineering, transport, social sciences and vehicle industry. Further, It is just not enough to collect data, but should be analysed, disseminated to all partners and utilized by all stake holders for program development and implementation (Gururaj et al 2010).

Information for road safety can be obtained through strengthening of existing systems and through additional research. Data can highlight current problem and patterns, identify risk population, track changes over time and help in monitoring the impact of interventions (Holder et al 2001; Gururaj et al, 2010). This has to be supplemented with additional research, in-depth crash investigations, risk factor studies, observational surveys, trauma registries and others through both quantitative and qualitative research methods. It is the major responsibility of health and police ministries to strengthen this activity in India. Minimum data should be collected in all police stations and hospitals (especially medical college hospitals, district hospitals, and apex trauma centres) in an uniform way. Based on initial experiences of RTI surveillance in Bangalore and Pune, and the injury surveillance in trauma care centres, along with computerization of police stations that is in progress, NCRB and Ministry of health should take initiatives to strengthen this area.

## 12.7. Programs for road safety

A program is a detailed scheme for the process of implementing the policy. It includes strategies, activities, time lines, budget, roles and responsibilities, targets to be achieved, and indicators to be monitored. It provides direction to all involved partners on what to do? How to do? When to do? etc., In India, programs should be clearly developed for road safety, in specific and focused areas like pedestrian safety, highway safety, child safety, two wheeler safety, car occupant safety and other areas. Programs can also be specific and focused on modifiable risk factors like helmets, seat belts, speed management trauma care and other areas.

At present, no general or specific road safety programs exist in India. An integrated or specific road safety program should establish basis, clearly specify priorities, identify solutions, methods of implementation, broad roles and responsibilities and monitoring mechanisms. Logically, a program should lead to a plan of action specifying implementation process (regulatory, educational or engineering or integrated mechanisms), work plans and measurable indicators.

## 12.8. Human resource development and Capacity strengthening

Road safety is a component (or an additional responsibility) in routine working of various ministries and departments in India. For example, police personnel are more concerned about traffic management, law and order, crime prevention, VIP security and many other day to day tasks. Similarly, transport people are more involved in transport issues and road safety is not a regular activity. Even health personnel are busy with trauma care and road safety activities are relegated to the periphery. In addition, all professionals in various ministries are not trained regularly with scientific knowledge and required skills to deliver road safety on a continuous basis. While there is need to develop road safety professionals, existing personnel need to be equipped with road safety knowledge and skills.

Availability of trained and skilled manpower to manage, implement and monitor road safety programs and activities is an essential prerequisite for India to promote road safety.

**Table 6 : Domains of capacity strengthening for road safety**

| Sector | Goal |
|---|---|
| Transport | Developing or strengthening Road safety policies and programs |
| Law and judiciary | Strengthening road safety and legal regulations |
| Police | Scaling up enforcement levels for implementing helmet laws, speed control laws, seat belt laws, drink drive laws |
| Health | Increasing mechanisms for advocacy, policy development, data collection and management, measuring impact of programs and others |

It is very essential to strengthen and build capacities of existing policy makers in health, police, transport, highways department, urban / rural development, judiciary and others in India. Road safety training for existing personnel and those interested should be undertaken by academic institutions with support from government.

Specific capacity strengthening includes building up the skills, resources, frameworks, mechanisms and other areas as shown in Table 6.

Some strategic approaches required for strengthening this area include:

- Capacity strengthening of policy makers, program managers and professionals in police, law, health, road engineering and other ministries at national and local levels.
- Short term training programs in selected and focused areas for police, transport, engineering, health, law, NGOs and related sectors.
- Identifying institutions in the country as national centers of excellence in road safety.
- Integrating road safety along with injury and violence prevention and control in the curricula of medical and nursing schools

## 12.9. Intersectoral approaches – key to success

The European Road safety Observatory report (2007) highlights that "many government departments share responsibility for road safety – transport, health, justice, education, employment, finance – but unless special arrangements are put in place, achieving accountability, appropriate coordination and realizing the full potential of individual sector responsibilities is difficult". Road safety and Injury prevention is the collective and joint responsibility of government, ministries, industry, international organizations and the community (Elvik and Vaa 2004; Mohan et al 2006). At present, as each organisation, ministry and sector work on their own with their respective agenda and activities, there is no unified and integrated approaches to road safety in India.

As RTI causation is multifactorial, solution lies in an intersectoral approach, which is the key to success. An intersectoral approach calls for recognition of the problem by all the members and joint development of policy – program and interventions along with shared responsibilities and resources for implementation to address the problem. This coordination should be both within and across ministries. Even though this area has been recognised as a major barrier for public health programs at large, situation is beginning to change as noticed by the recent programs in tobacco control, HIV/AIDS prevention and several others.

**Table 7: Strategies for speed management**

| Action | Ministries Involved |
|---|---|
| Assessing road usage and travel patterns | Transport |
| Examining crash patterns and mechanisms | Transport, Health, police |
| Specifying speed limits for different category of roads | Urban planning and Transport |
| Setting guidelines and standards | Transport |
| Establishing mechanisms for assessing speed violations ( like speed cameras) | Police |
| Review and formulation of laws to address speed | Law and justice |
| Fixing penalty levels for violators | Law and police |
| Enforcement of speed control laws | Police |
| Vehicle safety methods to control speeds ( improved braking systems) | Vehicle manufacturers |
| Increasing public awareness on effects of increasing speed | Health and education |
| Finances for implementing these mechanisms | Economics |
| Monitoring and evaluating the effect of interventions | Health |
| Coordinating all activities | ? |
| Periodic review and changes in speed issues | ? |

In road safety, each intervention strategy needs a mechanism for implementation even though there are multiple arms and several partners involved in the process. The example of speed management given in table 7 highlights the need and involvement of different partners and ministries in India.

Approaches to facilitate intersectoral strengthening for bringing all partners together to focus on road safety is by establishing the national lead agency - developing a policy – or through directives. In India, the recently established National Disaster Management Authority is an example for promoting intersectoral collaboration. Since health sector bears the maximum brunt of RTI and is a champion of prevention programs, Health Ministry should take a lead role in strengthening this approach.

## 12.10. Interventions

Road safety In India requires specific, targeted and focused interventions. Generally, and at times, rapid mobility and road safety are at cross purposes and it is important to decide whether fast movement is essential or saving lives is more important. For example, many motorists ask for wide – free roads, the development of which might increase speeds and lead to more crashes. In many cities and on highways, it is evident that roads are designed for fast movement of vehicles. If same roads do not accompany safety, it will result in more crashes.

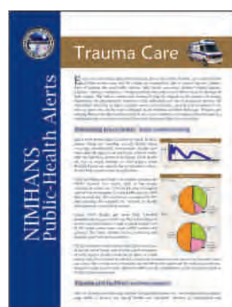
Today, road traffic injuries are predictable and preventable; this is clearly demonstrated by a growing body of knowledge and experience of high-income countries in the last two to three decades. This experience provides a platform for implementing proven interventions, while new solutions need to be developed specifically for India. Some interventions that are likely to work in India are outlined below.

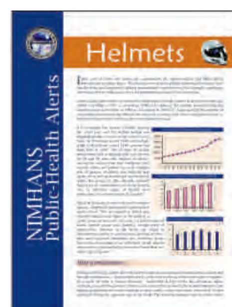
- Strengthening and expanding appropriate public mass transportation systems that are safer and economical.
- Mandatory installation of speed governors (tacho meters) in all heavy and medium size public and private vehicles.
- Fitting in auto doors at the time of manufacture of all buses.
- Manufacturing all cars with compulsory seat belts, air bags and child restraints.
- Increasing visibility of vehicles through better application of reflectors on front and back of all vehicles and encouraging day time running of head lights.
- Bringing design changes for motor cycles to make them more stable and crash resistant in terms of breaking, lighting, anti skid features and others.
- All possible passive and active mechanisms to reduce speeds in urban areas, rural areas and highways and near all traffic generators; speed standards need to be developed for this purpose.
- Separation of traffic and pedestrians on all possible roads, especially on high speed roads.
- Traffic calming in all urban areas and near traffic generators through road engineering measures.
- Scientific application and design of pedestrian facilities to facilitate walking and crossing in all urban areas, on high ways and other roads.
- Mandatory safety audits on all repaired and newly built roads.
- Mandatory helmet laws for riders and pillions of motorized two wheeler vehicles with immediate notification and higher level of enforcement in all states of India.
- Strict enforcement of drink driving laws in a random, visible and uniform way across the country.
- Mandatory use of seat belts for all car occupants.
- Strict implementation of 'no cell phone use', while driving
- Implementation of graduated driver licensing programs for drivers of all vehicles.
- Imposing strict legal penalty for drug users.
- Strengthening trauma care practices with improved facilities in district hospitals and community health centres (general hospitals) along with availability of basic first aid facilities in primary health centres.
- Safe transportation of individuals through common access numbers
- Introducing triage at all levels to refer and manage patients with varying severity in different levels of hospitals.
- Training of all doctors and para medical personnel in basic trauma life support programs.
- Trauma audits to be introduced in all medical college hospitals and apex tertiary referral care centres.
- Strengthening rehabilitation programs at district level with appropriate man power, technology and support systems.

Series of "good practice" manuals for road safety practitioners are available from WHO (http://www.who.int/roadsafety/projects/manuals/en/index.html accessed on September 10 2010). Most importantly, all implemented interventions needs to be monitored and evaluated for efficiency, effectiveness, sustainability and cost effectiveness. The real indicator of change should be a reduction of deaths and injuries. In addition, removal of all medico legal hurdles is essential, as it will promote good data, improve trauma care and eliminate unhealthy practices.

## 13. Approaches to road safety

Once an intervention is chosen, implementing or strengthening the same is a crucial activity and must be well thought out and planned. It is important to decide





"what works?" and "how to make it work?" and should be assessed over time to understand "did it really work?" As it comes to implementing one or more intervention/ program(s), standard and well known methods of "Education, Enforcement, Engineering and Emergency care" are followed, further requiring " Evaluation" to see " Economic and Health benefits". Traditionally and for too long, the emphasis was only on these approaches, and in recent years the importance and applications of larger road safety management through a safe systems approach is well acknowledged and is strongly recommended (WHO, 2010). It is important to know the strengths and limitations of these methods for using them at the local level. Further, these approaches have to be combined to obtain maximum benefits. For ex., for speed management, it requires a combination of engineering, enforcement as well as education. Each of the 4 methods has merits and demerits and are discussed in details under the prevention series of BRSIPP (Gururaj G, 2010 a b c and d).

## 13.1. Education of road users

As all investigations and official reports in India till date show that " Carelessness, negligence, driver's fault " are the main causes, a commonly applied strategy is education of people on safe road behaviours. Educational approaches have formed the mainstay of road safety programs across the world for decades, more so in India. Educational programs are primarily intended to provide and increase individual's knowledge, with the expectation that it will result in a change of attitude, reduce risk behaviours and result in safe road behaviours (Christoffel and Gallagher, 1999). Education programs aim to change people's behaviour and provide information for people to (i) convince them of being safe either on roads or in other places, (ii) enhance their existing knowledge and skills, (iii) change attitudes and behaviours towards risk and safety, and (iv) facilitate adopting safe behaviours and practices (Gielen et al, 2006) .

Several methods like, display of information in business areas (less in residential areas) / prominent roads or on highways (bill boards, hoardings, banners, signage's), newspaper messages (list of road safety practices), articles in print media, public announcements (through microphones in street corners), public functions (seminars and lectures) during road safety week celebrations, campaigns (on individual areas like helmets, drinking and driving, speed, seat belts), school based programs (teaching children about safe crossing of roads and use of safety devices), visits to traffic parks, road safety rallies and other promotion events, display of crash statistics, advertisements on television channels and annual road safety awareness programs have been undertaken by different agencies in India. Year after year, a variety of education materials ranging from posters, pamphlets, bill boards, songs, documentaries, movies, lectures, television spots (fillers) have been employed in different parts of the country, more so during annual road safety celebrations. In a diverse country like India, culture – language and cost need to be kept in mind.

Many lessons have been learnt from evaluation of such programs in recent years. It has been realized that education alone is not sufficient on its own to bring about safe behaviors, as people do not consider safety as an important issue (till it happens to them) and do not perceive the risk involved with unsafe behaviours. In road safety and injury prevention, it is also crucial that individual behavioral changes need to become a regular practice and should be sustained over time.

Experience of many countries reveal that simply imparting information to people without accompanying changes in roads, vehicles, products and systems governing them is "worthless in terms of reducing mortality and morbidity". At times, education programs have even resulted in more deaths and injuries due to early provision of information, boosting pseudo confidence and providing a sense of false security (educating young adults on driving leads to early licensing and increase in crashes due to lack of experience). World Health Organization, in its World Report on Road traffic Injury Prevention, based on available scientific data, concludes that "educational programs, when used in isolation have not demonstrated significant change in road deaths "(WHO, 2004). In the "World report on child injury prevention", it is concluded that "education on pedestrian safety can result in an improvement in children's knowledge and can change observed behaviour of crossing roads. Whether this reduces the risk of injury or that of a pedestrian suffering a collision with a motor vehicle is unknown" (McMahon et al 2008).

Specifically, education helps in (Gururaj 2010)

- preparation of the society to accept proposed changes to existing laws or for introduction of new laws, products and environment modifications, as they will be better prepared to accept the change. For eg. It will

be helpful to educate public about the advantages of helmet laws before introducing helmet legislation.

- increasing awareness among policy makers, professionals, vehicle manufacturers, road builders, print and visual media, and civil society members in shaping public attitudes (regarding what is acceptable and not acceptable in the society) and bringing systemic changes.
- in situations where enforcement and engineering may not be possible.

## 13.2. Regulatory and enforcement approaches

Regulatory interventions through legislation – enforcement which influence people – vehicles and roads have been recognized as a key strategy for reducing road deaths and injuries. The regulations can

- Proscribe certain behaviours (drinking and driving, speed limits, etc.,) or prescribe to enhance individual protection (wearing of helmets, harness, seat belts, etc.,).
- be aimed at the general public or selective segments of population,
- be direct (where people have to follow regulations) or indirect (legislation of products, vehicles or environment by enacting standards),
- be at the macro level (through national laws, standards, etc.,) and promote safety practices at the community level (Gururaj, 2010).

Road safety and Injury prevention series

LEGISLATION & ENFORCEMENT

**What police can do**

- Build consensus with politicians and policymakers on importance of notification and enforcement of helmet law; drink drive law, speed control laws and others by using local data.
- Develop mechanisms for co-ordinated implementation by increasing physical and human resources within the systems.
- Improve data collection systems with a focus on identifying factors amenable for prevention
- Undertake capacity building for officials at different levels within police department by emphasizing road safety and need for implementing laws.
- Sensitize citizens and society on presence of laws, importance of compliance from safety point of view and enforcement of procedures.

**Source:** Gururaj G, 2006, Road Traffic Injury Prevention in India.

- Presence of safety laws indicates the willingness of the government to ensure safety of people and increase the level of safety awareness in the society.
- Firstly, as laws are applicable to all road users or subsections of road users or entire populations, it promotes uniformity in safety behaviours on the road and targets the entire society for a positive change.
- Secondly, as one law is applicable to the entire society, it brings large sections of population in its coverage at one time.
- Thirdly, as generally (at least a large majority) people abide by laws, it will enable everyone to accept safety practices (for their own good) in their day to day life.
- Fourthly, it overcomes the difficulties and limitations of educating every one; over time it saves time and resources.
- Fifthly, as people do not want to get entangled with police and courts for violations, procedures and complexities, it deters them from adopting unsafe behaviours.

Most importantly, once laws are implemented in totality, results are noticeable, evident, can be monitored and its impact measured (through reduction of deaths and injuries).For enforcement to become effective, legislation is essential and implementing agencies like police need sufficient manpower, technology and support. In addition, enforcement has to be strict covering entire population, randomly implemented, visible and noticeable, with deterring penalty levels, and require people friendly enforcement procedures (Gururaj 2010c).

## 13.3. Engineering approaches

Limitations of human behaviour, less importance given to safety and risk taking nature of individuals resulted in making vehicles and road environment safer at the time of design, manufacture and use. Environment includes the physical environment such as roads, and the social environment which is the context and the situation in which people use roads and vehicles. Environmental modification is a broader term encompassing engineering approaches which range from vehicle design to environmental changes to social attitudes (Christoffel and Gallagher, 1999). This approach is based on the fact that products and environments can be made safer that result in less injury or no injury. This

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ENGINEERING & ENVIRONMENT SAFETY

is exemplified by the fact that today's cars come with anti braking systems, air bags, laminated wind shields, wider tires and many other safety systems. Similarly, presence of a round about or scientific speed breaker makes everyone to slow down their vehicles, irrespective of education, status and type of vehicle.

Many strategies that have been developed in road design and operations like traffic separation in all possible places, safer foot paths, designated walking and crossing places for pedestrians, decreasing speeds, speed controlled elevated pedestrian crossing zones, use of roundabouts, scientifically designed road humps, proper design of shoulders, control of speed in all residential areas and near traffic generators, use of speed cameras, increasing road visibility through quality markings and visibility enhancing materials, providing cycle lanes, promoting safe public transportation, have all contributed for making safe roads in HICs and some examples are also available from few LMICs (WHO, 2004).

**What vehicle manufacturers can do**

- Ensure that all motor vehicles meet safety standards set for high-income countries regardless of where the vehicles are made, sold or used – including the provision of seat-belts and other basic safety equipment.
- Begin manufacturing vehicles with safer vehicle fronts, so as to reduce injury to vulnerable road users.
- Continue to improve vehicle safety by ongoing research and development.
- Advertise and market vehicles responsibly by emphasizing safety.

**Source:** World Report on Road Traffic Injury Prevention, 2004

Engineering measures, once implemented, are not essentially dependent on the way people behave and do not require changes every time he or she uses that environment and related products. It does not require constant supervision and vigilance and are automatic and constant. Once developed and made with utmost safety concerns, they have a long life and increase safety even with an increase in the number of people using them (Robertson, 1992). Initially there may be a cost for the development of research and technology, but over time, usage by large number of people will reduce these costs.

Road safety and Injury prevention series
EMERGENCY & TRAUMA CARE
National Institute of Mental Health and Neuro Sciences

Further, it might even reduce indirect costs over time, which is currently being spent to enforce safety behaviour or educate people for safe behaviour. Review and evaluation of these interventions have shown these measures to be highly effective and governments and societies in HICs have strongly accepted this approach and are found to be cost effective.

Developing and implementing these measures to see that road crashes do not occur in the first place are primary prevention approaches (eg., legislation for seat belts, developing roads to control speeds, road engineering for pedestrian safety etc.,) and this requires a strong emphasis in India to address crashes occurring at crash site. Secondary prevention aims at provision of early care for the injured (eg., prehospital and emergency care), while tertiary prevention addresses rehabilitation services for those injured. Combined approaches and passive countermeasures are found to be beneficial in the long run combined with increasing safety awareness among people. Technology plays an effective role in road safety by focusing on passive countermeasures and can also bring in rapid results. Delivery and implementation of interventions needs a judicial and cost effective combination of engineering (vehicles / roads), enforcement (safety laws and regulations in all places), and education (incorporating safety behaviours in day to day practices) along with timely emergency care.

## 13.4. Trauma care

In India, trauma care is a crucial requirement in road safety as nearly half of the deaths occur in hospitals. Well organized trauma systems have reduced mortality by 15 – 20 % and decreased preventable deaths by nearly half (Mann 1999). Trauma care is a continuum of activities and

**What health professionals can do**

- Integrate injury prevention into public health agenda.
- Develop epidemiology of injuries in your area
- Undertake capacity building for injury prevention
- Strengthen emergency care &rehabilitation services
- Augment trauma care skills at peripheral levels
- Integrate road safety into other general programs (transportation, work safety, home safety, etc)
- Undertake advocacy along with lobbying and networking for road safety by providing leadership and co ordination
- Support and conduct research for developing and evaluating interventions
- Translate research to policies.

**Source:** World Report on Road Traffic Injury Prevention, 2004

aim at getting the right patient, to the right place, in the right time, for the right treatment (Mock et al 2004). It includes all activities from the time of occurrence of injury till the injured returns to optimum functioning. The key components of a trauma care system include efficient prehospital care, appropriate hospital care and adequate disability reduction activities. The major focus should be on adopting uniform guidelines, training for all staff, improving quality of care and better coordination mechanisms (WHO 2009). In the current five year plan, number of trauma care centres are being established in the golden quadrilateral program, EMRI 108 ambulances have been added and training for health and allied professionals have started. Prehospital care includes several activities like effective communication, first aid and stabilization, safe transportation, early training, proper referral along with aspects like proper documentation of information (Sasser 2005). Acute in-hospital care aims at immediate management of injured through recognition of injuries, training, investigative and managerial care, and facilitating recovery. The standard steps of initial assessment, emergency care, critical management, and appropriate referral should be followed. Many supportive factors like education, data collection and research play a vital role in shaping and improving quality of care.

In India, trauma care is more of an urban phenomenon. Manpower, facilities and supplies are grossly deficient in rural areas and consequently, negative outcomes are much higher. To strengthen prehospital and emergency and acute care in India,

- Minimum guidelines and standards for management of persons with RTIs and other injuries at both crash site and in hospitals should be developed.
- Basic first aid courses for health and first aid responders in the community like police, teachers, commercial vehicle drivers, students and others in a prioritized manner should be developed.
- Safe transportation of injured should be encouraged with the primary focus of delivering basic care and early transfer of injured persons.
- Adequate facilities in terms of manpower, supplies, equipment, and communication should be available in all district hospitals and medical college hospitals.
- Road safety, injury prevention and training of emergency care physicians and nurses should be included in the curricula of medical and nursing schools needs to be improved.
- Trauma audits should be an integral part of activities in medical college, district hospitals and apex tertiary centres.

## 13.5. Rehabilitation of the injured

Nearly one third of disabilities are because of injuries. It is ironical and paradoxical that children saved from communicable and infectious diseases are only becoming victims of injury and violence in their later ages. Every injury results in physical, social or emotional disability resulting in poor quality of life among the survivors. There is no data available in India in this area. An integrated approach towards rehabilitation requires combined services and different sectors.

Development and growth of technology and diagnostics along with advanced trauma care practices has resulted in improved outcomes of trauma patients. At the same time, increasing costs of trauma care have been a growing concern. With better management, injured persons are able to survive adding higher demand for rehabilitation services. This has resulted in discharge of many injured persons with varying levels of disabilities at the end of the hospital stay. It is known that appropriate management of injured persons soon after the occurrence of injury can result in significant decline of mortality and also reduce disabilities. Preventing secondary injuries requires development of deliverable health care services from injury site till the point of discharge. There is an urgent need to

- Undertake an assessment of the situation with regard to the burden of disabilities and availability of services.
- Formulate policies and programs and develop national standards for rehabilitation services at different levels of health care system.

## 13.6. NGOs and civil society

Non-governmental organizations at different levels (international, national and local NGOs), both within and outside health sector including those from social welfare, education and others can be involved effectively in this area as they are closer to communities, work at local levels, are in a better position to influence interventions at different levels and can take up advocacy activities. While there are few NGO's in transport, environment, ambulance services and others, there is a paucity of road safety NGO's in India. In this scenario, existing agencies need to be empowered to take on an additional role as new agencies can be set up or encouraged in this area. The Ministry of transport supports NGOs through grants and projects for road safety activities. These agencies should be encouraged to take an active role by provision of knowledge, identifying areas of participation, along with greater involvement.

**What communities, civil society groups and individuals can do**

- Encourage governments to make the roads safe.
- Identify local safety problems.
- Help plan safe and efficient transport systems that accommodate drivers as well as vulnerable road users, such as bicyclists and pedestrians.
- Demand the provision of safety features, such as seat-belts, in cars.
- Encourage enforcement of traffic safety laws and regulations, and campaign for firm and swift punishment for traffic offenders.
- Behave responsibly by:
  - abiding by the speed limit on roads;
  - never driving when over the legal alcohol limit;
  - always wearing a seat-belt and properly restraining children, even on short trips;
  - wearing a crash helmet when riding a two-wheeler.

**Source:** World Report on Road Traffic Injury Prevention, 2004

## 14. Measuring results – Monitoring and evaluation

The absence of monitoring and evaluation at different levels for road safety activities in India is glaring. Monitoring and evaluation forms the core component of all public health programs, and road safety programs. There is a need for tracking changes, identifying emerging problems, monitoring the impact of interventions, making mid course corrections along with setting guidelines for future activities. All road safety programs should be monitored and evaluated for progress of implementation and results. The results should show changes in crashes, deaths, hospitalisations, disabilities and economic benefits to the country. In addition, it should also be measured for institutional progress and larger impact of safety programs.

Data and indicators are crucial for monitoring and evaluation of road safety activities. In India, a set of minimum operational indicators should be developed to measure the progress of road safety and all other activities. Indicators should be developed at national, state and local levels. For eg., national indicator on helmet use can be – number of Indian states notifying helmet laws, while at state level- it can be number of adult motorcyclists wearing proper helmets. A qualitative indicator can be the type of helmets worn. This requires setting up mechanisms at the national and state levels. Establishing and / or supporting a rage of data systems (through surveillance, registries, data bases, surveys, focused studies, etc.,) in transport, police, insurance and health is crucial for this activity.

## 15. Role of Ministry of Health

Ministry of Health and Family Welfare has a major role to play in implementing road safety activities and has defined roles and responsibilities (WHO 2007). The specific roles of the Ministries of Health are to

- Strengthen trauma care and rehabilitation programs
- Establish data collection mechanisms and channels for application of data
- Support implementation of interventions by collecting data on risk factors
- Support and undertake advocacy activities for road safety
- Monitor and evaluate the impact of interventions on a scientific basis
- Facilitate the development of a lead agency
- Enable development of road safety policies and programs by providing leadership
- Undertake capacity building activities in health and related sectors

For carrying out these activities effectively and on a continuous basis, the MOH needs to establish a small cell and to have a small team of professionals. This team needs to be provided adequate budget, facilities and support to carry out the activities. The activities of this cell should also cover other injury problems as well.To begin with, a full time nodal officer should be identified in the Ministry for coordinating all road safety and injury prevention activities.

In conclusion, it is time India moves from a 'reactive phase' to a 'proactive phase' in road safety. The loss of more than 1,75,000 persons (majority being young) and hospitalizations of millions across the country should make all concerned to develop and implement road safety on scientific and programmatic approaches. This requires Political commitment, Professionals involvement, Protective media and People's participation. It is time to act.

**We know, life is not "as usual" for thousands of affected individuals, families and children after road crashes**

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# WEAR. BELIEVE. ACT.

## DECADE OF ACTION FOR ROAD SAFETY 2011-2020

The UN Road Safety Collaboration has developed a Global Plan for the Decade of Action for Road Safety 2011-2020 with input from many partners. The Decade of Action for Road Safety is an historic opportunity for India and many other countries to develop a framework for action which could ultimately save significant number of lives across the ten-year period. The vision is a world in which mobility is safe for all those who use the world's roads. The alternative is grim: if no action is taken to address the current crisis, road traffic fatalities are forecast to rise from the current level of nearly 1.3 million deaths annually to more than 1.9 million deaths per year by 2020. The goal of the Decade is to stabilize and then reduce the number of lives lost. The Global Plan for the Decade of Action for Road Safety, prepared by the United Nations Road Safety Collaboration and many other stakeholders, outlines a course of action for ensuring that this vision becomes a reality.

✠ The overall goal of the decade will be to halt or reverse the increasing trend in road traffic fatalities around the world by increasing activities at the national level, through:

- Setting an ambitious target for reduction of road fatalities by 2020;
- Strengthening the architecture for road safety;
- Increasing the level of funding to road safety
- Increasing human capacity within countries relating to road safety;
- Providing technical support to countries using successful experiences from others;
- Improving the quality of data collection at the national, regional and global levels;
- Monitoring progress on a number of predefined indicators at the national, Regional and global levels including both the public and private sectors.

✠ Categories or "pillars" of activities are:

- building road safety management capacity
- improving the safety of road infrastructure and broader transport networks
- further developing the safety of vehicles
- enhancing the behaviour of road users , and
- improving post-crash care.

✠ Details of Activities:

- Activity 1: Increase global funding for road safety.
- Activity 2: Advocate for road safety at the highest levels.
- Activity 3: Increase awareness of risk factors and the prevention of road safety
- Activity 4: Provide guidance to countries on strengthening road safety management systems and implementing road safety good practices and trauma
- Activity 5: Improve the quality of road safety data collection

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Details available at: http://www.who.int/roadsafety/decade_of_action/en/index.html