1. INTRODUCTION

Being on the upward growth of economic and social development amidst political changes, India is passing through a major socio-demographic and epidemiological transition with consequent changes in health scenario. With a population of more than a billion, India is facing the triple epidemic of Communicable and infectious diseases, Non-Communicable diseases and Injuries, amidst limited resources to manage these problems. Noticeably, in the last 2 decades, India has shown progress in prevention and control of certain diseases like polio, leprosy, tetanus, cholera, guinea worm, and nutrition related diseases with development of national policies and programmes (MOH & FW, 2002; Agarwal, 2005). The health sector has made rapid progress in expansion, coverage and technology, even though overall spending on health has not increased significantly (CSO, 2004). Political commitments and policy reforms has given a major impetus for changing health status of Indian communities.

A broad examination of changing social, economic, cultural, and environmental and health changes in India is worth examining to identify the emergence of Injuries and Road Traffic Injuries (RTIs) as a major public health problem. Table 1 highlights some of these changes during the last 2 decades. India with a population of 1,028,610,328 spread over 593 districts, 4378 towns, 6,38,365 villages and 35 towns/urban agglomeration (with a million plus population) units with varying population densities ranging from 13/km^2 to 9194/km^2 is diverse in several ways (RGI, Census 2001). Children and elderly constitute 42% and 6.8% of total population. Notably India has a large share of young and adult population accounting for more than 50% of total population. The literacy level has increased to 66% with male to female rates of 76% and 54%, respectively, during the period 1980-2001. Poverty levels have shown a gradual decline from 45% in 1973-74 to 26% by 2001 with significant differences across states (CSO, 2004). However, unemployment is still noticed to be more than 1/3 in the population of working age groups. Agriculture contributes for nearly one fourth of GDP (India, 2003). India with an urbanization rate of 28% is witnessing major changes in cities and rural areas. Nearly 285 and 742 million people live in urban and rural areas, respectively. The extent of urbanization varies from 14% in Maharashtra to as low as 0.1% in Arunachal Pradesh. During the period 1991-02, urban population grew by nearly 31% (Census, 2001). Industrialization has seen a significant development resulting in growing economy and increasing purchasing power of people. Migration has been growing at an unprecedented pace increasing from 22% in 1981 to 29% in 1991, nearly more than a third linked to employment. The inroads of print and visual media into the minds of people have been phenomenal. The values, beliefs and attitudes of present day Indians are undergoing a sea change in all spheres of life. The emergence of nuclear families, growth of empty nest syndrome, liberalized attitudes of youth, growing rate of alcohol and drugs, upsurge in violence are some emerging features. The combined influence of all these changes

has resulted in the origin of complex new environments in which survival is the need of the hour with safety relegated to the periphery.

At the same time, epidemic(s) of Non-Communicable Diseases and Injuries are also in place. With reductions in infant mortality, child mortality, crude death rates and marginal decline in maternal mortality, the life expectancy of people has increased from 56 years at birth in 1981 to 64.8 yrs by 2001 as shown in Table 1. Elderly today are increasing and living longer and are likely to increase to 8% of total population by 2010 (Census, 2001). Liberalized market oriented economies, increasing motorization and urbanization, changes in living standards and practices of people, impact of media and interaction of people with numerous products on road, at home and in work place has brought man made INJURIES to the forefront of health care delivery system. Injuries contribute for more than 10% of total deaths and 15% of DALYs (WHO, 1999). Based on data from WHO, the newly launched Integrated Disease Surveillance Programme highlights that Road Traffic Injuries (RTIs) are the sixth leading cause of death in India (IDSP, 2005). Among various injuries, RTIs contribute for a larger share of hospitalizations, deaths, disabilities and socioeconomic losses in young and middle-age population.

2. PURPOSE AND OBJECTIVES

The purpose of the present report is to identify the public health burden, impact, causative patterns and determinants of RTIs in India. The report highlights the burden on the health sector, while focusing on opportunities for prevention. The ongoing efforts for RTI prevention are briefly examined along with current mechanisms of road safety. The report draws on experiences and lessons learnt in the field of RTI prevention and lays a road map to save lives and limbs in the Indian region. Finally, the report indicates Policy, programme and research initiatives required for future.

The specific objectives were to:

a) assess the burden and impact of road traffic injuries and deaths,

b) understand the causes for RTIs,

c) examine current policies, mechanisms and interventions for RTI prevention, and

d) recommend strategies and approaches for road safety in India

Myth: When people don't want to be safe, what can we do?

Fact: People always wish to live the way they want to live. But, educating them; handing over safe products; making them live in safe environments (people friendly forgiving system) is the responsibility of everyone in society.

Table 1: Select health and related information of India (1981 To 2001)

		1981	1991	2001
A.	Proportion of population below poverty line			
	Combined	44.5	36.0	26.1
	Rural	45.7	37.3	27.1
	Urban	40.1	32.3	23.6
B.	Total Literacy Rate (in % for population > 7 years)			
	Combined	36.0	52.0	66.0
	Male	47.0	64.0	76.0
	Female	25.0	39.0	54.0
C.	Vital Statistics			
	• Crude Birth Rate			
	Combined	33.9	29.5	25.4
	Rural	35.6	30.9	27.1
	Urban	27.0	24.3	20.3
	• Crude Death Rate			
	Combined	12.5	9.8	8.4
	Rural	13.7	10.6	9.1
	Urban	7.8	7.1	6.3
	• Life expectancy at Birth			
	Persons	56.0	61.1	64.8
	Male	55.6	60.6	64.1
	Female	56.4	61.7	65.8
	• Infant mortality per 1000 live births			
	Combined	110	80	66
	Rural	119	87	72
	Urban	62	53	42
	• Under five mortality rate	41.2	26.5	20.4
D.	Health Manpower and Infrastructure			
	• Health personnel per lakh population for the years 1981, 1991 and 1998			
	Doctors	39	47	53
	Nurses	21	40	70
	Auxiliary Nurse Midwife	10	18	35
	• Number of Community Health Centres	214	2070	3043
	• Number of Primary Health Centres (1981, 1991 and 1998)	5740	20450	23179
	• Number of Sub centres	47112	130984	137311
E.	Health investment (as % of total investment)			
	Health	1.8	1.6	2.1
	Family welfare	1.3	1.3	1.8
	Total Health and Family welfare	3.1	2.9	4.0
	Per capita health expenditure (at current prices)	14	54	167

Source: CSO, 2002

		1980	1985	1990	1995
F.	Deaths due to*				
	Communicable and infectious diseases	27.4	27.0	23.0	22.3
	Non-communicable diseases	51.9	51.1	56.3	54.0
	Road traffic injuries	1.0	1.2	2.0	2.4
	Injuries	5.0	6.0	8.5	10.0

*Source: Mari Bhat P.N. Emerging trends in mortality in India. Institute of Economic Growth, New Delhi. Based on comprehensive review of data available from SRS, SCD, NFHS and Population census for the period 1980-1995. http://www.demogr.mpg.de/Papers/Workshops/020619_papers 06.pdf accessed on 22nd June, 2005.

3. METHODOLOGY

The present report is based on secondary data from various sources in India. Reports available from National Crime Records Bureau (NCRB, 2002), Ministry of Road Transport and Highways (MORTH, 2001-02), Survey of Causes of Death (SCD) (RGI, 1998a) and Medical Certification of Causes of Death (MCCD) (RGI, 1998b) in India have been reviewed in depth. Scientific publications and unpublished literature were obtained from individual institutions, researchers and local libraries across the country. Extensive web search was undertaken on selected key words from established data bases and by advanced search techniques. The available materials were examined in detail and classified under specific categories. Information on road safety policies was mainly carried out by web search. Focused discussions were held at local level with concerned ministry representatives and experts in Bangalore. Evidence based interventions have been drawn from WHO/World Bank report, Cochrane Review database on Road Traffic Injury Prevention (2004a), recent report by Mohan D (2004) and from published literature. The initial drafts of the report were critically reviewed in depth by Kruge E, Peden M and Melecki K of World Health Organization, Geneva; Varghese C, Office of WHO Representative for India, New Delhi; Mohan D from Transport Research and Injury Prevention Programme, IIT, New Delhi and Andrew Downing – India Coordinator for Global Road Safety Program. All suggestions by experts have been incorporated into the final report.

4. MOTORIZATION AND TRANSPORTATION GROWTH

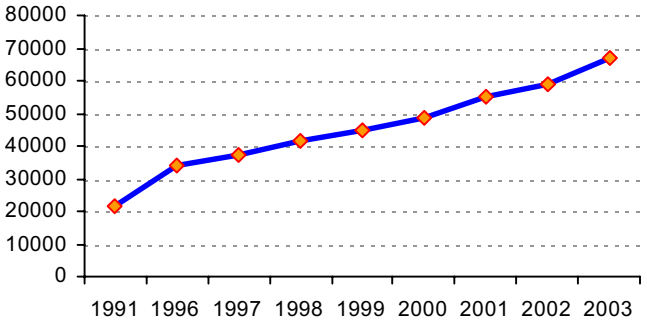
Transport and mobility are basic requirements of Indian life and lifeline of economic growth and development. The growth of motor vehicle industry, liberalized economic policies of successive governments, aggressive media promotion, increasing purchasing power of people, easy accessibility of loans through public and private sector banks, unreliable and unsafe public transport systems, changing values of youth have all contributed for increasing motorization and changing transportation scenario in the country. Unplanned and unsafe traffic environments with high density of vehicles and human beings is not only a place for road traffic deaths and injuries, but also a cause for psychosocial stress, air and sound pollution leading to poor quality of life and accompanying health hazards.

Motorization pattern in India has been unique with rapid growth in urban and semi urban areas, while large parts of country still do not have accessibility to motorable roads and rely heavily on non-motorized transport. Secondly, the increasing movement of people and transport of goods has resulted in high exposure and conflicting interactions of man with vehicle and roads. Thirdly, while population and motor vehicles (and non motorized transport) has increased, safety infrastructure and policies have totally lagged behind.

The changing trends of motorization reveal that the total number of registered vehicles increased from

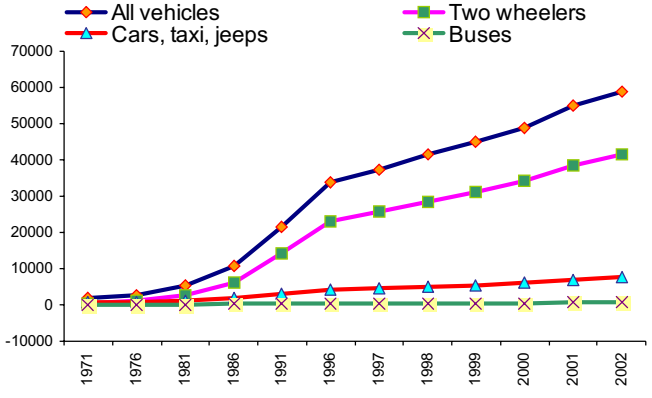
5,391,000 in 1981 to 21,374,000 in 1991 (increase by 4 times in a decade) to 58,863,000 by 2002 (increase by nearly 3 times in the next decade) as shown in Figure 1 (MORTH, 2002). The trend also reveals that while public transport buses increased slightly from 331,000 in 1991 to 669,000 by 2002, Motorized Two Wheelers (MTWs) have risen from 14,200,000 to 41,478,000 in the same period (Figure 2a). In addition, motorization has been rapid in states where socioeconomic growth also registered an increase during the same period. Further, the 23 metropolitan cities have seen a quantum jump in vehicle population in the last 10 years with some of the cities adding more number of vehicles in a short period of time, as in Figure 1a and 1b (annexure). In India, two-wheelers and cars account for more than 80% of vehicle population in large cities. Personalized vehicle population has been found to be more than 90% in 6 out of 13 sample cities (Singh, 2005). The share of buses is negligible in most Indian cities like in Kanpur, Hyderabad and Nagpur at the rate of 0.1, 0.3 and 0.8%, respectively. Due to increasing travel from towns and villages, large number of vehicles enter cities, adding to existing vehicles already plying on their roads.

Figure 1: Growth trends of vehicles (000's).



Source: MORTH, 2002

Figure 2a: Motorization pattern in India, 1971-2002 (000's)



Source: MORTH, 2002

Among the total vehicles, nearly 71% are Motorized Two Wheelers (MTWs), 12% are cars/jeeps/ taxis, 1% buses with the remaining 15% constituted by other vehicles (Figure 2b). This national distribution is not uniform, as nearly 80-85% of vehicles are motorized two wheelers alone in some states and cities in the country (Figure 2a, b & c in annexure). During the year 2001-02 nearly 3,473,401 two wheelers were added to roads of Andhra Pradesh, while the number of cars added was just 2,79,903. Similarly in a city like Bangalore, nearly 1.2 million two wheelers were added in 2001-2002 as against 11,267 buses and 2,34,888 cars with total vehicle fleet increasing from 1,08,437 in 1976 to 19,82,142 by 2004, an increase by 20 times. Nearly 35/1000 persons own a two-wheeler, an increase from 16/1,000 in 1991, while car ownership has risen from 3.5 to 6.1/1,000 in the same period (MORTH, 2002; CSO, 2002).

Table 2 shows the vehicle distribution in India and some high-income countries of the world. While cars account for nearly 60-80% of total vehicles in high-income countries, two-wheelers account for less than 5% of total vehicles. Conversely, India has 70% of its vehicles being MTWs alone. This major difference influences number of factors like mobility, speed, traffic density, volume and primarily the risk of exposure. Among other modes of transport, non-motorized transport (NMT) by pedestrians and bicyclists constitute a major share, while animal driven transport is still in place in many parts of rural India. Hence, even though motorized vehicles constitute a visible mode of travel, cycling and walking constitute a significant mode of transport and is often difficult to quantify. Since the existing road space is shared to a larger extent by this group, road conflicts are usual in almost every place. Road safety systems (road – vehicle) developed in HICs are focused on making car occupants safer. This major difference highlights the need for focusing on developing systems more applicable to Indian users.

Figure 2b: Distribution of vehicles in India 2003 (%)

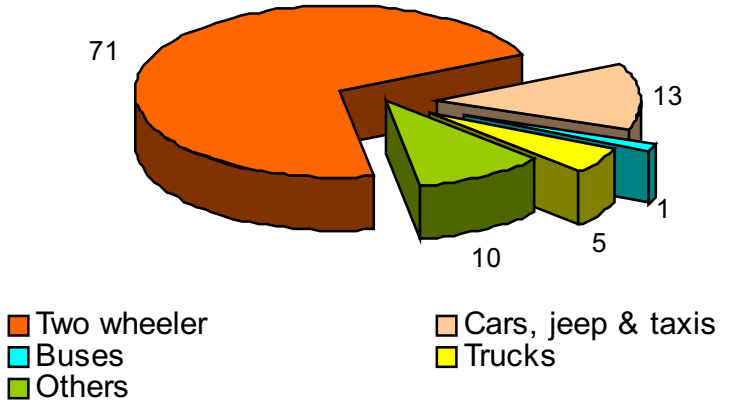


Table 2: Category wise vehicles registered in High Income Countries and India, (%)

Vehicle Type	Australia	Canada	USA	Japan	UK	India
Two wheelers	3	2	2	2	5	71
Cars	79	71	58	71	87	13
Buses*	1	1	1	1	1	1
Trucks	4	3	3	25	1	5
Others	13	23	36	1	6	10

* Rounded to nearest total number

Source

Australia	http://www.abs.gov.au/Ausstats/abs@.nsf/accessed on....
Canada	http://www40.statcan.ca/l01/cst01/trade14a.htm
USA	http://www.transtats.bts.gov/
Japan	http://www.jama.org/statistics/motorvehicle/inuse/mv_use_year.htm
UK	http://www.dft.gov.uk/stellent/groups/dft_control/documents/contentservertemplate
India	http://www.morth.nic.in/motorstat/Table 20 No11.htm

Ingram and Liu (2002) in a recent review concluded that per capita income, land use patterns, population density, rate of motorization, urbanization, fuel rates and presence of mass rail transport systems determine motorization pattern in every country at national level and, a subset of these in urban areas. Undoubtedly, economic growth propels demand for transport, greater reliance on motor vehicles and road infrastructure development. Motorization usually expands at a greater rate according to per capita income. In all countries, with an increase in per capita income and population, motorization has shown direct correlation during 1970-1990, with the converse also being true in some places. This has great relevance for India as both per capita income and motorization has been increasing in the absence of safe transport and road safety policies and programmes.

The Asia/Pacific region has only 16% of world's motor vehicles, but 54% of world population and contributes for 45% of total road deaths. Without increased efforts, resources, new initiatives and a sociopolitical commitment, the number of road traffic deaths and injuries worldwide is forecast to increase by 65% between 2000 and 2020, and in low and middle income countries by nearly 80% (WHO, 2004a).

Some historical aspects..... vehicles

- First long intercity coach… The first long intercity coach was introduced between London and Edinburgh in 1670, covering a distance of 631 km. The coaches were called "Stagecoachers", because they traveled in stages, stopping at scheduled places enroute for change of horses.
- First passenger carrying automobile…The world's first passenger carrying automobile was steam powered road vehicle with carrying capacity of eight. Developed by Richard Trevithick it first ran on December 24, 1801 in Camborne, Cornwqall (England). In 1804, Trevithick mounted this engine on a four wheeled undercarriage designed to roll along a track, and succeeded in pulling 5 wagons carrying 70 men and about 9 tons of iron loads along 15km long track
- First modern omnibus…In 1829 the first modern omnibus was introduced in London by George Shiller to facilitate the movement of factory workers with a seating capacity of 20.
- First "automobile"…The "automobile", the car as we know, was invented by two Germans, Daimler and Benz. In 1884 Benz produced a vehicle driven by spirit-fuelled engine. In 1885 Daimler developed better engine, which was later used in 1887, by French firm to manufacture vehicle whose basic shape was very much like modern cars.
- The first two-wheeler in the world was made by Hilde Brand and Wolf Mueller in Germany in 1894.

Indian First … ·

- The first car in India was that of Mr. Foster of M/s Crompton Greaves Company. It was brought to India in 1897.
- The first Indian to own the car was Mr. Jamshedji Tata in 1901.
- The first taxi arrived in India in the year 1911 and Bombay received this honor.
- The first woman to drive a car in India was (perhaps), Mrs. Suzanne R. D. Tata of Mumbai, around 1905.
- The first woman truck driver Parvati Arya of Madhya Pradesh started driving in the year 1975.
- The first woman taxi driver Jasbir Kaur of Calcutta started driving her Ambassador taxi in the year 1989.

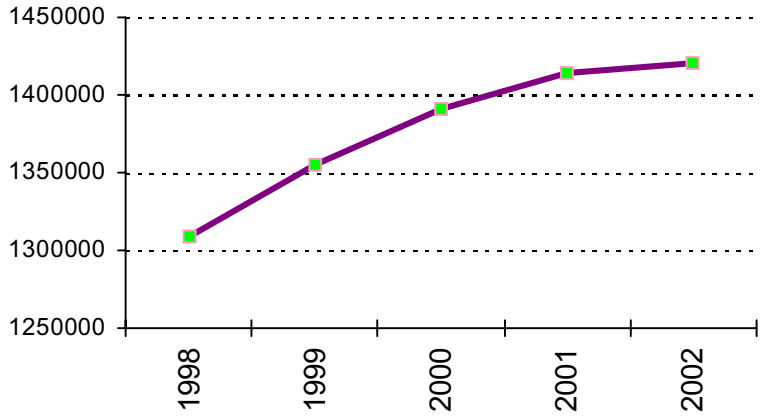
Source: Pasricha P. S. (2000)

4.1 Road Infrastructure development

The country's road network can be broadly classified as national highways, state highways, major district roads and rural roads. India has a total road network of approximately 33.83 lakh ('00,000s) kms with national highways, state highways, Public Works Department roads and urban roads constituting 2%, 4%, 21%, and 7%, respectively (MORTH, 2004). Surfaced road lengths have increased from 1.31 lakh kms^2 to 14.2 lakh kms^2 during the period 1998-2002. National highways (2%) carry around 40% of total road traffic, while state highways together with district roads carries 40% of traffic. While infrastructure growth has failed to keep pace with motorization, the quality of existing roads for safe mobility has been a matter of great concern. The scientific principles of road engineering followed in all HICs is not practiced in India and receives little or no importance, thus making our road environment unsafe from a health perspective.

The assumption that economic growth, increasing motorization and road infrastructure expansion leads to increase in road deaths and injuries is a myth as revealed by experience of HICs. Road deaths and injuries have decreased in many industrialized countries despite increase in motorization and road infrastructure expansion (Kopits and Cropper, 2003). The economic development often linked to motorization along with other factors showed a direct linkage between sharp rise in road deaths per head of population as GDP per capita increased only up to a certain level and not further beyond.

Figure 3: Development of road infrastructure in India, 1998-2002 (Km^2)



Source: MORTH, 2002

Some Historical Facts... Transportation

- The first traffic signal in India was installed in Mumbai at the junction of Mayo Road and Veer Nariman Road between Churchgate and Flora Fountain on 1st June, 1955.
- First Roads … Roads are as old as 3500 B.C. One of the oldest system was the "old silk trade route", connecting China with Rome passing through India and spreading over a distance of nearly 9700km.
- First paved streets … The concept of paved village streets first appeared in Mesopotamia around 4000 BC. Historians agree that the first major town was probably Jericho (near Jerusalem), which began its settlement about 10,000 years ago. (8000 BC)
- First paved roads … It was during the Roman Empire (100BC-400AD) that the extensive system of paved roads was constructed in order to facilitate efficient movement of troops and military supplies.
- First metal and concrete road … The first extensive hard surfaced road was commissioned in 1795 in America, using stones and gravel.

  First pedestrians crossing… was introduced in Britain in 1934, just marked by dotted lines.
- Zebra crossing…started in October 1951, the double white lines were introduced in 1959 in Britain.
- First traffic signal…The first traffic signal was installed at the intersection of 105th street and Euclid Avenue in Cleveland (USA). It had, however, only red and green phases. A bell was rung during change from green to red, and vice versa. It was only in 1918 that the first 3 color light signals were installed in New York city. These were however manually operated. The first automatic three-color light system was introduced in 1923. Interestingly, in England it was not an offence to disobey traffic signals until a law was passed in 1930.
- First fly over … The first fly over was constructed in Great Britain in 1939 over junction of Alton Road and Alresford Road.
- Street lighting…Oil lamps were installed for the first time in Paris in 167 for illuminating certain streets during the winter season. First electric lamp was later used in 1842 in Paris. Low-pressure sodium lamps were used for the first time in 1932 in Netherlands, and high pressure mercury amps were used in USA in 1935.

Source: Pasricha P. S (2000)

4.2. Transportation patterns

A characteristic feature of Indian road environment is the sharing of same available space by different modes of transport viz., buses and trucks, motorcycles, three wheeled auto-rickshaws bicycles, pedestrians and hand or animal drawn vehicles. Vehicles of different sizes, capacities and shapes fight for the same space to cover travel distance in a short time. In addition, Indian highways pass through a large number of villages and towns with dense populations. Further, the spatial distribution of various community agencies like schools, colleges, hospitals, religious places, public offices, business centres (including small and petty shops) on both sides of road ways result in frequent movement (and crossing of roads) of people, goods and vehicles. Along with motorized transport, non-motorized modes of walking and cycling is significant and large. This heterogeneous traffic is affected by income levels, transport needs and availability and modes of travel (urban/rural; highway/non-highway; arterial/non-arterial, etc). Understanding these transportation needs and modes is vital to develop road safety in India.

An imbalance between transport infrastructure vis-à-vis needs has resulted in transport crisis and also a toll on human life. Nearly 30% of total vehicles ply in cities catering to 11% of total Indian population. Personalised modes of transport was > 90% of total vehicle population in 6 out 13 sample cities, while public modes of transport are < 1% of total vehicles. The modal split in terms of percent of trips made on different modes indicate that share of mass transport is well below the desired range, while personal modes are already high in most Indian cities (Singh, 2005) (Table 3a and 3b). A large share of private vehicles increase the risk of exposure of large number of people, who in turn run vehicles based on their experience and behaviour. This trend is gradually expanding to B and C grade metropolitan cities as well. In this context major parameters influencing safety are - total number of vehicles, characteristics of traffic flow and speed (relating in a linear relationship) with other closely interlinked factors.

Table 3a: Existing Modal Split in Indian Cities (as a % of Total Trips)

City Population (in millions)	Walk	Mass Transport		Slow	IPT Car	Two-wheeler	Bicycle
	Total		Fast				
0.10–0.25	37.1	16.4	10.4	20.1	3.3	24.1	25.7
	100.0						
0.25–0.50	37.8	20.6	8.9	17.2	2.6	29.8	20.9	100.0
0.50–1.0	30.7	25.4	8.2	12.0	9.5	29.1	15.9	100.0
1.0–2.0	29.6	30.6	6.4	8.1	3.3	39.6	12.1	100.0
2.0–5.0	28.7	42.3	4.9	3.0	5.0	28.9	15.9	100.0
5.0+	28.4	62.8	3.3	3.7	6.1	14.8	9.4	100.0

Source: Ministry of Urban Development, Government of India, New Delhi. 1998. *Traffic and Transportation Policies and Strategies in Urban Areas in India*. Final Report; In: Singh, 2005.
Note: IPT denotes intermediate public transport vehicles such as taxies and three-wheeler autorickshaws.

Table 3b: Desirable Modal Split for Indian Cities (as a % of Total Trips)

City Population (in millions)	Mass Transport	Bicycle	Other Modes
0.1–0.5	30–40	30–40	25–35
0.5–1.0	40–50	25–35	20–30
1.0–2.0	50–60	20–30	15–25
2.0–5.0	60–70	15–25	10–20
5.0+	70–85	15–20	10–1

Source: Ministry of Urban Development, Government of India, New Delhi. 1998. *Traffic and Transportation Policies and Strategies in Urban Areas in India*. Final Report; In: Singh, 2005.

There is no systemic data available in India on transportation patterns covering highways, urban and rural roads. Studies undertaken by Transportation Research and Injury Prevention Programme (TRIPP), IIT, New Delhi indicate that the share of NMT varies between 30-70% during peak hours in some cities with variation in timings and location. Bicycle transport still occupies a major mode of travel in towns, rural areas and even in cities. In small town and villages, bicycles are still an important mode of transport accounting for 15-35% of trips (Mohan D, 2002; 2004a; Tiwari G, 1998). In many parts of rural India where income levels are low, the non-motorised modes of travel (walking, cycling, animal drawn modes, etc) are high.

As part of the "Suraksha Sanchar" programme in Bangalore, the 'Bangalore Agenda Task Force' undertook studies on travel pattern of people in select areas (Kirk et al, 2003; BATF, 2005). Nearly, 55% of the journeys started from the individual's home, while 38% were returning home. Majority of other journeys involved - coming from or going to an office, factory, shop, school or other place of personal interest. The study further indicated that people traveled quite often, with more than 50% traveling more than 5 times a week and rest between 1 & 5 times per week. The various traffic generators and attractors in the survey were individual households, apartments, places of worship, hospitals, government offices, commercial establishments, educational institutions and recreational facilities. Apart from speed issues, heavy traffic volumes, parking problems, mixing of motorized and non-motorised traffic and absence of infrastructural facilities were major problems.

Surveys conducted by the Urban Safety Management Approach Project in Bangalore, Department of Transportation Engineering of the Bangalore University on 800 pedestrians and 800 drivers in experimental and control areas has revealed interesting observation (Kirk et al, 2003). The study sample consisted of predominantly men (57% pedestrians and 88% drivers) with 65% of drivers in the age group of 25-50 years, 17% in 21-24 years and 12% aged >50 years. *Among the 800 drivers, 51% were riding motorcycles, 15% driving cars, 23% auto rickshaws and 10% bicycles.* Nearly 1/5th of the pedestrians were children below 16 years of age. 28% of pedestrians were employed full time, 75% of drivers were employed full time and >40% were students. Among pedestrians, every journey accounted for 15-45 minutes on the road. More than 60% of pedestrians informed that they felt unsafe while traveling on the road; the commonly sighted reasons were - too much traffic (39%), had to walk on the road (19%), lack of safe crossing places (12%), increasing speed of vehicles (11%), absence of foot path (10%) and uneven foot path (7%), indicating that pedestrian travel facilities are totally ignored and highly compromised in favour of fast moving vehicles. Among the drivers, 70% reported that they were feeling unsafe on roads during time of travel. Several reasons sighted for being unsafe by the drivers was the volume and speed of traffic, uneven foot paths, people walking on roads, absence of safe crossing places, violation of traffic rules and inattention paid to safety regulations. The study clearly emphasized that both pedestrians and drivers of all categories of vehicles felt unsafe on roads.

Systems … some historical facts

- The red flag Act…The red flag act was passed in Great Britain in 1865 to warn the people of approach of motor vehicles that, at that time, were noisy, smoky, and tended to frighten the horses. The act specified that a man carrying red flag by day and a red lantern at night must walk in front of the motor carriage, whose speed was limited to two miles per hr in towns, and 4 miles/hr on country roads.
- First Speeding ticket…The first ever speeding ticket was handed out on 28th January, 1896 to Mr. Walker Arnold Kent (UK) by a tough cop who chased his car on bicycle and apprehended him for exceeding the speed limit by nearly 4 miles per hour. (The speed limit was 2kmph). The limit was raised to 12kmph in 1896, and to 20kmph in 1903.
- First Driving license system…the driving license system was first introduced in the year 1903 in Great Britain. The driver was required to pay 1 pound towards registration and 5 shillings for the driving license. Interestingly there was no driving test –one could get a license by just making stipulated payment at a post office.
- First legislation for transport in India …The motor vehicle act 1939 was the first legislation in India, which was revised in 1988.

These characteristics and travel patterns indicate the need for understanding and incorporating local socio-cultural issues and economic factors in scientific design of safe roads and vehicles and transportation systems in India (Tiwari, 2000; Mohan and Tiwari, 1998). An indepth understanding of people, economy, culture, travel patterns is crucial to make them safer in their own environments.

5. BURDEN OF INJURIES

Globally, injuries result in death of 16,000 people everyday and rank third in overall mortality. Injury is the leading cause of death in productive age groups of 5-44 years (WHO, 2004a). The term 'Injury' is defined as "the presence of a body lesion due to an external cause, either intentionally or unintentionally resulting from a sudden exposure to mechanical, electrical, thermal, chemical or radiant energy" (Cristofel and Gallagner, 1999; Barss et al, 1998). This sudden exposure due to agent-human and environment interaction results in organ damage when it exceeds the physiological tolerance of the individual (Roberton, 1983). Injuries are classified as unintentional (RTIs, falls, burns, drowning, accidental poisoning, work place injuries, injuries in disasters) and intentional (suicides, violence, war, etc) based on external causes.

As per World Health Organization estimates, nearly 5 million persons lost their lives in the year 2002 due to an injury, contributing for 10% of total deaths (WHO, 1999). Nearly 80% of injury deaths and disabilities occur in developing countries of the world, where health care resources are limited resulting in a huge burden on health sector (Nantulya and Reich, 2002). A selective examination of injuries in 5-44 years has revealed that injuries are one among the three leading

cause of death and disabilities. Global injury mortality rate was estimated to be 98/1,00,000 population with male to female rates of 128 and 67/1,00,000, respectively (WHO, 1999). Injuries contributed for 13% of total Disability Adjusted Life Years lost (DALYS) during 2002. Unintentional and intentional injuries accounted for 69% & 31%, respectively with RTIs (34%), being the major cause with a global mortality rate of 20/1,00,000. **RTIs resulted in 10% of total deaths and 29% of DALYs among injuries (WHO 2003)**. Men were affected 3-4 times more compared with women.

A review of available national data from the recent "Burden of Disease in India" by the National Commission on Macroeconomics and Health, Government of India, reveals that road traffic injuries are a major public health problem (Table 4). The health sector faces the maximum impact by providing diagnostic, curative and rehabilitative services and incurs huge expenditure (at a time when it is established that RTIs are predictable and preventable in nature). The data reveals that burden of injuries and RTIs is in no way less compared with other problems of cancer or tuberculosis in the country. It is vital to note that prevention of RTIs has not received due attention in comparison with other health problems. Ironically, even HIV/AIDS prevention has received greater attention and RTI prevention does not figure prominently in terms of activities and programmes.

Table 4: Estimated number of deaths and cases due to selected NCDs and injuries | in India.

Condition	Year	New Cases / yr	Old Cases / yr	Deaths / yr
Leprosy	2003-04	3,67,143	2,65,781	-
Tuberculosis	2000	7,95,000	20,000,000	4,00,000
Malaria	2000	1,781,336	-	
HIVAIDS	2004	- 28,000	51,00,000 (HIV) 1,11,608 (AIDS)	-
Diabetes	2000	30,000	25,814,117	-
Cardio Vascular Disorders	2000	-	27,040,914	1,631,591
Cancer	2000	8,00,000	2,400,000	5,38,858
Mental Disorders	2001	-	66,859,671	-
Stroke	2000		1,081,480	2,70,370
Injuries	2002	8,70,839	-	4,12,747
Road Traffic Injuries	2002	3,82,900 1,650,000*	-	81,873 1,10,000*

* Estimates for the year 2001.
Source: Burden of Disease in India, National Commission on Macroeconomics and Health, 2005

In India, as per official reports from National Crime Records Bureau (NCRB, 2002), nearly 2,57,936 accidental, 1,10,417 suicidal and 44,394 violence related deaths were reported in 2002 with corresponding rates of all injury mortality being 40/ 1,00,000. 62% of these deaths included persons in 15-44 years, with an overall male to female ratio of 3:1. As per the survey of causes of death report from Registrar General of India, injury related deaths increased from 9% to 11% during 1994-1998 (RGI, 1998a). 70% of total injury deaths occurred in 5-44 years and predominantly among men and primarily in rural areas. Suicides (25%) and RTIs (20%) were one among the ten leading causes of deaths in the country (RGI, 1998a). The Medical Certification of Causes of Death (MCCD) examining nearly 4,98,586 deaths revealed that injuries accounted for 12% of male and 13% of female deaths, with 69% occurring in 5-44 years age group (RGI, 1998b). Injuries were the first leading cause of death in 15-24 years (35%), 2nd in 5-14 years (17%) and 25-34 years (30%), 3rd in 35-44 years (19%) and 5th in 45-54 yrs (11%). In a collective review of injury burden and impact in India, data from available hospital based studies indicate that nearly 10-30% of total registrations are due to injuries with case fatality rates ranging from 5-20% across studies (Gururaj, 2005a). Small number of population based studies indicate injury problem to be much higher with incidence rates ranging from 51-127/ 1,000 population (Gururaj, 2005a). All studies, irrespective of data sources indicate that RTIs, suicides, violence, burns and work related (including agricultural related) injuries to be the most frequent and common injuries with **RTIs being the leading cause of deaths, hospitalization and disabilities in India**.

Injuries constitute one of the most serious unrecognized public health problems in India. Reliable, good quality, population based information is not available in the country as research has not been a priority area. A comparison of total number of deaths for priority public health problems indicate that injuries are the leading cause of deaths as shown in Table 4. Similarly, injuries are also the 4th major cause of morbidity in India. For every death, nearly 15-20 would be hospitalized and 30-50 receive care in emergency room departments of health care institutions. Thus 16-18 million would have been hospitalized and 40-50 million received care for minor injuries. It is estimated that injuries will contribute for nearly 1,000,000 deaths and 20 million hospitalization during the year 2005 (Gururaj G, 2005a). **The study outlined that RTIs - suicides - violence - burns - occupational and agricultural injuries were the leading causes of death and disabilities. Nearly 90% of these occur in rural and semi urban areas, >70% occur in 5-44 years age group, predominantly among men, nearly three fourths in poor and middle income strata of Indian society with an estimated economic loss of around 5% GDP for India.** The study further reiterated that nearly one third of any type of disability is due to an injury cause, majority of which are preventable. Several measures for comprehensive injury prevention, management and timely rehabilitation have been outlined in the report. It is estimated that approximately 1.1 million

deaths, 21 million hospitalization and 55 million minor injuries will occur in India by 2015, if no systematic efforts are made to prevent injuries.

At the global level, nearly 1.2 million persons were killed in road crashes during the year 2002 with 80% of these occurring in low and middle-income countries. RTIs contributed for 2.1% of total deaths (men=2.9%, women = 1.2%), and 21% of total injury deaths. (WHO, 2004a). Projection of road traffic fatalities indicate that global death rates will increase by approximately 66% over the next 20 years. While High Income Countries will notice a decline by 28%, Low Income Countries will register an increase of 92%, and India by 147% (Kopits and Cropper, 2003). Reviewing the disease transformation scenario at the global level, it is observed that RTIs will be the 3rd leading cause of death by 2020, moving from its present 9 th position (Murray and Lopez, 1996).

6. PUBLIC HEALTH BURDEN OF RTIS

The National Crime Records Bureau (NCRB) under the Ministry of Home affairs is the principal nodal agency for collection – compilation – analysis and dissemination of information on RTIs in India. The agency receives annual inputs from state and city crime records bureaus from all over India. The NCRB publishes annual reports entitled "Accidental deaths and suicides in India" and "Crime in India". The limitation of receiving good quality data from peripheral areas, total and timely reporting of all deaths and injuries and data analysis focus needs to be considered in final interpretation of

Measuring the burden of RTIs

- The public health burden and impact of RTIs are measured in several ways.
- Commonly available data are total number of deaths and injuries in absolute numbers for each state, union territory and city of India from NCRB and Ministry of Transport. This has the obvious limitation of underreporting of injuries and deaths and does not relate to any defined denominator on its own. It cannot be used in isolation for estimating public health burden. Nevertheless, this will be of practical use for making broad comparison in developing local programmes and for increasing awareness.
- RTI deaths and injuries can be calculated per 1,00,000 persons as it is ideal (for making comparisons) for estimating the health burden as the denominator is the population. Since data on all deaths and injuries are not available, the rates may be lower than actual burden.
- Fatalities per 10,000 vehicles provides a relationship between deaths and motor vehicles with the limitation being activities like walking , cycling and other non-motorized forms of transport, which are significant in the Indian region are not included.
- Another measure is deaths and injuries per vehicle kilometer traveled as this gives an estimate of risk based on exposure. This information is not available in India and some Indian states are making early efforts in this direction.
- DALYS measures life lost due to injury disability and mortality by combining both events but has its limitation in terms of data availability and application. A simple measure of disability prevalence due to RTIs is often a good measure but can only be obtained through hospital and population based studies.

Thus, each measure has its merits and demerits and choice of a method is often decided by purpose and source of data.

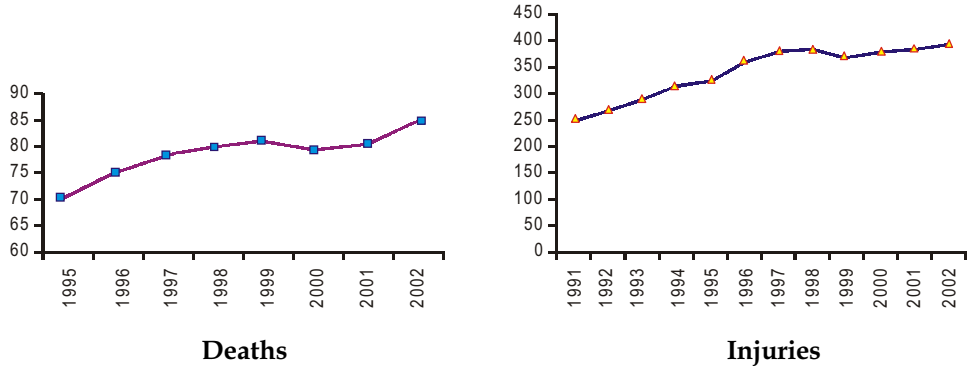
results. In addition, the Transport Research Wing of the Ministry of Transport and Highways also publishes limited information on deaths and injuries due to RTIs (www.morth.nic.in). The Ministry of Health and Family Welfare, Government of India, has included RTI information in "Health Information of India" and data is mainly from NCRB and comprehensive information is not available from hospitals across the country. In view of these varying reporting practices, the available data needs to be interpreted with caution for making broader generalizations for the country.

6.1. National Scenario

Among the reported 742 deaths occurring everyday due to accidental (natural and unnatural) causes in India (excluding crime and violence) during 2002, 273 (37%) were due to road traffic injuries. The total number of accidental deaths increased from 1,22,221 in 1982 to 188003 in 1992 to 257936 in 2001 (NCRB 2002). During the year 2002, 99,772 deaths occurred due to traffic accidents (includes road, road-rail and other railway accidents) constituting 42% of total unnatural deaths. Among them, 82% were road deaths (n=81,873), 1% railroad deaths (n=1,011) and 17% railway deaths (n=16,888). Thus, road accident deaths comprised 34% of unnatural deaths and 32% of total accidental deaths (men = 38% and women = 22%) (excluding deaths due to other natural causes and disasters) in the year.

As per NCRB 2002, road accidents increased in the country by 5% from 323,700 to 329,400 in 2000-2001. During the year 2002, a total of 324,400 road accidents were reported resulting in deaths and injuries of 81,873 and 353,100 people, respectively. However as per transport ministry sources 84,700 deaths and 408,700 injuries have been reported for 2002. Among these deaths 9814 (12%) deaths were reported from 35 cities (with population of 10 lakh or 1 million) of India with the rest occurring in rural, semi urban and periurban areas. RTI deaths have increased from 58,000 in 1991 to 84,700 by 2002, while registered injuries increased from 2,50,000 to 4,08,700 (Figure 4).

Figure 4: Trend of Road Traffic Deaths and Injuries in India, 1991-2002 ('000s)



The RTI incidence and mortality for 2002 based on official reports was 36 and 8/100,000 population, respectively. The number of deaths per 100 road accidents was 25% at the national level (roughly corresponding to case fatality rates). Across the states, this varied from 7.5% in Kerala to as high as 108% in Nagaland.

- Among the 28 states of India, RTI mortality rate / 1,00,000 population varied from as low as 1 in Haryana to as high as 18 in Goa, with national average of 8/100,000. The states of Andhra Pradesh (12.0), Karnataka (12.0), Gujarat (9.0), Maharashtra (10.0), Himachal Pradesh (14.0), Kerala (9.0), Tamil Nadu (16.0) and Rajasthan (10.0), had rates higher than national average of 8/100,000 as shown in Figure 5 and Table 1 of annexure. Interestingly, these are some of the progressive states, being high on various indicators of growth and development in health, literacy, economy, transport and motorization and other development indicators.
- The national average for deaths / 10,000 vehicles was 14.3 with significant variations across states. Lowest rates of 1 in Haryana and high rate of 54 in Arunachal Pradesh, were seen with wide variations across states. States of Andhra Pradesh, Karnataka, Tamil Nadu, Kerala and Maharashtra had rates of 22.0, 17.0, 18.0, 12.0 and 14.0, except Goa and Gujarat with rates of 7.0 and 8.0 / 10,000 vehicles, respectively. The north eastern states showed higher rates above national average of 14.0, probably influenced by denominator comprised by lesser number of vehicles. Mohan (2004a) argues that as vehicles not in operation / usage are included in the denominator, at times this can be a false indicator of the problem.
- At the national level, the ratio of deaths and injuries was 1:4 with corresponding rates of 8 and 36/ 100,000 population, respectively. Bihar (1.0:1.6), Jharkhand (1.0:2.0) and Uttar Pradesh (1.0:1.1) had almost similar rates of deaths and injuries / 100,000 population (indicates severe under-reporting). Among other states, a wide variation has been observed with states like Kerala reporting nearly 15 injured persons and Karnataka with 7 injured persons per death
- Similar examination of data for major Indian cities (vehicle populations were not available for smaller cities) reveals that the mean mortality and incidence of RTIs was 12 and 58/ 100,000 population with a ratio of 1:5 as shown in Table 2 (annexure) and Figure 6. Bangalore (14.0), Indore (20.0), Jaipur (16.0) and Kanpur (18.0) had rates higher than national rates. Kolkata (3.0) and Mumbai (5.0) had lower rates, probably due to more vehicles and low average traffic speed. Interestingly, many of the grade B cities had rates exceeding 12.0/100,000 population. Similarly, the injury rates were 1:10 in some cities like Bangalore, Indore and Vadodara, while it was on the negative side (8 deaths per injured person) in Pune, indicating severe under-reporting of injuries. In all other cities, the ratio varied from 1:1.5

(Patna) to 1:8. This important observation reveals that in many of the grade B and C cities all RTIs are not reported to official agencies.

Figure 5: State wise distribution of RTI in India, 2001
National Average – 8/100,00 population

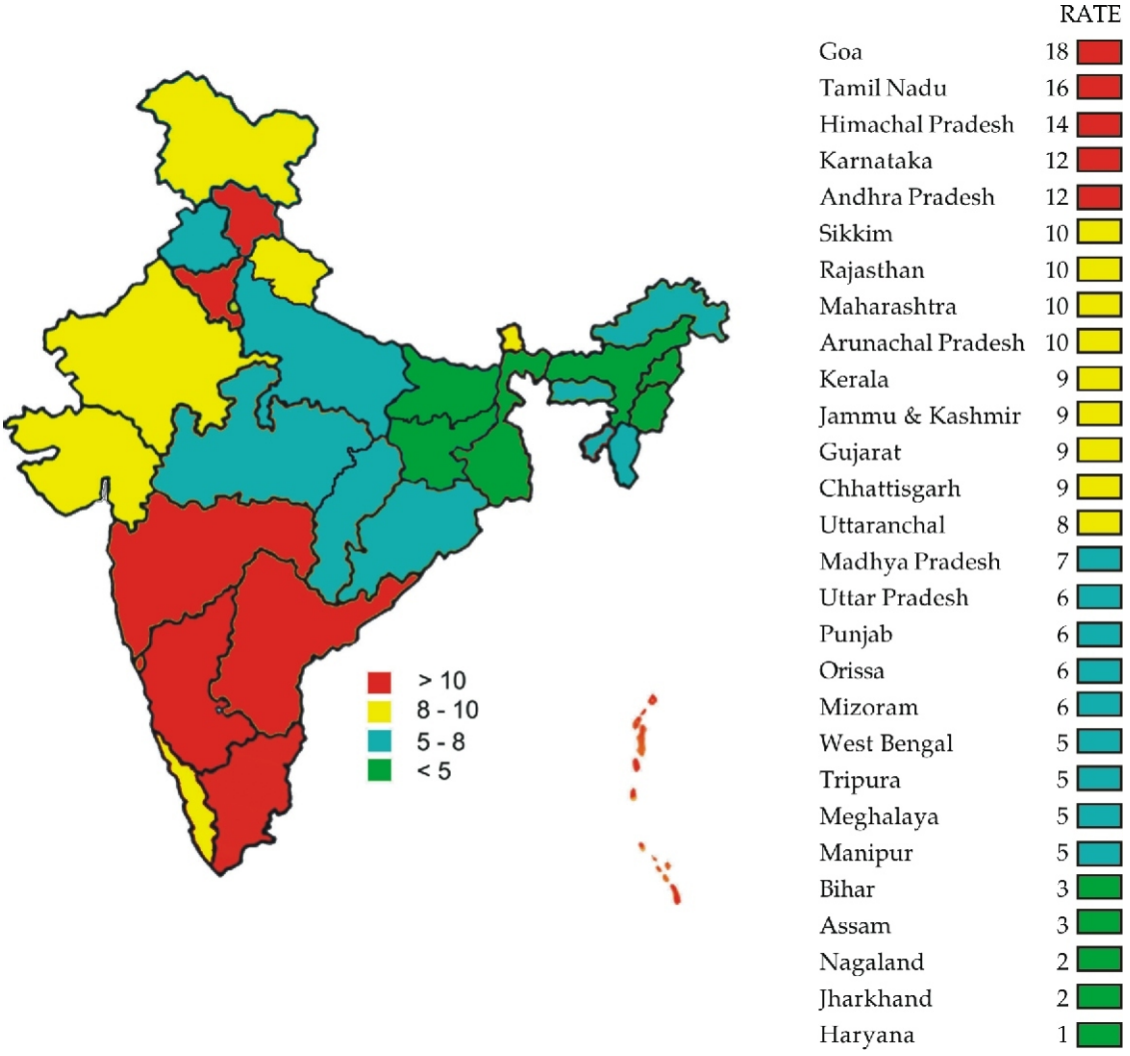
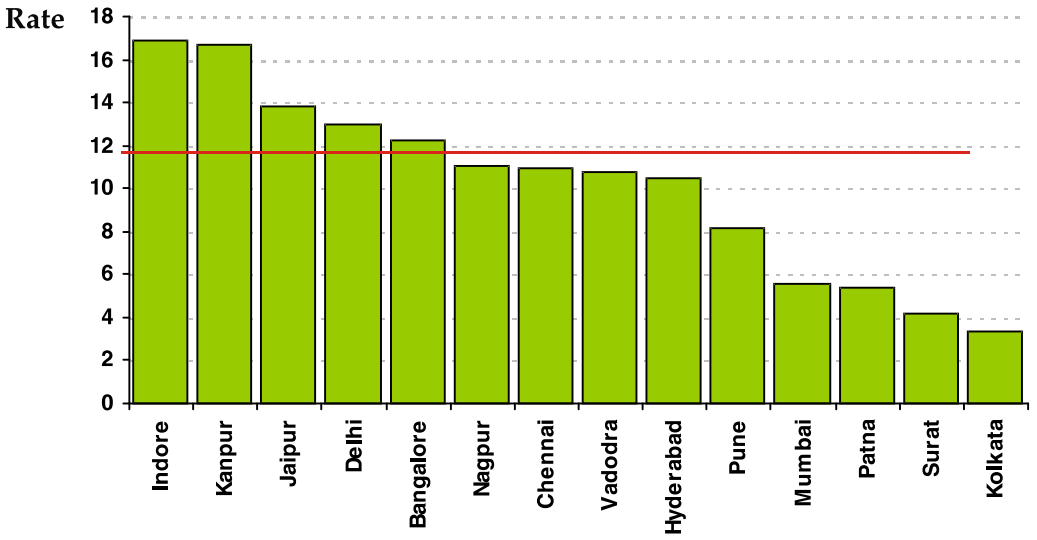


Figure 6: City wise distribution of RTI deaths in India, 2001

National average across major cities - 12/100,000 population



The survey of causes of death covering 40,351 deaths from all over India from 1602 reporting units, revealed that 2.6% of total and 21% of injury deaths were due to vehicular accidents. Transport related deaths occupied 10th place in overall ranking with a ratio of 4:1 among men and women (RGI, 1998a). RTIs were identified as the 8th leading cause in a review of estimates of years of life lost (YLL) due to top nine causes of death in rural areas of major states in India (Indrayan, 2004). Based on SRS data, YLL/1,000 population for RTIs was 6.0, varying from 2.0 to 10.7 across states. Vehicular accidents were the 2nd leading cause of YLL in Haryana, 3rd in Maharashtra, 4th in Rajasthan, and in 8th/9th places among other states.

The survey of Medical Certification of Causes of Death (MCCD) during 1998 covered 4,98,586 deaths from urban areas (RGI, 1998a). Transport related deaths (n=7248) constituted 1.5% of total and 16% of injury deaths. Road traffic injuries accounted for 92.5% of transport deaths with a male to female ratio of 4:1, respectively. States reporting highest deaths were Maharashtra (33%), Karnataka (30%) and Andhra Pradesh (14%), probably more influenced by reporting practices.

6.2. Hospital based studies

Odero et al (1997) in a review of RTIs observed that RTI related trauma contributed for 30-80% of hospital admissions in different countries. Hospital based studies in India are very few and all these studies indicate the huge burden of RTIs in India on the health sector (Table 5). These studies based on different sample sizes have reported RTI registration to vary from 15-65%. Sidhu et al in a study

of 2,382 hospital admissions noticed that 45% of injury admission and deaths were due to RTIs. A one month casualty study in Chennai (n=1,906), revealed that 35% of registrations were due to RTIs (Sathyasekaran, 1991) NIMHANS studies on Traumatic Brain Injuries (TBIs) in Bangalore revealed that 60% of TBIs were due to RTIs and 10% of beds were occupied by this group with a case fatality rate of 7% in the series (Gururaj, 1993 & 2005b). In a RTI survey of 23 major hospitals in Bangalore, RTIs contributed for 12% of total casualty registration, 52% of total injury registration, 6% of total casualty deaths and 35% of injury deaths (Gururaj, 2000b). In the largest autopsy based study, Bhattacharjee (1996) and

Table 5: Burden of RTIs in hospital based studies

Author & Year	Place	Sample size	Remarks
Sathiyasekaran BWC, 1991	Govt. General Hospital, Chennai	670 RTI patients	35% of all accident trauma cases 59% with serious injuries Only 32% reported to police
Bharti P et al, 1993	LLRM Medical College, Meerut	385 head injury patients	64% of head injuries due to RTIs
Gururaj G, 1993	One year survey of 8 hospitals in Bangalore	1,784 brain injured persons	52% of total brain injuries due to RTIs
Sidhu et al, 1993	Govt. Medical College, Patiala	2,482 deaths	45% of total injury deaths due to RTIs
Bhattacharjee J et al, 1996	Deaths registered by Police, New Delhi	3,623 post-mortem analysis	40% of deaths due to RTIs
Gururaj G, 2000	23 hospitals in Bangalore	3,105 hospital subjects in Emergency Departments	12% of casualty; 52% of total injuries; 6% of ER deaths and 35% injury deaths due to RTI
Gururaj G, 2005b	3 years study at NIMHANS, Bangalore	6,700 brain injured person due to RTI	60% of brain injuries due to RTI
Singh D, 2003	Post Graduate Institute of Medical Education and Research, Chandigarh	5,933 deaths postmortem analysis	50.3% of deaths due to RTI

Sharma (2001) observed that 40-50% of deaths were due to RTIs based on analysis of post motem reports. All these studies indicate (i) occurrence of RTIs in younger age groups of 15-44 years, (ii) greater involvement of men and, (iii) higher deaths and injuries among pedestrians, motorcycle occupants and bicyclists compared with other categories of road users. The case fatality rate often influenced by nature - severity of injuries, quality of care and several other factors has varied from 2-20% in several places. In the absence of studies with uniform methodology, it is difficult to arrive at comparable indices in a uniform manner.

6.3. Population based surveys

There are no large scale population based studies in India to clearly establish the burden of RTIs. Gordon et al (1962) in their first study in Punjab noticed that 7% of total accidents were related to vehicles. Verma PK (1998) in a study of 1095 individuals from 215 households observed that RTIs was the leading cause of injury to the extent of 30% and two thirds of these injuries had occurred on village roads, with rest on highways. In a recent WHO study on epidemiology of injuries in Delhi, traffic injury incidence rate was found to be 670/100,000 for major and 2857/100,000 for minor injuries. Among total injuries, 82% were hospitalised, 15% were disabled for more than 1 month and 2% died in hospitals. Traffic injuries contributed for 31% of total injuries (Verma and Tiwari, 2004; WHO, 2003). Vargeese and Mohan (2003), in a study of 9 villages in Haryana covering a population of 25,000 noticed that 18% of all injuries were transport related and included vulnerable road users in 70% of RTIs with an incidence rate of 649/100,000 population. Sathyasekaran (1996) in a study of 800 households from slums of Chennai, observed the incidence to be 1600/100,000 population. Further, 3% had to be hospitalised, 6.5% and 3.8% were bedridden for <2 weeks and >2 weeks, respectively. A population based survey in Bangalore of 4,822 households revealed that 47% of total injuries were due to RTIs and 15% were hospitalised for >24 hours (Gururaj G, 2002). A recent study from Bangalore covering a total population of 96,569 persons from 19,919 rural, slum and urban households revealed mortality and incidence from RTIs to be 34/100,000 and 649/100,000, respectively, with a ratio of 1:20 (Aeron Thomas, 2004; Gururaj and Suryanarayana, 2004a). The variation with regard to deaths and injuries in comparison with national figures was 1:4 and 1:18, respectively. Different rates have been observed due to variation in study methodologies over a period of time as shown in Table 3 in annexure.

6.4. Under-reporting of RTIs

Under-reporting of road traffic injuries is a serious and universal global problem, more so in India (Mohan, 2004a; Aeron Thomas, 2000). A scientific approach to road safety requires accurate, reliable and comprehensive information on a geographical basis. The most commonly used definition of RTI death is "any person dying immediately or killed within 30 days as a result of an injury accident" (WHO, 2004a). Information on RTI deaths is routinely collected by police, transport and health sectors depending on the place of death; however, RTI deaths and injuries have to be reported for police.

The reporting system varies and is influenced by nature and requirements of individual agencies. Even though different sectors collect and report data, there is no common methodology and system and, computerization of records is just beginning in some of the Indian cities.

The spectrum of road crashes and injuries vary from instantaneous death - hospitalization - outpatient management – manage-ment in casualty divisions of hospitals - treatment by local physicians/ native healers and home remedies, depending on place-severity - nature of injury. Majority of deaths are reported to police due to its medico legal nature, prosecution concerns, compensation needs and in few as a sense of public responsibility. Also, as public do not like to handle deaths police are called for immediate help, who in turn take them to hospitals.

Print and visual media reports RTIs (primarily deaths) regularly with available information from police. In a comparative study of police and media reports in Hyderabad, Dandona and Mishra (2004) observed that 3,039 crashes were recorded in police data base for the period Jan 1 – Dec 21, 2002; 411 people were killed in 400 of the 3039 crashes (13.2%). In the same period, newspapers reported only 316 crashes including 353 deaths. The study revealed that only severe crashes resulting in fatalities are more commonly reported in media and only those reported to police are documented in police databases.

In a study undertaken at Bangalore covering 23 hospitals, number of deaths between police and hospitals varied by 5% (hospitals had 5% more deaths; which did not include late hospital post discharge deaths), while injuries were under reported by 52%. The study revealed that children and elderly, pedestrian and bicyclists, women, weekend injuries, night time injuries were recorded in higher numbers in hospital records. The ratio of deaths to hospitalized injuries was 1:18 in the series (Gururaj, 2000b). The study undertaken in Haryana though biweekly visits to all households in 9 villages covering nearly 25,000 population showed that the ratio between critical, serious and minor injuries was 1:29:69 (Varghese and Mohan, 2003). In a recent longitudinal study of traumatic brain injuries in Bangalore over a 3-year period, it was observed (based on verbal autopsy) that 14% of patients had died within 3 months after discharge from a hospital (Gururaj, 2005b). An examination of records revealed that RTIs were not mentioned as cause of deaths. Probably, these deaths may not be included as RTI deaths as these had occurred after 30 days of crash. These observations reveal significant underreporting and some causes are:

- 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.

In view of the above observations, it is clear that both now and during the years to come, RTIs are going to be under reported by a very significant extent. In this complex chain of events, RTIs have been neglected significantly even though the morbidity, mortality, disability and socio-economic losses are on the increase. Consequently, scientific analysis of causes, resource allocation, prioritization, human resource development, and evaluation of interventions has not received any importance.

Underreporting of RTIs should be a matter of serious concern for policymakers and researchers in the Indian region. Any understanding and formulation of road safety policies and programmes should be based on a scientific understanding of the problem. Application of the existing data would have limitations for prioritization of problem and interventions as available data is under-reported, not analyzed in a systematic way and not focused on real category of road users killed and injured.

Myth: Accidents are accidents

Facts: Accidents are not accidents. The term accident means that the event is random, unpredictable and unpreventable. It has been shown beyond doubt that Road Traffic Injuries (and not accidents) happen due to known factors in our environments.

6.5 FUTURE TRENDS

Estimating the public health burden of RTIs is very vital to forecast changes in the existing scenario, develop strategies for reduction in the coming years and to implement and evaluate interventions.

Study from Bangalore has revealed the ratio of deaths to hospitalized injuries (excluding those receiving care from general practitioners) to be 1:18 from a hospital based study (Gururaj et al, 2000b). Another population based survey from Bangalore covering 19,919 households estimated the ratio of deaths : serious injuries to be 1 : 20 (Gururaj and Suryanarayana, 2004b). A study from 9 villages of rural Haryana estimated the ratio of critical: serious: minor injuries to be 1:29:69 (Varghese and Mohan, 2003). Recently, the working group of the Planning Commission of the Government of India estimates the ratio between deaths and hospitalized injuries and minor injuries to be 1:15:70 (Planning Commission, 2003). Correspondingly, it is estimated that nearly 100,000 (including late post hospital deaths) persons die of RTIs in India every year. In addition, 1,500,000 people are hospitalized and 7,000,000 would receive minor care.

To arrive to a more realistic public health burden of RTIs in India, 3 assumptions have been made based on available data.

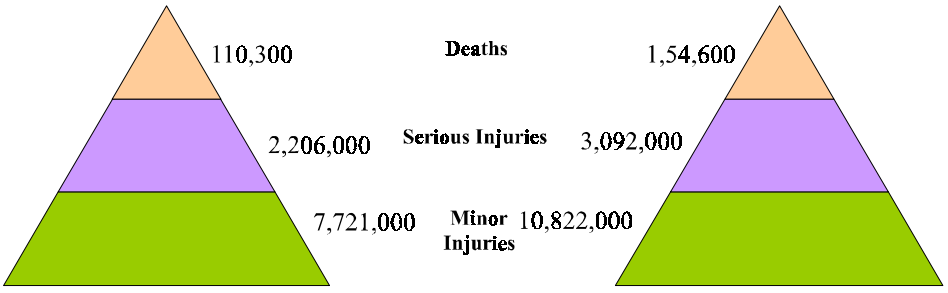
- An under reporting of 10% has been considered for estimating deaths for the base year 2001
- A 5% increase of RTI deaths has been recorded from year to year during the period 1992-2001, which has been applied for coming years. This could vary from 5%-10% depending on further changes in transportation changes and road safety scenario.
- A ratio of 1:20:50 has been applied for deaths: serious injuries and minor injuries.

Scenario 1: Using the constant increase method (assuming that RTIs will increase as at present without any changes) with 5% increase every year and under-reporting factor of 10% for deaths, it is estimated that 1,10,300 persons lost their lives, 2.2 million were hospitalized and 5.5 million received care for minor injuries during the year 2005 (Table 4 in Annexure 1). This might increase to ~ 1,32,470 deaths and 2.7 million hospitalizations by 2010 and 1,54,640 deaths and 3.1 million hospitalization by 2015.

Scenario 2: Applying progressive increase method with an annual increase of 5% and under reporting correcting factor of 10%, 1,12,478 deaths, 2.5 million hospitalizations along with 5.6 million persons with minor injuries in 2005. Deaths would increase from this number to 1,43,554 deaths and 2.8 million hospitalizations by 2010 and 1,83,216 deaths and 3.6 million hospitalization registrations by 2015 (Table 5 in Annexure 1)

Scenario 3: As per survey of causes of deaths, 11% of deaths were due to injuries and 21% of these deaths were due to RTIs in 1998. With changing crude death rates of 8.5/1,000 in 2000 and 8/1,000 in 2015 it is estimated that nearly 2,00,000 deaths would have occured in 2005. Caution has to be exercised due to small sample size (extent of coverage) though representative in nature. Hospital admitted injuries and minor injuries are likely to increase by 20 and 50 times respectively (Table 6 in annexure 1) assuming that injury deaths will remain at 24% of total injury deaths.

Figure 7: RTI deaths and injuries, India, 2005-2015



The differences in number of deaths and injuries are due to application of different components for estimates. Also, calculations have the limitation of not using motovehicle growth for the coming years. In summary, it can be concluded that approximately 110,000 deaths, 2.2 million hospitalizations and 7.7 million minor injuries would have occured during the year 2005 in India. This essentially means that everyday 342 persons would die and 6,900 injured persons would get hospitalized in India.

6.6. Disabilities and RTIs

Disabilities following RTI are varied and complex affecting physical, social, economic, spiritual and psychological spheres of life. With decline in communicable diseases, disabilities due to injuries, especially RTIs will increase in the coming years. With poor and deficient rehabilitation services in rural and semi urban areas and health care becoming expensive in urban India, the quality of life of survivors is often poor. There are no longitudinal and long-term follow-up studies in this regard.

United Nations estimates that nearly 10% of population in developing countries is disabled in one way or other (Helander, 1993). As per 2001 census, nearly 2.1% of Indian population were disabled, an increase from 1.9% in 1991. Among various disabilities, 7.5% were speech, 48.5% visual, 5.7% hearing, 27.8% locomotor and 10.5% with mental disabilities and handicaps. The National Sample Survey Organization (NSSO, 2002) estimated that 2% of Indian population was disabled. The study further highlighted that nearly 11% had multiple disabilities, high in rural areas (1.8% Vs 1.5%), predominant in 5-44 yrs and 13% of disabled could not undertake self care even with aids and appliances. Head injuries alone as a cause for disability accounted for 30,50,51,56 and 279/1,000 population for mental illness, visual, hearing, speech and locomotor disabilities. Injuries are responsible for nearly 1/3 of total disabilities and RTIs contribute for nearly half of these disabilities (Gururaj G, 2005a). Based on this observation, nearly 3.5 million people live in India due to disability from injuries. **The prevalence of RTI related disability is estimated to be nearly 2 million in India.** It is important to note that in the age group of 5-44 years injuries are a

major cause of disabilities, while congenital causes predominate for childhood disabilities and neuro-degenerative and musculoskeletal conditions are responsible for elderly disabilities.

An in-depth examination of RTI disability reveals the complexities and phenomenal burden on individuals and families. Among 425 patients at four months discharge, 43% were experiencing various health problems. Among the various posttraumatic sequelae, locomotor problems, headache, anxiety features and memory problems were common problems affecting day-to-day life (Gururaj, 1993). A follow - up study of 607 patients revealed that 15% of those discharged continued to have posttraumatic sequelae at the end of 2 years (Gururaj, 2005b). In a hospital based study of neurological disabilities due to RTI, 5% of mild, 14% of moderate and 81% of severe (based on GCS) brain injured persons were living with disabilities, with nearly 30% having major difficulties in activities of day-to-day living at 6 months discharge (Taly, 1996).

6.7. Impact of RTIs

Any injury resulting in severe damage leads to disabilities, primarily dependant on injured body organs. Significantly, brain injuries can lead to various posttraumatic sequelae or posttraumatic syndrome of varying severity. Problems with day-to-day living, memory, information processing and behaviour can disrupt an individual's life for long periods of time. Spinal cord injuries can lead to restriction or loss of or restricted movements. Facial injuries can damage facial contours and lead to disfigurement and psychological suffering. Injury to long bones can result in restricted or loss of movements, interfering in activities of day to day living. These injuries not only lead to loss or decreased productivity, but also lead to disruption of social, psychological and spiritual areas of one's life (Gururaj, 1998b).

A comprehensive assessment of social, psychological and economic impact of RTIs has not been undertaken in India. RTIs result in loss of work, schooling and cancellation / postpone-ment of social activities following injury for the affected person and his family for varying periods of time depending on extent, nature and severity of disability (Aeron Thomas, 2004). Every year, lakhs of children would suffer from psychosocial and economic deprivation due to loss of their parent getting killed or injured in an RTI. This early childhood psychosocial deprivation can lead to high-risk behaviors in adolescence or later part of their life (Fishbein, 2000). Many emerging minor mental health problems like depression, anxiety, personality and mood problems, violence, suicide, alcohol and tobacco usage, high risk sexual activities can often be related to psychosocial disturbances in formative years of a child (WHO, 2003).

In summary, the costs of RTIs can be grouped under direct medical costs (transport, immediate medical care, rehabilitation, delayed medical expenses, funeral expenses and others), indirect costs (administrative / legal / police expenditure, property damage costs and other distant costs), loss due to work

absenteeism and loss of productivity apart from distant losses (long term disability, insurance, etc). In addition injury survivours often lead poor quality of life and have to live with pain and suffering which are difficult to measure even with advanced methodologies.

The economic impact of RTIs is huge and little attempt has been made to measure this aspect. Two of the recent studies from All India Institute of Medical Science, New Delhi and National Institute of Mental Health and Neuro Sciences, Bangalore have estimated the cost of managing head injuries. Vaishya et al (2002) estimated the cost of stay in ward to be Rs. 1062/bed/day, in neurosurgical ICU to be Rs.3,082/ bed/day and, average cost per surgical intervention to be Rs.11, 948. The cost of hospital stay for minor, moderate and severe head injuries was Rs.1,921, Rs.2,569 and Rs.2,713 per day, respectively. Gururaj et al (2005b) estimated the cost of managing a head injury patient per day at emergency room level in NIMHANS to be Rs.2,152/day. Both studies are from public sector hospitals and costs would be much higher in urban/district private hospitals.

RTIs are also linked to issues of poverty and equity. A recent study from Bangalore revealed that the incidence and death of RTI were high among poor communities (Gururaj and Suryanarayana, 2004a; Aeron Thomas, 2004). The families with an RTI death spent approximately Rs.17, 000 - 35,000 for medical care and Rs. 3,000 - 8,000 for property and vehicle damages; 35% of families had to adopt many sudden measures like sale of family assets (3.7%), incur loans (63%), pawn self and family property (35%) and a seriously injured person lost work for nearly 80-100 days. Seven of the ten poor households with a seriously injured person reported a decrease in their earning potentials and income. Families with a seriously injured RTI person had spent approximately Rs. 28,600. Number of rural households reported a decline in food production. One of the members had to give up work or education to take care of injured in nine out of ten poor households. The study also showed that poor people had become poorer after a serious road traffic injury or death. A recent study on brain injury after RTI reported that managing disabilities and loss of schooling / work were major concerns for families (Gururaj, 2005b). The average loss of schooling was 30-50 days after a brain injury. Only 65% were able to work as before and among them 60% had reduced work capacity, 33% could work in sheltered environments and 8% could not do any work compared with pre-injury levels. Nearly 2/3 spent an average amount of Rs.10,000, with 15% spending more than Rs.25, 000/- as out of pocket expenses. Only 2/3 were able to return to their previous jobs at the end of one year. Very few (<5%) had received compensation after death or serious injury in 2 years time following injury. Verma and Tiwari (2004) from Delhi have reported that 13% could not resume normal work for 1-2 months.

In reality, RTIs has a major impact on poor and middle class society of India as they are killed, injured and disabled in larger numbers; do not have access to quality care, do not receive timely compensation; are unable to work and

generate income; and hence lead poor quality of life. Mohan (2004a), in a recent review of economic impact highlighted that the estimated economic loss due to RTI was to the tune of nearly 55,000 crores every year or nearly 3% of India's GDP. Many of the earlier studies carry serious methodological limitations and hence gross underestimates (Mohan, 2004). This economic burden and impact indicates the seriousness of the problem and the need for prevention.

7. SOCIO-DEMOGRAPHIC CORRELATES

Several socio-demographic correlates like age, sex, residence, education, occupation, income, marital status are significantly associated with causation or socioeconomic burden or psychosocial impact. The precise associations of these are difficult to ascertain (except age and sex) in the absence of good quality nationally representative data.

Impact of Road Traffic Injuries

Victims Voices…

On a Saturday afternoon, my husband's two-wheeler collided with a maxi cab coming in full speed on a small connecting road. My husband was thrown on to pavement and died immediately. I would not have become a widow today, if something (in vehicle or in road or by police) would have reduced speed.

Anuradha, 29 years

I am a paraplegic today and have to lie in the bed for the rest of my life. On a Monday morning while I was walking on the street, a two-wheeler came and hit me and ran over my legs. After repeated surgeries and spending more than 2 lakh in 4 hospitals, I am still unable to walk after 3 months.

Chandrakanth, 42 years

After the death of my husband, I had to take heavy loans and sell our 30 X 40 (land) site to meet medical expenses. After 2 years, my son still gets up in the middle of the night in horror and asks for his father. From where can I get him his lost father?

Savitri, 32 years

The day my friend got a promotion in office, he invited few of us for a party. After drinking till 2 am, we were returning home. No helmets, no control and all in josh. A deep road cutting on the dark road missed our attention and both of us were thrown up in the air. My friend died on the spot and I have lost my right upper limb. I cant even think of holding a glass now….

Manohara, 23 years

Due to the untimely death of my father in a road accident, I had to discontinue my studies with no money for college, my mother and I are with my grandparents in a joint family. I have joined work as a security guard and my dreams of education are not only shattered, I can't even think of a decent job in my life.

Praveen, 20 years

Names have been changed to maintain confidentiality

❖ **Age & sex (who are the affected people?)**

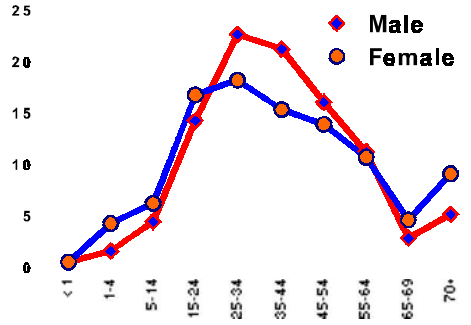
All national reports and independent studies conclusively point out that men are killed and injured in greater numbers with male to female ratio varying from 4:1 or 5:1. Similarly, available data point to the fact that RTIs are one among the 3 leading causes of death and disability in the economically pro-ductive age group of 5-44 years (Figure 8).

As per NCRB report (2002), 63% of deaths occurred in 16-44 years with children and elderly constituting 8.6% and 7.5%, respectively. The male and female rates were 13.0 and 3.0 /100,000 respectively. Among men, highest rates of 45% were noticed in 30-59 years (Table 6). Data from SCD (n = 1,049; RGI, 1998a) reveal that the age group of 25-34 years recorded highest number of RTI deaths (21%), followed by 15-24 years (19%), 35-44 yrs (16%), 45-54 yrs (15%), 60+ yrs (14%) and 5-14 yrs (11%), with a total 71% in 15-54 years; while 69% of RTI deaths were registered in 15-54 years as per MCCD (n = 7,248) reports (RGI, 1998b). Children (<15 yrs) constituted 7.2% and 15% of motor vehicle deaths in MCCD and SCD reports, while elderly (65+) accounted for 10% and 21%, respectively. Several studies of RTI victims based on analysis of police (Gururaj, 2000b; Dandona and Mishra, 2004; Mohan and Bawa, 1985; Rautzi and Dogra, 2004; Sarin, 2000) and hospital records (Gururaj, 1993; 2000b; 2005b; Colohan, 1989; Goel, 2004; Jha, 2003; Maheshwari and Mohan, 1989; Sidhu, 1993; Muralidhar, 2004; Sahadev, 1994; Singh, 2003) reveal that nearly 60-70% of RTI subjects were in 15-44 years age group (Figure 8). The limited number of population-based studies also indicate that the age groups of 15-44 yrs constitute nearly **2/3** to ¾ of total RTI patients (Varghese and Mohan, 2003; Gururaj and Suryanarayana, 2004a; Verma and Tiwari, 2004; Sathyasekaran, 1996). Children and elderly have contributed for approximately 10-15% of deaths in these studies.

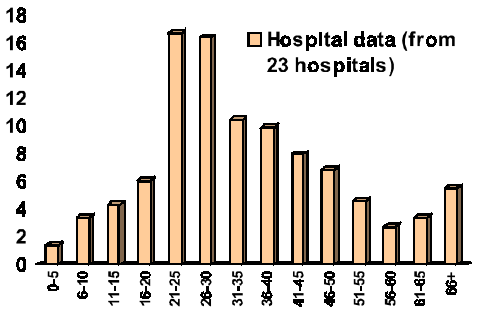
Table 6: Age – Sex specific mortality rates of RTIs, NCRB, 2001.

Age group	Male			Female			Total		
	Popn.	Deaths	Rate/ 100000	Popn.	Deaths	Rate/ 100000	Popn.	Deaths	Rate/ 100000
<14	178045000	4757	3	168885000	1677	1	346930000	6434	2
15-29	151973000	21003	14	138136000	3616	3	290109000	24619	8
30-44	102943000	23869	23	99657000	3988	4	202600000	27857	14
45-59	64079000	14234	22	56967000	2386	4	121046000	16620	14
60+	37046000	5180	14	35274000	1163	3	72320000	6343	9
Total	534086000	69043	13	498919000	12830	3	1033005000	81873	8

Figure 8: Age-Sex distribution of RTI deaths in Indian reports (%)



MCCD, 1998



Hospital based study (1998) in Bangalore covering 23 hospitals (1998) (Gururaj, 2000b)

Clear association of other attributes like education, occupation, per capita income, marital status with RTIS is not available totally. Information on these aspects is crucial to understand exposure related issues, affordability to care and several other factors. Generally it is acknowledged that more than half of those injured and killed are from low-income categories (WHO, 2004a). The population based survey undertaken in Bangalore (Gururaj and Suryanarayana, 2004a) and Chennai (Sathyasekaran, 1996) revealed that 2/3 of injured and killed were with lower levels of education, employed in skilled and unskilled categories and were married. A recent study from Bangalore has revealed that mortality from RTI was 13.1 and 48.1 in poorer categories of urban and rural population, while it was 7.8 and 26.1 per 1,00,000 population in non-poor categories. Similarly, the incidence of serious injury was 151 and 222 in poorer segments of rural and urban areas. The poor were more likely to be killed and disabled in road crashes as they are vulnerable and also have limited or no access to quality care after a crash (Gururaj and Suryanarayana, 2004a; Aeron Thomas, 2004). The recent report of WHO also highlights that poor people in all low and middle-income countries bear the greatest burden of RTIs (WHO, 2004a).

❖ Vulnerable road users (who are killed and injured)

With current car ownership of 6/1,000 households and mainly being in cities, large number of road users are pedestrians, two wheeler riders-pillions and bicyclists, the vulnerable road users (VRUs) of India. Official data indicate that drivers and occupants of heavy vehicles are involved and killed in greater numbers based on type of vehicles involved in crashes (NCRB, 2002). As per national report, percent of deaths as per type of vehicle revealed that Trucks/Buses and Jeeps were involved in 25%, 14% and 10%, respectively. Two-wheelers and pedestrians were involved in 13% and 9%, respectively. *This data has to be interpreted with caution as earlier*

discussion has indicated that official figures represent only serious crashes and may not include a broader picture of all those injured and killed in road accidents. In addition, it indicates the type of vehicle involved and not category of road users killed and injured in crashes. Sarin (2000) point out that even though buses and trucks constitute only 6% of total vehicles, they are responsible for 40-50% of fatalities. These vehicles accounted for 74% in Pune, 65% in Kanpur, 69% in Lucknow, 62% in Nagpur and for 65-70% of reported accidents from other cities.

As per Mohan (2004a), nearly 80% of those killed in Delhi and Mumbai are vulnerable road users. Collision of heavy vehicles like buses and trucks with these road users result in greater number of severe injuries and deaths. In urban and suburban areas, buses and trucks are involved in higher proportion of fatal crashes with VRUs. Among fatalities during peak hours, 62% of responsible vehicles for crashes were buses or trucks, while those killed were primarily pedestrians, bicyclists or motorcyclists. Even on national highways, pedestrians constitute 30% of fatalities and 65% of all deaths occur among VRUs. Car and bus occupants constituted 15% and 5% of total deaths, respectively. Data from Delhi indicate that 40% of fatal bicycle crashes occur during peak traffic hours when traffic volumes are high but speeds are low due to serious conflicts, as available road space is shared by all types of vehicles (Tiwari et al, 1998; Mishra et al, 1984). The results from a 14-location study on national highways indicate that pedestrians and other vulnerable road users constitute 60% of deaths and injuries (Bansal et al, 2002 quoted in Mohan, 2004). Among fatal crashes, heavy vehicles are involved in significant number of deaths of vulnerable road users even on highways (Dandona and Mishra, 2004).

Data from several independent and hospital based studies also reveal that VRUs are killed and injured in greater numbers as shown in Table 6. In an analysis of records from police database in Hyderabad for 2002, Dandona and Mishra (2004), observed that pedestrians (40%) and motorized two wheeler riders and pillion (32%) were the major category of killed people. Data from Chennai reveal that pedestrians, two-wheelers and cyclists constituted 28%, 15% and 29% of total deaths (Sathyasekaran, 1991). Hospital studies in Bangalore during 1993, 1998, and 2005 have shown that pedestrians, motorized two wheeler occupants and bicyclists are injured and killed to the extent of 25-35%, 30-40% and 7-10% with minor variations across studies (Gururaj, 1993; 2000; 2005). Studies from Delhi, Pondicherry, Chennai, Hyderabad, Patiala point to similar observations. Data from population-based surveys also indicate a similar picture. In a recent study of 709 RTI injured persons from a population base of 96,619, it was observed that pedestrians, two wheeler occupants and bicyclists constituted 26%, 43% and 8%, respectively. Verma and Tiwari in a study of 5412 households covering 30,554 populations in Delhi noticed that two wheelers (46%), pedestrians (25%) and bicyclists (14%) were involved in very high numbers. Sathyasekaran from Chennai point out that these 3 groups represent 28%, 15% and 29%, respectively.

Table 4: Road user categories killed and injured (%) in road traffic injuries in India.

Author (nature of study)	Year	Place	Pedestrians	Two wheeler riders & pillions	Bicyclists	Three Wheeler Occupants	Four Wheeler Occupatns	Heavy Drivers & passengers	Others
Mohan D et al (HS)	1985	New Delhi	33	16	21	3	3	4	10
Maheswari J et al (HS)	1989	New Delhi	26	39	12		1		14
Colohan et al (HS)	1989	New Delhi	20	22	1		25		32
Sidhu D S et al (Deaths) (HS)	1993	Patiala Punjab	16	17	8		58		
Sidhu D S et al (injurie) (HS)	1993	Patial Punjab	14	29	12		43		
Gururaj G et al (HS)	1993	Bangalore Karnataka	31	35	10		1	21	3
Sahadev et al (HS)	1994	New Delhi	33	40	6		4		17
Gururaj G (HS)	1998	Bangalore Karnataka	26	44	4		5	21	
Jha N et al (HS)	2003	Pondicherry	23	23	23		10	15	7
Sathyasekaran BWC (PS)	1991	Chennai Tamil Nadu	28	15	29	8	15	4	
Varghese (PS)	2003	Harayana	35	18	25		1	11	
Gururaj G (PS)	2004	Bangalore Karnataka	26	43	8	3	7	13	
Verma and Tiwari (PS)	2004	New Delhi	25	46	14	5	4	3	3

HS = Hospital Study PS = Population Study

The variation between police and hospital reports might be due to consideration of impacting vehicle rather than injured / killed person per se. As heavy vehicles are involved in greater proportion of deaths when they impact vulnerable road users, they tend to get noticed easily and are reported in greater numbers to police. In large number of non-fatal crashes, pedestrians and two wheeler riders and pillions are injured in greater numbers. These class of road users form the major bulk on Indian roads and hence their exposure is significantly high. Further, as these categories of road users are unprotected, their involvement in crashes leads to greater energy transfer (even in low velocity crashes) resulting in serious injuries and deaths. Several other contributory factors are higher speeds, continuous road conflicts, sharing of available space by heavy – medium – light vehicles with pedestrians, bicyclists and possibly driving practices two-wheeler drivers (heavy vehicles use center or side lanes which are also used by VRUs and poor visibility factors as reported by Mohan (2004a) and Tiwari (2000). In addition, due to their reduced access to quality health care, mortality and morbidity rates are also higher within this group.

❖ Spatial distribution of RTIs (where does it occur?)

An understanding of RTI distribution is important at different levels. At the macro-level, it helps in identifying places (states and cities) with high crashes and enables comparison for greater investment in states with poor safety record; at the micro-level, it helps in planning local interventions (Reddi MN, 1997, unpublished document). Since there is considerable variation in transport patterns and type of crashes between urban and rural areas, highways and non-highways, slums and taluks often influenced by density of traffic, transportation need and patterns, speed and other issues, the distribution of RTIs varies significantly.

In general, states with rapid and high motorization growth have registered higher number of deaths as shown in Figure 5 with fatality rates for Indian states varying from 3 to 17/100,000 persons. The overall contribution of cities to deaths and injuries was 12% and 13% respectively, with the rest occurring in vast rural and semi-urban areas of the country. Data from NCRB and Ministry of Road Transport and Highways (2002, various issues) indicate that 38-40% (38% in 2000; 40% each in 2001 and 02) of total RTI deaths in different states occurred on highways during the period 2000-2002, as shown in Figure 9. It is likely that since highway crashes are severe, result in greater number of deaths and serious damages to goods and property, and are more visible, their reporting might also be higher. Analysis of road user fatality patterns in 14 locations on national highways in India revealed that 65%, 15% and 5% of deaths occurred among VRUs, car occupants and bus occupants, respectively (Report of Ministry of Transport, 2000 as quoted in Mohan, 2004a). The nature of vehicles contributing to these deaths were primarily heavy vehicles like buses and trucks.

A study undertaken by NIMHANS during 1993 (Gururaj et al, 1993) on a

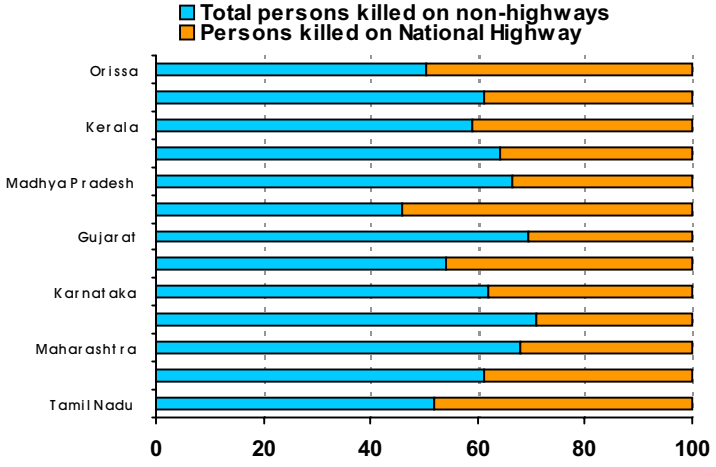
sample of 1,784 brain injured persons admitted in 8 major hospitals of city due to RTIs revealed that injuries and deaths in highways and non highways contributed for 80% and 20%, and 71% and 29%, respectively; 78% of crashes had occurred on highway main roads, 13% near highway circles and 8% on interconnecting roads. A recent study of 6,190 brain injured persons registered at NIMHANS, Bangalore revealed the distribution of highway and non-highway RTIs to be 28% and 72%, respectively (Gururaj et al, 2005b). Data from both studies revealed that 50-70% of RTIs had occurred in mid blocks, 4-6% in circles, 5-10% near street corners and 1-3% at traffic light junctions. This data (with observations from a single health care institution) is only an indicator to the fact that geographical analysis is of vital importance to understand crash patterns.

In the absence of multidisciplinary crash investigations in India, it is difficult to pinpoint exact reasons for this distribution. Some of the possible reasons could be design of highways (less concern for safety of VRUs and greater focus on rapid transport at higher speeds), size and capacity of vehicles impacting VRUs, Speed related factors, poor visibility of VRUs (and of dangers on the road), driver related factors like fatigue – sleeplessness, higher involvement of alcohol, absence of trauma care on or near to highways and others.

❖ Time of Occurrence (when does it occur?)

Information on crash timings is vital for designing strategies for prevention and for organization of trauma care. Generally, there is agreement between studies that nearly 1/3 of fatal crashes occur during night times. As per NCRB reports (2002), 27% and 34.5% of accidents across states and cities had occurred between 9 pm - 6 am (Figure 10). Daytime accidents contributed for 2/3 of crashes. Nearly 26-34% of fatalities in Bangalore, Madurai and Kolkata occurred

Figure 9: Number of persons killed in Road Accidents



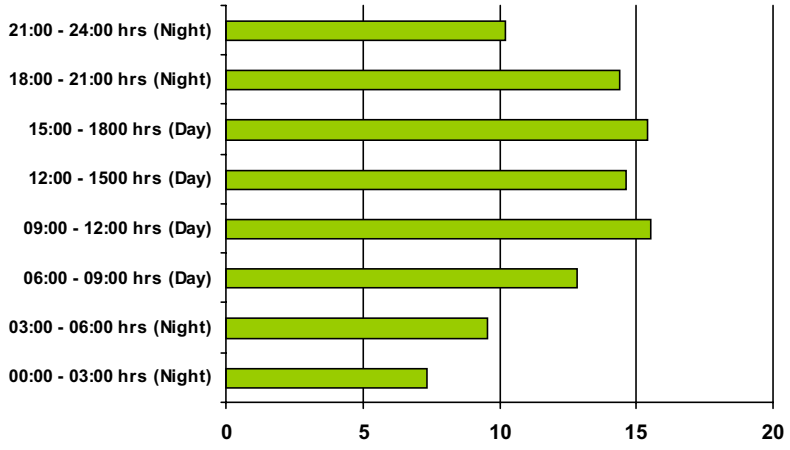
during 8 pm - 12 midnight. For other cities like Pune, Delhi and Indore, this was to the extent of 22%, 17% and 14%, respectively. Sarin S (2000) has reported that 14 - 33% of crashes occur during early hours of 3 am - 6 am.

Mohan and Bawa (1985) in an analysis of police records observed that 32% of pedestrian deaths, 40% of motorized two-wheeler deaths and 30% of bicyclist deaths occurred during 6 pm and 6 am. Limited hospital based studies indicate that nearly 30-40% of RTI patients are brought in during 9 am - 6 am (Jha, 2003; Sathyasekaran, 1991). Gururaj et al in 3 of the studies during 1993, 1998 and 2005 recorded emergency room registrations of RTI during 9 pm – 6 am to be 35%, 33% and 25%, respectively. The greater incidence of nighttime crashes can once again be attributed to several factors like poor visibility, greater speeds, high involvement of alcohol, driver fatigue/ sleeplessness and low enforcement levels.

8. Injury patterns and outcome

The severity, nature and outcome of RTIs is primarily determined by impact of crash and amount of energy generated and transferred to human beings. Many factors like age, sex, fragility of body organs, presence of co-morbidity, influence of alcohol, presence of protective equipments like helmets - seat belts - child restraint seats, nature and speed of vehicle, and availability - accessibility and affordability of trauma care services determine the severity and nature. Information on injury patterns, nature and outcome are extremely limited in India as trauma registries and hospital based research have not developed fully. No conclusion can be drawn from limited Indian data and they only indicate a

Figure 10: Distribution of crashes as per time of occurrence in India, 2002 (%)



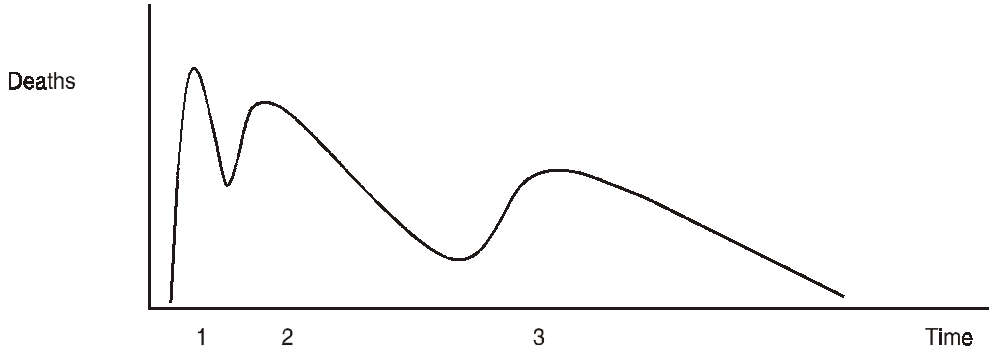
broader picture due to different methodologies.

➢ Time of death

Information on time of death is vital to develop primary, secondary and tertiary prevention strategies. Deaths from severe injury occur in one of three phases, viz., immediate deaths (at crash site or within minutes after crash), immediate deaths (within first few hours) and delayed deaths (days or weeks after initial injury) as shown in Figure 11 (Sasser et al 2005).

Generally it is estimated that nearly 50-60% die at crash site or during transfer to a hospital, 20-30% during hospital stay and 5-10% after discharge from a hospital (WHO, 2004a; Trunkey, 1983). As per Trinca et al (1988) road deaths occur in one of the clearly defined three time periods. The first is within few minutes after crash generally due to injury of vital organs like brain and is estimated that nearly 50% of those who die immediately are due to this major insult. The second peak is generally within 1-2 hours after crash and accounts for nearly 30-40% of deaths in highly motorized countries. It is acknowledged that this is much higher in India and other LMICs due to lack of early care (Varghese, 2000; Sethi, 2000). Remaining 5-10% of deaths are generally late deaths due to brain death, organ failure and septicemia. Among few Indian studies, Sahadev et al (1995) in an autopsy study of 177 RTI deaths in New Delhi noticed that 23% were dead on the spot, 13% en route to hospital and 64% during hospital stay. Four peaks of death at within one hour, 2-3 hours, 24-48 hours and 2 days - 2 weeks were noticed among deaths. Delayed transport and failure to recognize internal injury were cited as primary reasons. Data from Bangalore city police for 2003 reveal that 38% died at crash site, 14% during transport, and 48% during or after hospital contact (Personal Communication). In an autopsy study from Jammu, Delhi and Chandigarh, 28%, 24% and 23% had died on the spot/brought dead to hospital within one hour of accident (Bhatacharjee, 1996). Dandona et al reported from Hyderabad that 53% died at crash site, 9% on the way to hospital,

Figure 11: Trimodal distribution of deaths from RTIs



21% in hospital and 18% later, based on analysis of media reports (as mentioned earlier, only major crashes catch the attention of media).

➢ Cause of death

Injury to vital organs like brain - spinal cord and, intrathoracic - intra abdominal organs lead to death in a short time after injury. In a study of 127 autopsy deaths, exsanguinations and brain injury were responsible for 31% and 38% of deaths, respectively. Sepsis and multiple organ failure were mainly responsible for late deaths. Irreversible shock was mainly responsible for 41% of deaths as per Sidhu et al (1991). Bharati et al (1993) from Meerut reported high mortality rate of 41% among brain injured persons. Sahadev et al (1994) in an autopsy study of 177 RTI deaths observed that neurological injury and hemorrhagic shock were primarily responsible for 60% and 25% of deaths. It was concluded that 23% of deaths were preventable, 46% possibly preventable and 30% not preventable by any intervention (except by primary preventive measures). Singh (2003) from the largest autopsy based study (n=6,184) reported that, brain injury was the commonest cause of death in 73% of road crash victims. Haemorrhage and shock accounted for other deaths. 4-7% of late deaths were due to septicaemia and multiple organ failures.

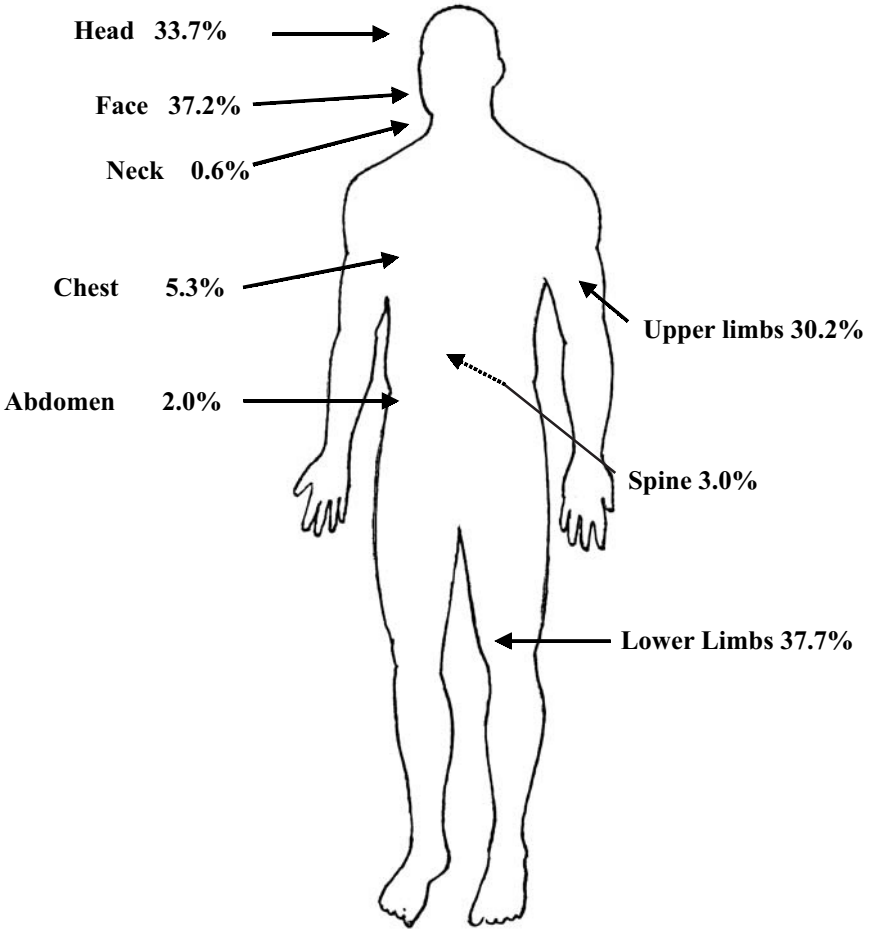
➢ Injury patterns

The Global burden of disease study reveals that nearly ¼ sustain brain injuries, 10% suffer from open wounds and ¼ have fracture of long bones (WHO Global burden of disease project, 2002, version 1.0 quoted in WHO 2004a). Majority of Indian studies have documented greater occurrence of injuries to brain, face and long bones. Sidhu et al (1993) noticed that 42% had polytrauma, while Gururaj et al (1993 & 2005b) noticed polytrauma in nearly 25% of patients. Brain injuries among RTI patients has been documented in 50-60% of patients. However, in neurosurgical settings it has accounted for 1/3 of patients. Facial injuries have also been seen in nearly 40-50% of injured subjects. Long bone injuries, specially lower limb injuries have been noticed to the extent of 14-40% among hospitalized subjects. Fractures have been observed in 18-22% of patients. Injury to chest and abdomen has been comparatively less, seen among 2-10% of injured persons.

Myth: We need to build more hospitals and get more advanced equipment

Fact: While hospitals and equipments are required to save lives, it is more ethical, economical and practical to prevent the occurrence of injuries.

Figure 12: Injured Areas – Hospital Data



Observations from pooled data of RTI study among 3,077 patients from 23 hospitals in Bangalore (Gururaj et al, 2000b) has shown that head and face, upper and lower limbs are the most commonly injured areas (varies as per road user category) as shown in Figure 12. Motorcyclists had more injuries to face and lower limbs, while pedestrians had greater injuries to lower limbs. Sathyasekaran (1991) noticed that head, thorax and abdomen, upper and lower extremities were damaged in 38%, 7%, 22% and 32% in a study of 1096 trauma patients. It was observed within the same study that 11% had life threatening injuries, 11% had serious disabling and 38% mild disabling injuries. Gangveer and Tiwari (2005) from Medical College, Nagpur, reported that fracture of long bones in lower limb was the commonest injury (46%) among RTI patients, apart from multiple injuries (27%) and lacerations.

Very few studies have studied severity distribution using standard methods. Minor injuries with AIS <3

constituted 35%, 66%, 74% in studies in Delhi and Chennai, respectively. Severe injuries (life threatening) with AIS 4, 5 and 6 accounted for 65%, 10%, 11%, respectively. Jha et al (2003) utilized trauma scale and noticed that 48% were in the score of 8-18 with 1% being >18 (very severe). Two of the studies on brain injuries in 1993 and 2003 at NIMHANS (Gururaj et al) revealed that nearly 60% were mild, 15-20% moderate and 15-20% serious based on Glasgow Coma Scale. Similarly, Bharati et al (1993) from Meerut noticed that 42% were mild, 25% moderate and 33% severe in nature among head injuries. Mishra (1994) observed that 60% had skull fractures and 36% intracranial lesions in a study of 87 two-wheeler crash deaths.

➢ Outcome from RTIs (at hospital discharge)

In recent years, case fatality rates have declined considerably due to technological and managerial advances in tertiary and referral institutions of urban areas, even though total number of deaths due to RTIs is on the increase across the country. Since large majority of RTIs occur in rural and semi urban areas where trauma care is deficient and poor, the outcome from RTIs is poor in these areas. Among the survivors of a crash, many leave the hospital with varying degrees of disabilities. It is known that among brain injuries, 100% of severe, 50% of moderate and 10-20% of mildly injured persons have short to long-term disabilities depending on type and severity of injury requiring short to long-term rehabilitation services (WHO, 1995). Recent data indicate that even mild brain injuries can lead to significant impairments and poor quality of life (Cassidy et al, 2004).

Information on length of hospital stay is crucial to understand the health burden of RTIs on institutions and families; this information is not available from large sample sizes with varying levels of severity and injury patterns.

Studies undertaken at NIMHANS have examined outcome at the end of hospital stay among brain-injured persons due to an RTI. Among 3,345 hospitalized persons, 5% died, 4% were in a persistent vegetative state, 16% and 47% had severe and moderate disability (at discharge) based on Glasgow Outcome Score (Gururaj et al, 2005b). In an earlier study during 1993 on 1792 brain injured persons it was noticed that 34% improved and 66% were discharged with varying types of disabilities (Gururaj et al, 1993); 56% of patients stayed for 1-4 days.

9. CAUSES OF RTIS

Epidemiological information on "Why and how does it happen?" is crucial to understand the etiology and develop interventions. Information on type of colliding vehicles - patterns, situation, circumstances and specific human – vehicle and road design factors influencing crashes are crucial for designing interventions. This type of data is not available in India as independent research and multi-disciplinary crash investigations are limited. Police and legal investigations into deaths and some serious injuries are based on prosecution (at crash site or on roads) of traffic offenders or those who survive a crash. The list of traffic violations include a large list of factors, while the causes for RTIs

maybe totally different. Consequently, much of the investigation concludes that human error is the single major cause for RTIs. Even, national road transport policy reports that 83% of accidents are due to human error (www.morth.nic.in, road development policy). Consequently, greater emphasis has been laid on increasing knowledge and awareness among road users. However, research during the past 3 decades in HICs has unfurled the complex interaction of human - vehicle - road and system related factors. Following this, many innovations and strategies have been designed to make human beings and environment safer; vehicles less crash worthy; and systems upgraded, resulting in reduction of RTIs in HICs.

Available Indian data does not throw much light on mechanisms, situations, patterns and causative factors. Even though police and transport departments collect vast amount of information in crashes (and in routine checks) as they are considered medico legal events, the data provides very limited directions for preventive strategies. Further, skills required for scientific investigation and analysis of RTIs are limited with investigating agencies. Thirdly, even collected data is not available in the public domain for analysis by professio-nals. Fourthly, as everyone uses roads and vehicles, individual perceptions and experiences are often placed as solutions for reducing RTIs. However, such simplistic approach has not shown results in the past (Trinca et al, 1998). Understanding causation of RTIs require multidisciplinary inputs from traffic engineering, urban development, biomechanical engineers, police, public health specialists and epidemiologists, trauma care physicians, psychologists, social scientists and others. In the absence of such expertise in India, investigation of RTIs and elucidating causes has not received much importance.

The recent WHO/World Bank preport on RTI Prevention (2004a) has reviewed available global evidence and delineates that the risk of getting involved in a crash is due to exposure (amount of travel by different road users); probability of a crash (given a particular exposure); probability of injury (given the occurrence of a crash); and outcome of injury. Studying collision patterns provides vital clues about categories of injured / killed road users, type of colliding vehicles, type of collision with mobile and immobile objects(head on, roll over, rear end, skid and fall, etc.), nature and severity of injured body organs and several others. Limited analysis of police and hospital information has only revealed few areas of importance in Indian region.

Myth: Accidents are due to acts of god, bad time, sin of previous life and I had to pay.

Fact: Road Traffic Injuries are no more considered acts of god or due to bad times. Road Traffic Injuries happen due to complex human, product (vehicle/others) and environmental interactions. Understanding this issue has lead to reduction of Road Traffic Injuries and deaths in many countries.

Major risk factors for road traffic injuries

- Factors influencing exposure to risk
  - Economic factors, including social deprivation
  - Demographic factors
  - Land use planning practices which influences the length of a trip or travel mode choice
  - Mixture of high speed motorized traffic with vulnerable road users
  - Insufficient attention to integration of road function with the decisions about speed limits, road layout and design.
- Risk factors influencing crash involvement
  - Inappropriate or excessive speed
  - Presence of alcohol, medicinal, or recreational drugs.
  - Fatigue
  - Being a young male
  - Being a vulnerable road users in urban and residential areas
  - Traveling in darkness
  - Vehicle factors-such as braking, handling and maintenance
  - Defect in road design, layout and maintenance, which can also lead to unsafe road user behavior
  - Inadequate visibility due to environmental factors (making it hard to detect vehicles and other road users)
  - Poor road user eyesight
- Risk factors influencing crash severity
  - Human tolerance factors
  - Inappropriate or excessive speed
  - Seat belts and child restrains not used
  - Crash helmets not worn by users of two wheeled vehicles
  - Road side objects not crash protectiveInsufficient vehicle crash protection for occupants and for those hit by vehicles
  - Presence of alcohol and other drugs
- Risk factors influencing severity of post crash injuries
  - Delay in detecting crash
  - Presence of fire resulting from collision
  - Leakage of hazardous material
  - Presence of alcohol and other drugs
  - Difficulty in rescuing and extracting people from vehicles.
  - Difficulty in evacuating people from buses and coaches involved in crash
  - Lack of appropriate pre-hospital care
  - Lack of appropriate care in the hospital emergency room.

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

RTIs are non-random events and occur due to - conflicts within traffic systems; the size and nature of energy impact, tolerance of the individual; and quality and availability of emergency and trauma care services (WHO, 2004a). These risks can only be reduced with several scientific interventions. *Some of the important reasons for increasing road crashes and poor outcomes in India are - heavy mix of motorized and non-motorized vehicles, inappropriate road designs and standards, lack of vehicle safety for Indian vehicles, increasing individual modes of transport due to lack of efficient public transport, fast addition of rapidly moving vehicles, less importance for pedestrian - motorcyclist and bicyclist safety, increasing speeds on roads, poor implementation of helmets and safety belt laws, increasing use of alcohol, visibility factors, inadequate emergency and pre-hospital care, lack of trauma audits, lack of coordinated - integrated - Intersectoral activities, absence of institutions to coordinate safety, and total absence of research (Mohan 2002 and 2004a; Gururaj 2004d; Tiwari 1998). A systems approach to road safety is conspicuously absent in India, despite increasing road crashes from year to year.* A broad and crude summation of factors directly/indirectly incriminated and responsible for occurrence of RTIs, is provided in Table 7 (Annexure).

No single crash occurs due to one single factor and crashes are often due to complex interaction of several factors. Mohan and Bawa (1985) analyzed crash records of victims registered with police and concluded that (i) crashes are multifactorial in nature, (ii) dependant on type of road users and colliding vehicles, (iii) varies with time and location, (iv) high speeds of vehicles and road design features are important factors, (v) death rates are higher when collision of heavy vehicles occurs with vulnerable road users and, (vi) buses and trucks are involved in majority of fatal crashes. Qualitative analysis based on self reports among 1,500 hospitalized patients at NIMHANS, Bangalore, revealed that nearly 90% of injuries were due to combination of more than one factor (mean 5±2) (Gururaj G, 2005b). The involvement of various factors varied with type of road user and involvement with other vehicle or environment. The 5 major human factors responsible for injury were over speeding, overtaking another vehicle in speed, not wearing helmet, driving under the influence of alcohol and sudden road crossing without observation. The prominent 5 vehicle factors were poor visibility of vehicles, loss of balance, brake failure, problem with head and taillights and overloaded vehicles. The predominant environmental / road / system factors were absence of efficient and reliable public transport, poor street lighting conditions, obstacles on existing roads, poorly designed roads and absence of traffic systems. Immediate emergency care was not available for more than half of the patients. There were many other factors present in each of the 4 domains.

Some important factors that have emerged based on limited and independent analysis of RTIs and road safety issues in the Indian region are discussed below.

- Travel and mobility is a basic need for survival and livelihood rather than luxury in India. Lack of safe/efficient public transport systems - increasing motorization - increasing vehicle

ownerships have brought more number of vehicles and drivers onto the existing roads in the absence of expansion of safe infrastructural facilities and road safety regulations. This obviously increases the exposure risk of people and consequent occurrence of crashes.

- A heavy mix of motorized and non-motorised traffic on existing roads brings vehicles of different sizes, capacities, engine powers to interact with different road users of varying threshold limits at different travel speeds. Absence of traffic separation, traffic calming and designated travel mechanisms has resulted in increasing road deaths and injuries (Tiwari, 1998; Mohan, 2002 & 2004a).
- Road design – maintenance and operation plays a major role in the causation of RTI. The country is at a stage of growth and development where road infrastructure development is receiving greater importance and resources. However, the country-specific standards and guidelines for India have received little importance and is in early stages. Thus, when roads are made permitting greater speed (without automatic speed control measures), crashes will increase and deaths will be higher. Presence of many immobile objects like trees, poles, pillars, protruding objects, etc., and other hazards (like cuttings, ditches, potholes, unscientific speed breakers, etc) can contribute for increasing risk. Neglect of safety of vulnerable road users like pedestrians and bicyclists with lack of clearly specified places for walking, crossing and cycling in conflicting road environments could be major contributing factor. Road maintenance - development – expansion of existing roads and development of new roads needs to incorporate scientific features in tune with local socioeconomic and cultural determinants along with transportation modes.
- Vehicle safety features are vital in crash occurrence and in reducing the impact in the event of a crash. In India, many locally manufactured vehicles continue to operate in the absence of strict guidelines (Mohan, 2004a). Even though the Indian Motor Vehicles Act stipulates specific standards, compliance of the same is uncertain (Motor Vehicles Act, 2002). Further, vehicle crashworthiness and stability are crucial aspects in safety, especially in ensuring protection to drivers and occupants. Many new vehicles on Indian roads have capability of higher speeds in mixed traffic environments. Speed governors/tachometers are yet to be installed in many public transport vehicles. Lack of suitable protection, both within and outside vehicles is a major factor for both occurrence and poor outcomes.
- Driver certification and licencing procedures have been extremly lax in Indian and its various states. Lack of computerization and easy way of getting any (any number of course) licence has made all individuals to obtain licence in an easy manner. Even the offenders cannot be traced in the absence of certification.

consequently, skills required and to be upgraded are conspicuously absent.

- Ever increasing speed of vehicles on Indian roads, directly influencing crash occurrence is a major causation factor for RTIs in India (Mohan, 2004a). In a qualitative study of 1500 hospitalized RTIs, the injured persons attributed their injury to higher speed and overtaking by either their own or another vehicle in higher speed resulting in nearly 70% of injuries (Gururaj et al, 2005b). A recent study from Delhi also attributes high speed to be responsible for 32% of injuries (Verma and Tiwari, 2004).
- Poor visibility of vehicles, human beings and risk situations on Indian roads are a set of predisposing factors (Mohan, 2002; 2004a).
- Greater involvement of alcohol in nighttime crashes has been an issue of major concern. Alcohol consumption affects vision, judgement, coordination, reflexes and management in hospitals. Limited data from India reveal that more than a third of crashes are attributed to alcohol consumption (Gururaj 2004b & 2004e; Gururaj and Benegal, 2003; Davis et al, 2003). The extent of alcohol presence among injured persons was 17% in Pondichery (Jha et al, 2003), 29% in Delhi (Verma and Tiwari, 2004), and 15-25% in Bangalore (Gururaj, 1994 and 2005b) based on physician certification. Two-wheeler drivers (20-40%) were represented in higher numbers in all studies. In a recent survey of 12 hospitals in Bangalore city, alcohol involvement in night time RTIs was 22%. In roadside surveys, 80% of drivers suspected by police and 35% of randomly checked drivers were under alcohol influence. Interestingly, 98% of drivers tested positive declared themselves to be fit and confident to drive and were unaware of the dangers to themselves and for others on road (Gururaj and Benegal, 2003; BATF, 2005). Nearly 43% of those under alcohol influence were intoxicated at severe and very severe levels based on WHO Y-91 codes. Severity (more than 2 times), extent, mortality, disability and duration of hospital stay have been higher in the alcohol group (Gururaj, 2004e). The possible involvement of medicinal and recreational drugs is not known in India (Davis et al, 2003). Presence of driver fatigue and sleeplessness among vehicle drivers has not been investigated clearly.
- With nearly 70% of vehicles being motorized two-wheelers and 30-40% of those killed and injured being motorcyclists, many of the Indian states does not have mandatory helmet legislation. Even though Indian Motor Vehicles Act specifies that helmets should be worn, many of the Indian states have neither notified the law nor enforce the same in totality. It is generally observed that helmet usage rates are <5% in the absence of law, increase to 30% with notification, 60% with beginning of enforcement, and reach 80% with total enforcement. In two of the studies undertaken at NIMHANS, Bangalore during 1993 and 2004, helmets were not worn by majority of

the injured motorcyclists (Gururaj et al 1993 & 2005b). Absence of helmet laws and failure to wear helmets are proven to result in increase of - deaths / severe brain injuries / skull fractures, neurological disabilities, duration of hospitalization and medical costs (Channabasavanna and Gururaj, 1994; Gururaj, 2005b).

- Absence of efficient and timely pre-hospital and emergency care is another major factor in India. A recent review of current status of pre-hospital and emergency care and limited studies (Joshipura et al 2003 & 2004; Gururaj, 1993; 1999a; 2005b) have observed that - (i) absence of timely help, (ii) lack of early first aid care, (iii) delay in transfer of patients, (iv) barriers in reaching a definitive care hospital, (v) failure to recognize and manage different injuries at various levels of health care facilities, (vi) absence of triage, (vii) increasing referral from government hospitals due to poor physical and human resources, (viii) deficient skills among health care personnel, (ix) high costs of care in private hospitals and (x) lack of coordination among different agencies as some major gaps in emerging care. Matching severity of injuries to appropriate facilities by triage requires identification – assessment – initial care and referral. The problems related to emergency care are more severe in rural, taluk and district areas as timely help is not available.
- Trauma care in hospital settings is a major concern. Lack of facilities and personnel (Gururaj, 1999b), absence of triage, non-application of trauma audits, lack of clearly defined protocols and guidelines for trauma care, increasing referrals, high cost in private sector are some major barriers for timely trauma care. Reliance on high cost technology at the cost of basic and essential scientific care has only added further (Varghese, 2000).
- Poor and deficient rehabilitation services in rural and district areas affects outcome from RTIs as majority with disabilities at hospital discharge time do not receive timely rehabilitation services (Gururaj, 1998a and 1998b). Increasing costs of health care which deprives large number of poor and middle class families to seek timely and quality care is emerging as a major barrier across the country.
- Absence of comprehensive understanding and delineation of modifiable risk factors based on research has been significant limiting factors for growth of road safety in India. Road safety requires integration of transportation growth – infrastructure (roads) development – urban and rural growth - trauma care and other related issues in an integrated and coordinated manner based on multisectoral inputs. This lack of fundamental approach from a systems perspective has been a major contributing factor for continuous and year to year increase in RTIs in India.

Harshad, 36 years:

I was travelling on a Sunday evening with my wife on my motorbike in one of the suburban areas of Bangalore. We were travelling to our relatives house to invite them for the sixth birthday of my daughter, to come three days later. It was around seven in the evening and we were going from one relatives house to another. Since we had to invite couple of people within the same evening, we were also in a bit of hurry. Also, since I had other commitments in my workplace on Monday, we had to complete this work on Sunday itself.

I was travelling around 45-50 kilometres per hour. Since it was evening, the light was getting dark and there were no streetlights on this stretch of the road. Due to constant traffic, my speed was going up and down to manage within the traffic. Since it was the month of January and whether was good, we decided to cover long-distance in this time. Incidentally, I also left my helmet at home thinking that I could talk to my wife throughout the journey.

We were just discussing something serious and driving down. The road I was driving was a relatively straight stretch with traffic from both sides. Since many narrow roads rates join this main road, there were other drivers joining this road frequently. While going on this road, I did not notice a truck coming fast behind me. Suddenly, the truck came in full speed from behind. At the same time, there was a road opening which was left uncovered. Simultaneously, another motorist coming from the left side joined the road and was coming very close on my left side. In order to avoid hitting the motorist, I turned my vehicle to the right side. I also had to avoid the road opening, which was right in front of me. When I was taking this turn, the truck coming in speed at nearly 80 kmh just passed and hit my vehicle from the back. Soon after we were told that we were lying on the road in a pool of blood.

I did not remember everything that happened afterwards. My wife was also lying on the road and was found to be unconscious. Soon there was chaos on the road and lot of people gathered at the site. There was a big fight between the other motorist and the truck driver and many people joined them. Since I was bleeding all over and in extreme pain, I did not remember everything. Sometime later, I realised that I was in the hospital ward and was told that my wife was in intensive care unit. Several of my relatives came to the hospital after six hours of injury. I was told that some roadside people called for an ambulance, which reached nearly 45 minutes later. It seems the police also reached the spot after some time. I was told by my relatives that my wife had to be shifted to another hospital and had to undergo a major surgery. Since I was not there to decide on hospital payments, my relatives came to some understanding and had agreed to meet the hospital costs.

Three days later I learnt that my wife had passed away on the second day of operation. My relatives or the hospital staff did not inform me nor I was in a state to comprehend. I was gradually recovering at this time and it hit me like a big boulder. The sudden absence of my wife brought such immense agony for me, my daughter and to all our relatives. I stayed in the hospital for 20 days and 4 of the fractures were corrected. My relatives took care of me during this time and many of them had to come in shifts bringing food and other day-to-day requirements.

Following the death of my wife, my daughter has been left in the care of my relatives and is still in a state of shock and disbelief. She does not attend classes and refuses to go and constantly asks for mother. I have not been able to work even though it is three months after the accident. I have been informed that I need to file case in the court of law to receive compensation. All my

savings were finished within the first month after the accident and my relatives are supporting me after this. My company came forward with Rs. 20,000 in the first week after the accident.

Three months after the accident, my whole life is totally disturbed and shattered. I do not know how I would be taking care of my daughter and pulling along in life. Even though many of my friends and relatives come and talk to me, I need to make the final decision. In the absence of money, no work, disturbed mind and a young child, I do not know how I would be able to manage. The first two months were bedridden state for me and I was in extreme pain. As the pain has subsided, my mental agony has increased. I am not sure of what is in future.

Varun, 28 years:

Six months back, I moved from Baroda to Bangalore in search of a job. Being the third son of my parents, I was educated in the field of information technology and had done extremely well with good marks. On the campus placement job, I had got a job in a new computer company in Bangalore. After coming to Bangalore, I had settled down in one of the apartments and made couple of friends in my workplace. Gradually, we all became close friends and life was very interesting. I even started saving some money and planning to settle down in life. My parents were already in search of a bride and it was still going on.

Life was very joyful with loads of work and pots of money. Once in a while, we all used to go out for parties to break the monotony of increasing work. On a friday evening, we all decided to go out for a party on the outskirts of the city. Since I did not have a car, one of my friends brought his vehicle and five of us left for the party.

As usual, the party was fun. After couple of drinks and food, it was already 1 AM. We decided to head back home and get some rest. One of my friend who was driving the car was also under alcohol influence and was still capable of driving. We were all chatting in the car and making jokes. Since it was middle of the night there was not much of traffic on the road. Also, since it was a national highway, there were lots of heavy vehicles moving on the road. We never used to put on seat belts while driving.

As lots of vehicles were coming in from both sides, the glare was too much and at times it was difficult to drive. My friend kept on telling that it so nice to drive in the middle of the night as traffic was less. We saw a board that we were nearing the city and had to take diversions to reach our home. There were also quite a few vehicles that were overtaking us from all sides. We reached narrow intersections of the city; however our speed did not reduce. We had to take a left turn on a nearby street and go forward. As we were moving in full speed, another car at the intersection also came in high-speed. My friend tried to avoid the other vehicle and took an extreme left. We never knew that there was a big tree right in the corner. Our car rammed into the tree and suddenly none of us knew what had happened. The other car just sped away without stopping.

Due to the noise of our car hitting the tree, a few residents came out and called police. The vehicle came in 15 minutes and in turn called an ambulance. The ambulance reached in another 30 minutes and we were taken to a nearby nursing home. Here, we were asked to get admitted and 2 of my friends were in unconscious state. We were informed to deposit money for admission. However after 15 minutes of discussion we were taken into the hospital. After examination, we were told that 2 of the seriously injured had to be taken to another hospital for immediate investigation and surgical procedures. We were rushed to other hospital and by that time 2 of my other friends joined us. We were told that the required Doctor was out of station and were

referred once again to another hospital. We reached the third hospital with two unconscious people and were admitted. Necessary tests and procedures were undertaken. Nearly six hours had elapsed by this time. In the end, one of my friends died and the other was in the post operative room after the surgery.

What was supposed to be a fun loving party turned out to be a nightmare. All of us sustained injuries and we were treated. One of my friends had a broken arm and was in a sling. We were also asked to register the case with the police. The death of my close friend has cast a great shadow on our lives and we are still unable to overcome this tragedy. I am unable to concentrate neither on my work, nor on my life after this tragedy. Till date, we have spent nearly Rs. 2 lakhs on hospital care for all of us. All families have been supportive and are meeting the necessary expenditure.

One of my friends who had brain injury is undergoing constant headache and problems of memory. He is unable to work to his preinjury levels and is constantly getting irritated, angry and disturbed. His company has been telling him that he should stop working for about one year and take good care. He has also been advised that the company will not be able to keep him on the job as work has to progress at the required pace.

Even though I have recovered fully from this accident, the terrible death of a friend, another friend being still in hospital, another friend getting thrown out of the job has been very traumatic and disturbing to me.

10. CURRENT STATUS OF RTI PREVENTION AND CONTROL IN INDIA

Many major public health problems of today like communicable diseases, heart disease, HIV/AIDS, cancer, diabetes and hypertension were once considered unpreventable when causes were unknown. Research during the last 2-3 decades, technological advances, development of scientifically engineered policies and programmes, political commitment and community participation have changed this scenario. Significant reduction of deaths and disabilities have been noticed across the world, more so in HICs. India has also reacted positively to this challenge and efforts are on the anvil, even though success in prevention and control is yet to be demonstrated. RTIs were also considered unpreventable and assigned to fate or bad times at one time. Scientific research has demonstrated that RTIs are predictable and preventable and HICs have reduced the burden of RTIs.

The current status of road safety policies and programs in India have been discussed in a recent World Health Organization – South Asia Regional Office report on burden and impact of injuries (Gururaj, 2004b) and also by the United Nation E S C A P report on road safety (1999), Planning Commission (2003) and by Mohan (2004a), TRIPP, IIT, New Delhi. The non-availability of good information at all levels has been a major stumbling block due to absence of injury/RTI surveillance and trauma research. Consequently, efforts to tackle the problem have not received serious attention at different levels.

At the national level, India lacks a road safety policy and programme with clearly defined objectives, components,

resources and indicators. Road safety often linked with transportation growth is an individual and isolated responsibility of different sectors like transport, police, road and urban development, law and health. With lack of clearly defined agency and implementation mechanisms at national and state levels for coordinating, integrating and monitoring road safety, the progress has been far from satisfactory. Lack of research institutions, skilled manpower across sectors, limited participation of health sector in prevention and resource constraints has only added further. Even existing safety regulations are yet to be implemented in totality. The National and State level road safety councils have been recommendatory bodies and have not taken a comprehensive approach to road safety. NGOs in road safety are very few in India.

The draft National Road Safety Policy and National Road Transport Policy have just been formulated by the department of Road Transport and Highways and National Urban Development Ministry (policy is still open for comments by concerned citizens www.morth.nic.in/rspolicy.htm accessed on February 15, 2006). Section 8.7 of the Road Transport policy deals with road safety and outlines steps (DUVERT) related to driver, user, vehicle, environment, road and traffic (www.morth.nic.in/drafttransportpolicy.pdf accessd on February 15, 2006). The policy has outlined measures on strengthening infrastructure and transportation growth and falls short of delineating clearly defined mechanisms and steps for integrating transport, urban development and safety with mobility. Section 8.7.4 specifies that a realistic road safety policy needs to be developed to reduce road deaths and injuries.

The draft National Road Safety Policy (www.morth.nic.in/rspolicy.htm accessed on Feb. 15, 2006) still open for public comments as on February 15, 2006 (Copy provided in annexure)) has identified 11 strategic areas for road safety. These include - raising awareness, providing legal-institutional and financial environment, road safety information database, safer road infrastructure, safer vehicles, safer drivers, safety of vulnerable road users, road safety education and training, traffic enforsement, emergency medical services, human resource development & research for road safety. The policy has outlined several strategics to implement safety aspects. It is hoped that a implementable plan of action with defined roles, responsibilities, resources and co-ordination mechanisms will follow soon.

Independent state road safety policies have been formulated recently in Kerala, Tamil Nadu and Andhra Pradesh. Road safety has also been included (in general) in documents of other states. Each of these specify the creation of road safety units and includes recommendations for various subsectors (www.keralapwd.net/road_policy.jsp : www.tnhighways.org/policy.htm). The Kerala road safety policy has an action plan focusing on - coordination and management mechanisms, accident data systems, road safety publicity and campaigns, planning and designing of roads, improvement of hazardous locations, traffic legislation, safety education of children, law enforcement, driver training and testing, vehicle safety, emergency aid to accident

victims, road safety research and funding options. The action plan has also outlined activities for immediate and long term strategies (Kerala road safety action plan draft report, unpublished document, 2001). The Tamil Nadu policy envisages reduction of 1% fatalities every year from 2002 onwards. The policy focuses on 4 E's of RTI prevention and control. It is anticipated that similar policies would be developed across other states along with greater clarity in mechanisms of implementation, resources, programmes and measurable indicators.

The working group of Planning Commission on accidents (2003) has recommended establishment of an independent National Road Safety Board along with strengthening of research and academic institutions. At present only 15-20 institutions exist in the country and activities are uncoordinated and all of them suffer from severe resource constraints. An expert working committee set up by the Ministry of Shipping, Road Transport and Highways is developing a blue print in this direction.

In recent years, few NGOs in india are taking an interest in road safety. Institute for Road Traffic Education (www.irte.com) has undertaken activities in education, enforcement and research. The first national workshop (June, 2005) on involvement of NGOs in road safety (www.grsp.org) has identified series of steps for greater participation of NGOs in road safety. These include greater role for advocacy, networking, strengthening research, formulating victim support groups, better coordination with government sector and increased role of NGOs.

The Ministry of Health, Government of India has identified trauma care as a priority area. Ugrading facilities at peripheral levels has received a thrust. Trauma care centres and facilities are being developed / upgraded across the country (impact to be seen). However, efforts in prevention, rehabilitation have been very less from the health sector. Trauma care has been more of urban phenomenon and confined to acute care in hospitals with neglect of both emergency care and rehabilitation services (Joshipura, 2003). Acute hospital care is expanding with technology and specialized care, more so in private sector (with increasing costs). There are no uniform/defined protocols and guidelines for management of trauma patients across the country.

A recent working group constituted by National Human Rights Commission (2004) has suggested several mechanisms for strengthening trauma care in India. Among several recommendations for immediate implementation include formulation of National Accident Prevention Policy, establishment of coordinating bodies, centralized administrative bodies at state levels, establishment of national trauma registry and training programmes at all levels. Long term implementation strategies include establishment of dedicated trauma centres at different levels, development of emergency medicine as a specialty and steps for monitoring of progress. Efforts are in progress at national and state levels to develop implementation mechanisms to ensure that basic medical care at all levels is a human right (National Human Rights

Commission, 2004). The first national consultation on trauma system development in India (Government of Gujarat and Academy of Traumatology, www.indiatrauma.org, 2005) has recommended establishment of a "National Trauma Council" to coordinate and monitor activities in trauma care. Setting up specific standards for training, accreditation and quality assurance, financing, legislation, surveillance, prevention, developing pilot programmes with national and international agencies are other recommended strategies. The state of Gujarat is in the process of enacting an Emergency Medical Services Act to bring emergency care within the reach of a common man.

Several Institutions like Automotive Research Association of India in Pune (www.araindia.com) and several vehicle manufacturers have independent facilities for vehicle testing, research and certification. Similarly, Central Road Research Institute in Delhi (www.tifac.org.in), The Indian roads congress (www.irc.org.in), National Institute for training of Highway Engineers, Indian Institute of Technology in Delhi, Kanpur and Chennai, Engineering Departments of some Institutions are all independent bodies involved in research, design and development of roads. The transport departments of selected universities are involved in transportation research at independent levels. Engineering solutions for vehicles and roads are being translated from HICs and concerns have been expressed about their efficacy and effectiveness in the absence of evaluation (Mohan and Tiwari, 1998).

It is likely that several technical committees and working groups would have examined individual components of road safety (details are not available in public domain). Integrating independent observations into an integrated action plan and implementation is the need of the hour.

The current ground level interventions at grass root level focuses broadly on education of people and passive implementation of selected laws amidst rapid motorization and infrastructure expansion. The ongoing education programmes are general, sporadic, isolated and have not been systematically evaluated. The activities carried out by police and transport sectors (with minimal involvement of health sector in intervention) aim at mere provision of safety information to general public at selected time periods in a year. The implementation of laws with regard to helmet use, drinking and driving, speed control, driver licensing, vehicle standards are passive, often limited by resources (manpower and technical) and skills. The lack of implementation of these safety regulations has only resulted in disrespect for laws among public.

A review of ongoing initiatives reveal the total inadequacy in terms of absence of – defined road safety policies and programs, coordinating bodies at national and state level, national and local research, institutional mechanisms, specified budget and other human resources, implementing even a few successful interventions, specified guidelines and protocols for trauma care along with other issues.

11. GLOBAL EXPERIENCE AND LESSONS LEARNT

To achieve a significant reduction in RTI burden - political commitment, policy makers right approaches, professional's contribution, people's participation and proactive media are required. An integrated, coordinated need based approach founded on scientific evidence base is often driven by data and information. This also requires the total cooperation and participation of all sectors like health along with transport, police, urban and rural development, education, social welfare, excise, economics, judiciary, information and broadcasting and others. This amalgamation of resources and inputs, channelized towards safety of people through coordinated efforts by responsible agencies is essentially referred to as a "systems approach" (Trinca et al, 1988; Christofel and Gallagner, 1999; Task Force on Community Prevention Services, 2001). This approach not only reduces RTIs, but also addresses associated problems like traffic congestion, air pollution, noise pollution and also promotes physical exercise.

Road Injury Prevention and Control-The New Understanding

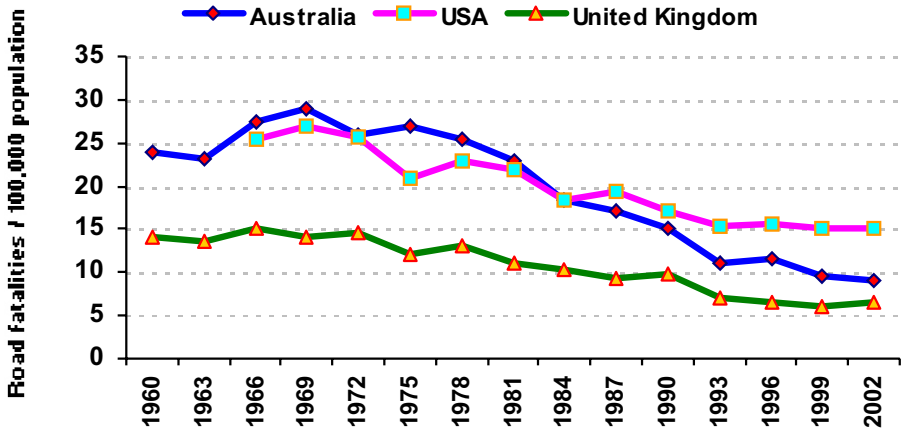
- Road crash injury is largely preventable and predictable; it is human-made problem amenable to rational analysis and counter measure.
- Road safety is a multi sectoral issue and a public health issue-all sectors, including health, need to be fully engaged in responsibility, activity and advocacy for road crash injury prevention.
- Common driving errors and common pedestrian behavior should not lead to death 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)

High income countries have significantly reduced the burden of RTIs in the last 2-3 decades, as shown in figure 13. The lessons learnt reveal that RTI prevention and control -

- Is possible and feasible.
- Requires establishment of an independent road safety agency with authority, status and resources to guide – develop – coordinate – implement – and evaluate safety aspects.
- Needs political commitment, policy maker's cooperation, professional's participation, and public involvement and media contribution.
- Is an intersectoral activity with combined inputs and joint efforts from all partners like health, transport, police, social welfare, education, information, media and several others.
- Is dependent on development of institutional mechanisms for understanding problems and priorities and for joint coordinated activities with independent monitoring and supervision of research, policies and programmes.
- Should be developed and implemented on a public health approach of identifying the problem, delineating risk factors, implementing right interventions and evaluating them for cost effectiveness - sustainability - culture specificity and ***measured by actual reduction of deaths and injuries.***
- Is an integrated activity as multiple interventions need to be combined and implemented to get maximum benefits and greater success within each intervention
- Is based on combined approaches of education, engineering, enforcement, emergency care and evaluation.
- Requires implementation of more and more passive countermeasures as these are more beneficial given the limitations of human behavior.
- Requires increased resources that needs to be invested in prevention and

Figure 13: Global Trends in Fatalities, 1980 - 2001



Source: WHO / World Bank Report, 2004

control at the primary level to see that society has safe people, safe vehicles, safe environments with adequate support and care for injured.

- Should be based on programmes developed on local, regional and national analysis of data collected through well-designed information systems.
- Is not possible if unspecific, adhoc, knee jerk reactions and populist measures are promoted.

Analysis of injury data is the backbone for developing relevant, cost effective, culture specific and sustainable interventions. Injuries are the final outcome based on the amount of energy generated in an event, presence of energy absorbing protective barriers and energy thresholds of individuals (Bangdiwala, 2000). William Haddon, Jr. proposed a matrix for various strategies that have formed the backbone and revolutionized injury prevention and control programmes all over the world (Haddon W, 1968). These ten strategies are:

- Prevent the initial aggregation of energy
- Reduce the amount of energy marshaled.
- Prevent the release of energy
- Modify the rate or spatial distribution of release of energy from its source.
- Separate the structures from the energy by means of space of time.
- Interpose a material barrier to separate the energy.
- Modify contact surfaces that can be impacted.
- Strengthen living / nonliving structures susceptible to damage.
- Early detection, evaluation and prevent its continuation.
- Institute all measures between emergency period following damage and ultimate stabilization of the process.

Example of Haddon's matrix as applied to two wheeler road traffic injury

	Human	Vehicle	Environment
Pre-event	Increase awareness about safe driving, helmet wearing, drink driving etc.	Increase visibility of vehicle	Implement safety on roads mechanisms
Event	Early transfer to hospital and appropriate care	Increase breaking systems of two wheelers	Crash protective road side stationary objects
Post-event	Rehabilitation services	Improve safety technologies and components	Facilities for early rescue of injured persons

From the above table, it is evident that several actions can finally reduce two wheeler injuries. Also evident is the fact that it requires careful and well-conducted research to identify each of these components. Further, it illustrates that implementation at different levels requires inputs from road designers and builders, police, transport, media, vehicle manufacturers apart from health professionals. Each partner can contribute by individual program components; however, it requires a combined - coordinated and integrated approach for implementation.

While it is essential to understand the principles and lessons learnt over a period of time at global level these solutions cannot be merely implanted in India (Mohan, 2002; O'Neil, 2002; Johnston, 1993). The ten strategies mentioned earlier have been converted to action primarily through 4 E's of injury prevention and control viz., Education, Enforcement, Engineering and Emergency care with a focus on safe people, safe vehicles and safe environment.

RTIs have evolved from a phase of accident reduction to injury prevention and control over a period of four decades. The five general approaches are:

1. Designing road environment to minimize probability of crash in all places.
2. Require that people restrain from risky behaviors or increase protection by appropriate road design, policing and enforce-ment.
3. Change vehicles or environments to increase automatic protection (the individual at risk need not modify his behaviour regularly).
4. Improve post injury emergency measures and rehabilitative treatment services.
5. Increase awareness and road safety literacy at all levels of society to develop mechanisms for positive actions by all sectors and people.

11.1. Educational approaches

Educational approaches have been used for considerably long period of time in prevention and control of many public health programmes. This approach is based on the assumption and understanding that road crashes are often the result of inadequate knowledge, wrong attitudes, improper skills and hazardous practices. Consequently, efforts are made to provide more knowledge to promote safe behaviours with the anticipation that people change their behaviour (Robertson, 1983). In India, it is strongly believed that human error is the single most responsible factor for road crashes. Thus several education programmes are held every year across the country by communicating road safety information through posters, leaflets, brochures, campaigns, exhibitions, competitions, etc. Messages are also beamed on television channels in local languages and in all local newspapers. Speeches and talks are delivered by experts frequently. Road safety week is an annual programme and significant resources are spent in organization of this programme at local levels. Often, the messages are directed at individuals

Road safety week in progress...

informing them to wear helmets, seat belts, not to drink and drive, not to drive in speed, not to travel on foot boards, not to overtake other vehicles and to follow all traffic rules.

Considerable debate exists around the effectiveness of road safety education. Educational activities take longer time to achieve the desired change, difficult to sustain, involves huge resources and are often subjected to individual perceptions (Robertson, 1983). The recent WHO/World Bank report on RTI prevention (2004a), examining global experience and evidence highlight that education is needed, but "when used as a single, isolated intervention, do not deliver tangible and sustained reductions in deaths and injuries". The report further states that "although such efforts can be effective in changing behaviour, there is no evidence that they have been effective in reducing rates of road traffic crashes". However, educational efforts on a broader approach should help in sensitizing and increasing awareness for policy makers, vehicle manufacturers, road developers and for public (Gielen and Sleet, 2003). Johnston (1992) in a collective review highlight that education at times can lead to changing behaviour, supports other safety measures, creates a climate of concern, change social norms and develop general skills and activities. Education activities can also help in accpetance of laws and improved compliance. Considerable difficulties have been experienced in measuring impact of educational programmes on large populations and no systematic population based evaluation in India has been carried out till date. In a recent evaluation of a televised road safety education programme in Ghana, it was concluded that overall road safety activities would be strengthened by increasing law enforcement activities related to speed and drink driving, apart from education alone. The limitations of televised programmes were language, content, mode of communication and focus of messages (Blantari, 2005).

11.2. Enforcement approaches

Health sector has also relied heavily on number of regulations, (e.g., food safety, tobacco control, travel regulations, water safety, etc.) to improve health of societies. Restraining individuals from

undertaking risk behaviors which are dangerous to themselves and for others on road has been undertaken with laws along with enforcement. Traffic law enforcement in India is partial and limited by number of enforcement personnel. Dandona et al (2005) observe that there are 2 traffic personnel for a population of 10,000 and only 1/3 of their time is spent on enforcement. The Indian Motor Vehicle Act of 1988, chapter 8 and portions of 13 has many rules and regulations. Specially laws with regard to wearing of helmets by motorized two-wheeler drivers, drunken driving, exceeding speed and violating traffic rules, measures for safer vehicles, compensation issues are noteworthy from a road safety point of view. Experience of many countries from around the world reveal that such laws are effective in reducing deaths and injuries when enforced in totality, random in application, visible in nature and with moderately stiff penalties. Laws with regard to helmets, alcohol control, speed violation, safer vehicles have been highly effective (Robertson LS, 1993). Since laws are part of a larger political process and not just an abstract set of principles, it requires active support from political leaders and policy makers, along with commitment from enforcing agencies. As such laws apply to large populations (are already part of Motor Vehicles Act), they can be enforced even with available manpower and can be effective. The initial public opposition in this regard need not be a barrier as safety of society is the overriding principle and can be overcome by well designed and targeted education programmes. Legal sector in collaboration with enforcing agencies has a major role to play in formulating effective laws and

Police officials checking for drinking and driving in Bangalore

mass media can play an effective role in disseminating information to increase compliance. Due to their impact on large populations in defined geographical areas, they can be evaluated by both direct and indirect methods and are often effective.

11.3. Environment modification approaches

Considering the limitations of education and enforcement strategies, modifying/ altering / strengthening environments and products assumed greater importance. This approach highlighted that passive protection (where individuals have to make less efforts on their own to be safe) yields greater benefits as much of the intervention is directed to vehicles and roads (Robertson, 1993; Christofel and Gallager, 1999). The term environment modification in a broader sense includes all specific interventions of making road environment safer, vehicles safer and includes social environment also. Thus, roads with better design and markings, traffic calming techniques, soft medians, vehicles with safety belts, airbags, auto ignition anti-locks, laminated windshields, improved crash worthiness, better braking systems and others are in place. Since these are not dependent on actions of people, need not be observed every day and are forgiving in nature, they have been identified as effective approaches all over world. However, some of these technologies needs greater resources (except a few) in the early stages. Some of these interventions can be measured very easily in terms of reduction of crashes, deaths and injuries.

These measures are passive, one time design efforts, individual efforts everytime a person is on road is not required, people - friendly and forgiving and does not require constant monitoring within a given environment. Even though much of this has focused on roads and vehicles for HICs, no right solution seems to be in place for Indian environments (Mohan, 2002; Tiwari and Mohan, 1998). Nevertheless, some time tested solutions like proper design of roads, speed control methods on roads, energy absorbing barriers on roads, improving visibility by greater reflectorization of vehicles at the point of manufacture, speed governors/ tachometers in all public and private vehicles can be effective in Indian region. More research is required to identify newer cost effective solutions for Indian environment. Epidemiological and biomechanical research can be effective partners in this process. Undoubtedly, this is an intersectoral activity with great potential.

11.4. Emergency and Trauma care

Trauma care services include range of activities from the time of injury till appropriate rehabilitation. There cannot be an exactly fitting approach in this area and should be developed based on geography, technology, resources and need. Mock et al (1998) in a review of trauma outcomes in 3 different settings noticed that mortality was 63% in facilities with low resources compared with 35% in HICs. Including only patients who survive to reach a hospital,

a 6 times increase in mortality was noticed for similar injury severity between hospital in a high income setting to a rural area of low income country (6% and 36% respectively). Reductions of trauma mortality to the extent of 15-20% have been achieved in HICs during the last 2 decades (Sethi et al, 2000; Mann, 1999).

The needs of an injured patient have been broadly summarized as – treatment of life threatening injuries, treatment of disabling injuries and reduce pain and suffering (Mock et al, 2004). A well developed Emergency Medical Service (EMS) aims at provision of basic first aid, early transportation of injured persons, referring patients to the right hospital based on nature and severity of injury, minimizing time interval, strengthening facilities in peripheral areas along with upgradation of skills among the functionaries by a well coordinated system (WHO, 1983). The recent WHO "Pre hospital trauma care systems" (Sasser et al 2005) and "Guidelines for essential trauma care" (Mock et al 2004) recommends establishing achievable and affordable standards for injury care based on better organization, good planning, training for skills upgradation, organization of trauma teams, systematic hospital inspection policies and improved coordination systems. The essential trauma care defines minimal injury care services; required resources and developing administrative mechanisms at different levels (Mock et al, 2004).

Recent Cochrane reviews have outlined that there is no evidence for certain high technology intervention in terms of reduction in deaths and injuries (Bunn et al, 2000). Varghese (2000) in a recent review of trauma care mentions that it is crucial to develop cost effective interventions that are scientific and realistic in nature. It is crucial to develop simple techniques that can be adapted by large number of people that would help injured persons without causing further damage (Varghese and Mohan, 1998). The recent WHO essential trauma care guidelines highlight that with reorganization of services, increasing skills, improvement of physical and human resources and better communication along with coordination mechanisms can result in saving lives.

THE EXPERIENCE SO FAR ....

The road safety lessons from HICs reveal that no country was successful in reducing crashes and injuries significantly till the 1960's (Trinca et al, 1988; O'Neil, 2002; WHO, 2004a). The policies currently followed in India are similar to those countries in the period before 1960. Earlier efforts in these countries focused only on education, punishment, setting up committees and councils and aimed at broad changes. A scientific approach to road safety started with - a greater push for research, setting up institutional mechanisms, understanding limitations of modifying human behavior, people friendly systems with strict laws, establishing road safety departments, developing multidisciplinary systems approach and an increased focus for scientific planning – implementation and evaluation. Success started emanating only when mechanisms and systems were developed by integration of several components of road environment with policies and programmes (Trinca et al, 1998).

"The early history of traffic safety in almost every motorized country was characterized by disperse, uncoordinated institutional units performing isolated single functions like road building, traffic management, law enforcement, public education, etc. The dominant official view that traffic accidents were caused by inadequate or reprehensible behavior created a climate in which the community simply did not see for help from scientific and technological sector……What brought this stage to a close was the explosion in traffic fatalities that accompanied the intense period of economic growth in the industrialized world …… one of the major response was to create a traffic safety body …… A second key development was creation of technical/scientific support for traffic safety decision making process". Many other developments followed subsequently.

- Inadequate data provided a fragmentary information base and led to incorrect conceptions of the traffic safety problem.
- One incorrect conception was that, to the extent that crashes were caused by deficient and / or reprehensible behaviour by individuals, the solutions must lie chiefly in behavioral change. This was in part caused by, and in part reinforced by, the original institutional arrangement in which the police were the primary traffic control and crash investigation and hence traffic safety agency
- This early concept of traffic safety militated for a long time against any major scientific study and ensured both that the involved agencies developed no applied science culture and that the transfer of technology from such areas as aviation safety was exceedingly slow.
- The dominance of the behavioural cause- behavioural cure view meant that the road, traffic and vehicle engineering professions and institutions were slow to accept accountability for the traffic safety impact of their activities.
- There was little co-ordination between the road construction, traffic management, law enforcement, public health, post crash management and public education agencies primarily because there was no belief that the problem required an integrated, system wide approach.

Resolution of extensive conflicts between competing goals of mobility and safety by attitudinal changes towards road safety in the form of – Rationality, Limited Objectives, Systems Approach, Cost Effectiveness and Pilot testing and Evaluation set the stage for changes for a mature approach to road safety.

Source: Trinca et al, 1988

Road safety often requires putting in place systems, which are sustainable, evidence based and cost effective in nature. Inter-ventions developed in the west cannot be merely implanted in the Indian environment as there are wide differences in knowledge – attitude – behavior of road users, level of technological growth and safety awareness, varied patterns and levels of systems and of ways the society has been responding to the crisis (Gururaj, 2000c; Mackay, 2000). However, the lessons learnt, principles that have evolved and the evidence basis should form the guiding principles. Mohan (2002 & 2004) has observed that efforts in India will have to focus on Indian problems, specially making vulnerable road users safer. Answers to this will not be available from any HICs as majority of them have not faced similar problems of mixed low and middle income economy, high mix of motorized and non-motorized traffic, presence of local vehicles, high density and varying patterns of land use, absence of research and lack of resources. The composition of traffic (75% being motorized two-wheelers and huge volume pedestrians), crash patterns and levels of care are not only different from HICs but also different in comparable stages of development of those countries.

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.
- 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 analyze data and use the data to improve safety.
- Set appropriate design standards for roads that promotes safety for all.
- Manage infrastructure to promote safety for all.
- Provide efficient, safe and affordable public transport services.
- Encourage walking and the use of bicycles.

(Source: WHO/World Bank, 2004)

12. INTERVENTIONS ... TOWARDS REDUCING RTIs

A broader approach to road safety in India should be with a focus on safe roads, safe vehicles and safe people in scientifically operating systems. Road safety interventions should consider a broad range of programmes beginning with developing a safe environment in which crashes do not occur or are minimized (primary prevention), access to timely care and management for preventing secondary injuries (secondary prevention) to appropriate rehabilitation of the injured (tertiary prevention).

A broad set of interventions is provided below for which considerable evidence exists and is applicable to India (with necessary modifications in some areas). For some specific interventions, research has clearly demonstrated their effectiveness, but modalities of implementation and evaluation needs to be developed. A detailed description of some effective and promising interventions and their role in decreasing RTIs are outlined in the recent "World Report on Road Traffic Injury Prevention" by WHO/World Bank and "The Road Ahead: Traffic Injuries and Fatalities in India": by Mohan of TRIPP, IIT, Delhi (2004a). Some examples as evidence for interventions have been provided at appropriate places.

12.1. Safer vehicles

Since large number of vulnerable road users either walk, cycle or drive a motorized two wheeler in India, their risk of exposure is high resulting in large number of fatalities and injuries. Except the import of car technology, a large number of buses, trucks, motorcycles, auto rickshaws, and bicycles are manufactured locally and have their own independent standards. Consequently, there is no precedence of international safety standards for these vehicles and hence need specific local standards. Hence, vehicle safety should be given significant importance in areas like 'road worthiness', 'crashworthiness', improved visibility and other issues. All safety standards mentioned in Motor Vehicle Act should be totally implemented and enforced. Some interventions which remain promising are:

- Improving and expanding the existing public mass transport vehicles for better safety performance as this would reduce individual exposure and make travel safer.
- Setting country specific standards for buses, trucks, motorcycles and auto-rickshaws in a comprehensive manner.
- Designing of buses and trucks with softer energy absorbing materials, especially in the front along with provision of impact absorbing cushioning materials within vehicles.
- Design changes for motorcycles (braking, lighting, crash worthy features) to make them more stable and crash resistant.
- Compulsory installation of automatic speed governors (tachometers/black boxes) in all public and private vehicles.

- All buses should be fitted with auto doors at the time of manufacture along with provision of emergency kits.
- Improving braking conditions of vehicles.
- Installing suitable lights to reduce glare while travelling.
- All cars to be fitted with compulsory safety belts, air bags and child seats.
- Increasing reflectorization and visibility of front and back of all vehicles.

12.2. Road and Environment safety

In India, conclusive evidence does not exist in India on reduction of crashes with improvements in road infrastructure alone even though this is gaining importance. This area has been receiving major thrust in recent years, specially on national highways and in urban areas. However, changes in designs that limit and regulate speeds, prevent major impacts and provide safer mobility to vulnerable road users can lead to reductions in injuries and fatalities. Some promising interventions applicable to India include:

- Reduction of speed in all possible places by both passive and active measures based on speed limits developed on research.
- Restricting pedestrian and bicyclist's access and/or creating spaces for these categories of road users to high-speed roads especially on highways (but movement facilities to be provided).
- Separating traffic on all possible roads (highways; urban arterial roads and other possible roads) and ensuring safer routes for pedestrians, bicyclists and slow moving vehicles.
- Area wide traffic calming techniques, use of roundabouts and separate lanes for slow moving vehicles.

  Road engineering measures with proper shoulders, designs with softer medians and crash cushions.
- Scientifically evaluated pedestrian crossing facilities that are visible and conspicuous in all urban areas, highways and other roads.

Vehicle manufacturers can

- Improve crashworthiness of vehicles.
- Help in setting safety standards for all locally manufactured vehicles.
- Adopt safety standards wherever and whenever technology transfer happens.
- Manufacture vehicles with safer vehicle fronts.
- Improve braking, lighting and visibility aspects by strengthening research.
- Combine promotion and sales with a greater thrust on safety (e.g., all two-wheelers should be sold with helmets).

(Source: WHO/World Bank, 2004)

- Accident black spot treatment in high crash locations.
- Scientifically designed and clearly visible speed breakers (presently they are known to be bone breakers) at locations identified by crash data, and on all roads closer to school and colleges, religious and business places, hospitals, etc.
- Increasing visibility of roads with lighting along with improving road markings and signage, especially in rural areas, highways and in busy places.
- Introducing safety awareness in planning, design, expansion and construction of road networks.
- Area wide urban safety management.

  Better land use by reducing traffic volume by replacing with safer public transport systems and by providing shorter/safer travel.
- Promoting safer community concepts with low cost engineering solutions.
- Mandatory safety audits on all repaired and newly built roads.

12.3. Legislation and Enforcement programs

Some of the major human behavioral issues have been addressed in road safety through legislative and enforcement approaches. These include speed control, violating traffic rules, use of helmets, reducing drink driving and modifying high-risk behaviors like use of cell phones and others. The Indian Motor Vehicles Act and its periodical subsequent amendments outline number of laws to be enforced in these areas. Global experience reveals that when mandatory laws are enforced in a systematic, continuous visible and random manner, it can reduce deaths and injuries on the road and no law can be effective if it is not - visible, enforced uniformly and sustained continuously. The existing laws have not made significant impact as they have not been enforced in totality due to lack of prioritization among enforcing agencies. The most effective interventions include:

If you are involved in road expansion and building activities, you can: ·

- Design and build roads with provision for safe movement of vulnerable road users.
- Plan, design and develop roads keeping future traffic expansion on road.
- Develop scientifically designed roads with all safety aspects.
- Make provision for traffic separation from early stages of road development.
- Use quality materials to ensure long life and safety and visibility.
- Include mandatory road safety audits on all roads.
- Coordinate in a better manner with other agencies involved in various activities on roads.

- Strict enforcement of speed regulations within and outside city limits and on highways, more with automatic measures like speed cameras and road design changes.
- Mandatory helmet use laws for riders and pillions of motorized two wheeler vehicles across the country with immediate notification and enforcement in all states.
- Strict enforcement of drink drive laws in a random, visible, uniform way across the country.
- Mandatory use of seat belts for car occupants.
- Moderate and stiff penalties for violators of traffic laws (like users of cell phones, speed violators and others).
- Limiting drivers work hours in public flight and transportation vehicles to reduce driver fatigue and sleeplessness.
- Mandatory child restraint laws.
- Strict enforcement of driver licensing systems for all vehicles.
- Imposing legal penalties for drug users.

If you are a police official, you can …

- 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 coordinated 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 procedures.

Myth: Road Traffic Injuries are a problem of America, Europe, and Japan and not of India, Nepal or Sri Lanka

Fact: Road Traffic Injuries are a problem in every country. While it has been calculated and estimated in developed countries, the actual problem is not known clearly in India and other developing countries due to lack of good reporting systems and surveillance.

12.4. Improvements in Prehospital care

In a country - where nearly 60% of health care services are provided by private health sector; industrial cities - rural towns - remote villages coexist; trauma care is in early stages of development amidst controversies; budget for primary and secondary trauma care is grossly inadequate; health functionaries being unskilled; disparities existing within states and with absence of clearly defined trauma care policies, trauma care in India is definitely at cross roads and without direction. Poor outcomes after an injury can be linked to poor availability of first aid services, deficient transportation, delay in reaching a definitive hospital and absence of triage. Lack of physical and human resource in health care settings is a major barrier to adequate trauma care services (Sethi et al, 2000; Gururaj et al, 2005b; Varghese, 2000; WHO, 2004a).

An Emergency Medical Services (EMS) System is an integral part of comprehensive health system, which provides for the organization of personnel, facilities, logistics and equipment for effective and coordinated delivery of health care services covering all geographic areas of the country under emergency health conditions" (WHO 1983). First Aid is defined as "measures taken by lay people in cases of injury to prevent deterioration in condition and to maintain vital functions until definitive help becomes available" (Berger and Mohan, 1996). A comprehensive system should respond to all types of emergencies.

Compoents of EMS Care (Seidel and Henderson, 1991)

- Recognition and assessment of unforeseen events.
- Notification, coordination and communication.
- Organization of system including participation, performance, training of all personnel.
- Emergency medical treatment that will increase the chances of survival and minimize the effect of injury.
- Legal and administrative frameworks.
- Trained and skilled personnel at all levels.
- Training for all categories of medical staff.
- Facilities for first aid services and early care.
- Availability of critical care units.
- Referral based on triage.
- Standard protocols.
- Uniform records keeping.
- Coordination with public safety agencies (police, fire, etc.).
- Communication systems.
- Early transportation facilities..
- Provision for redistribution of patients.
- Appropriate referral networks.
- Disaster linkage systems.
- Public information, education and participation.

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 reflectorsing colours on motorcycles, bicycles, autorikshaws 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 by drivers to wear seat belts and properly use child restraints, which can be achieved by proper legislation and enforcement along with education programmes.
- 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 0.08 g/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 a 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 Survillence system in Cambodia and Iraq. Even though this was demonstrated for landmines, it also applies to strengthening prehospital care for other injuries (Husum, 2003). Traning 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, evaluatory 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 larger benefits.

Supreme Court Judgement

All hospitals in the country must compulsorily provide basic minimum care to RTI persons, irrespective of their ability to pay and also avoid unnecessary referrals. Despite thepresence of directness by Honorable Supreme Court of India, public do not come forward to help accident victims on the road. The judgement of the Supreme Court in the case of Pt. Parmanand Katara v. Union of India and others reported in 1989 ACJ 1000: AIR 1989 SC 2039: 1989(3) SCR 997: 1989 (4) SCC 286. The following excerpts from the said judgement are relevant: -

"The petitioner who claims himself to be a 'small human right activist and fighting for the good causes for the general public interest' filed this application under Article 32 of the Constitution asking for a treatment should instantaneously be given medical aid to preserve life and thereafter the procedural criminal law should be allowed to operate in order to avoid negligent death and in the event of breach of such direction, apart from any action that may be taken for negligence, appropriate compensation should be admissible. He appended to the writ petitionreport entitled 'Law helps the injured to die, published in the Hindustan Times. In the said publication it was alleged that a scooterist was knocked down by a speeding car. Seeing the profusely bleeding scooterist, a person who was on the road picked up the injured and took him to the nearest hospital. The doctors refused to attend on the injured and told the manthat he should take the patient to named different hospitals located some 20 kilometers away authorized to handle medico-legal cases. The Samaritan carried the victim, lost no time to approach the other hospital but before he could reach, the victim succumbed to his injuries.

Source: www.morth.nic.in/rescue_of_victims.htm accessed on 14 September, 2004

If you are a health professional, you can:

- 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 programmes (transportation, work safety, home safety, etc)
- Undertake advocacy along with lobbying and networking for road safety by providing leadership and coordination.
- Support & conduct research for developing and evaluating interventions
- Translate research to policies.

Some of the potentially useful approaches for India are:

- Training of all health (public and private) functionaries along with police, drivers, teachers and community leaders in basic elements of first aid to deliver ABCs (Airway maintenance, Breathing and circulation) of trauma care. (Uniform training procedures, guidelines, training methodology and manuals have to be developed by a central agency).
- Simple first-aid kits should be available in all public places and transport systems (effectiveness of this needs to be determined by research).
- Training of all doctors in provision of basic services for injured persons by a uniform methodology with a focus on providing basic care, better management at individual levels, identifying life threatening injuries and referring patients to appropriate places (based on nature and severity of injury).
- Upgrading human and physical resources in all public health care institutions (with availability of basic physical, investigative and human resources for emergency services).
- Development of a uniform geographically defined EMS with integration of public and private systems to provide minimum basic care.
- Development of "minimum care guidelines and protocols" for different levels of health care system by professional bodies.
- Designation of all district hospitals and those situated on highways as integrated trauma care centres (with necessary upgradation of resources and skills among health personnel).

- Better coordination and functioning of ambulance networks on a geographical basis with common access numbers.
- Establishing proper referral networks (preferably within a district).

  Removal of all medico legal hurdles (which exist in many places across the country).

12.5. Trauma care in hospital settings

In a recent survey of trauma care facilities in India (Joshipura et al, 2003), it has been observed that - trauma care is more of an urban evolving phenomenon with much of the care provided by private sector; there is no designated unit within health ministry to integrate, coordinate, implement and evaluate programmes; there are no minimal - uniform standards for trauma care across the country and a systems approach to trauma care is totally hacking. In addition lack of resources, absence of legal and administrative frame works for training, accreditation and support systems, lack of training in basic care; absence of minimal and stipulated standards for education and training of medical, paramedical and ambulance personnel are major hurdles. A recent emerging problem in Indian cities is the high costs of trauma care (specially in private sector) as injured persons (specially the poor and middle class) are unable to pay, and hence referred from hospital to hospital, leading to poor outcomes.

Limited surveys of hospital settings (primarily in public sector) have shown lack of communication facilities, standard protocols and lack of resources along with trained personnel (Gururaj, 1998b). Since national insurance covers less than 1% of population, quality care is difficult to access by many of the injured.

The 10th five-year plan document (MOH and FW, 2002) clearly acknowledges that, "at present, there is no organized comprehensive trauma care services either at the centre or in the state". Effective multidisciplinary trauma care system was under active support and consideration. The document has outlined that during 10th plan period, efforts will be made to strengthen primary, secondary and tertiary care institutions through - adequate training to medical and paramedical personnel; provision of facilities for transport; suitable strengthening of existing emergency and medical services and improving referral linkages.

Some promising and highly useful interventions for India include:

- Strengthening basic essential care at first contact hospitals (taluk, district, Community Health Centre settings).
- Training of doctors and other health functionaries with uniform methodology, simple manuals and periodical refresher training programs.
- Ambulance networks/easy transport systems to be developed on a geographical basis with better communication and coordination.
- Upgradation of casualty services of all public sector hospitals with required physical, human and essential supplies.
- Development of minimum standards, guidelines, protocols and deliverable

services by a centralized agency (for both public and private hospitals).

- Introducing triage at all levels to refer and manage patients with varying severity in different levels of hospitals.
- Strengthening communication facilities at all levels, specially in rural and taluk areas.
- Compulsory trauma audits to identify weak links in the existing system.

12.6. Rehabilitation services

For every road death, nearly 20 are hospitalized and provided care for varying durations. Majority of them leave the hospital with varying nature and severity of disabilities. Rehabilitation is an integral part of total trauma care services. The overall aim of rehabilitation care is to restore optimal functioning of the individual and to reintegrate him into his/her family and society. In India, since large majority of injured persons reside in rural areas where trauma care is poor and deficient, there is an urgent need to strengthen this area. Any rehabilitation should ideally start during the course of hospital stay and continue till the functions are restored to the best capacity. Rehabilitation should be comprehensive and multidisciplinary. Inputs are required from several disciplines from within health sector like orthopedics, neurosurgery, psychology, social work, speech therapy, nursing and others. Simultaneously, inputs are also required from other sectors like social welfare, engineering, education, urban and rural development and others in this area. In recent years, community based rehabilitation has been accepted as the ideal strategy to deliver services.

Some promising interventions include:

- Upgrading skills by training of family members to undertake simple rehabilitation exercises, nursing care and psychosocial support during the course of hospital stay.
- Incorporating simple technologies for restoration of activity with inputs from local doctors and specialists.
- Enhancing skills among health personnel by short term capacity development programmes.
- Establishing suitable referral services for integrated care of disabled persons.
- Extending social support systems in the areas of education and employment through legal, administrative and social service mechanism.
- Early and timely compensation for injured persons or for families with an RTI death with necessary and required legal changes.

What communities, civil society groups and individuals can do:

- Encourage governments to make the roads, vehicles and people safe.
- Support for 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 helmets and seat belts by appropriate laws.
- Encourage enforcement of traffic safety laws and regulations.
- Form advocacy and victim support groups to demand safety by coalition and networking.
- Strengthen procedures for early and appropriate compensation after injury.

As a responsible citizen you can:

- abide by road safety rules with regard to speed and driving.
- avoid driving while under the influence of alcohol.
- wear a crash helmet when riding or traveling a two-wheeler.
- always wear seat-belt and properly restrain children, even on short trips.
- plan your journey time.

The above mentioned range of interventions and responsibilities at different levels highlight the need for a multipronged, combined and integrated approach for road safety. Adding interventions at different levels results in incremental benefits. Since there are multiple stake holders, the need for well designed and targeted approaches are crucial.

13. AN INTERSECTORAL APPROACH

Road safety is an intersectoral activity. Each partner needs to identify roles, responsibilities and activities clearly. The role of health sector is provided as an example and each sector has to define their roles and responsibilities. All such activities need to be coordinated by a empowered lead agency at centre and state levels.

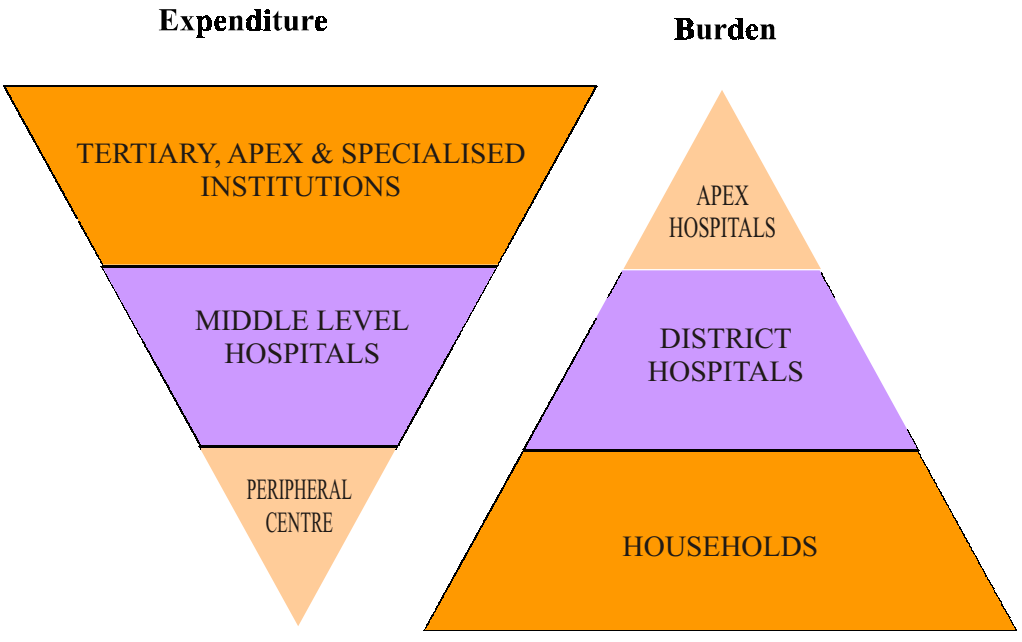
Health sector has played a significant role in preventing deaths and increasing life expectancy of people during twentieth century. The primary goal of health sector and systems are to improve, maintain and restore health of communities. The four major functions of health systems are service provision, resource generation, financing and providing leadership (WHO, 2004b). In all HICs, health professionals have taken a lead role in reduction of RTI deaths and disabilities.

* The objectives of health sector in road safety are to promote safety and health, prevent injuries and improve quality of life of those afflicted.
* Health sector as a "partner in prevention" needs to focus on prevention of RTIs along with provision of acute and rehabilitative care by taking a participatory role in planning, programming, implementing and evaluating road safety programmes.
* Health sector has to take a lead role in advocacy and knowledge generation for road safety activities by

highlighting the burden and impact of RTIs along with advocating for various prevention programmes.

* Health systems should develop required data by undertaking and collaborating for research with related sectors. Health professionals can identify the burden-impact- situation - circumstance - objects producing injury and individuals at high risk by developing injury/RTI surveillance and trauma registries.
* Trauma care needs strengthening by developing integrated trauma care services-improved notification methods-rapid transport of victims-suitable referral systems based on injury triage through manpower development and strengthening of facilities at peripheral levels.
* Health care agencies can highlight the amount of resources spent on care and management of injured, thus focusing the attention of policy makers towards prevention programmes.
* The burden and impact of RTIs is more pronounced at family levels especially among the vast rural and district population while much of the government spending is on acute care in urban areas (Figure 14). This vast imbalance needs to be corrected by prevention and safety promotion issues.
* Health professionals should undertake advocacy in several areas of enforcement, engineering and education and for implementation of several safe technological measures (e.g.: helmets, seat belts, better technology etc.).

Figure 14: Health burden and expenditure due to RTIs



* With a "new role of NGO's" gaining momentum, their proximity to community being greater, innovative strategies being a strong factor, road safety should form in important area of concern for NGOs.
* Health professionals can increase awareness among engineers, road builders, vehicle manufacturers, police personnel, lawyers, social service agencies, media personnel and policy makers and support in developing right standards, guidelines and regulations. Advocacy, lobbying, networking should form an important thrust area in promoting safe communities.

The growing burden of RTIs in India has placed greater demands on health sector as large amounts of physical, human and economic resources are spent on provision of care and rehabilitation. The circle in which health systems function has expanded with increasing knowledge on health impacts of developments related to motorization, urbanization, transport, environmental issues and globalization of trade (WHO, 2004b). With changing demands, health sector and professionals must provide the vision, intelligent research and exert influence on other sectors to improve health and safety in societies (Mohan, 2004b).

Implementing each intervention needs identifying critical gaps at various levels and strengthening with appropriate measures. For example, implementing helmet law requires several activities as mentioned below:

Myth: Road accidents have already reduced in the country.

Fact: This is not true. In many cities and in central areas of these cities, road traffic injuries have reduced due to traffic congestion and more vehicles. These injuries have only shifted from central to peripheral areas and are less reported due to absence of police in these places.

All Indian states to notify helmet law

↓

Police, health, transport & legal sectors to inform society about advantages of helmet laws and increase compliance

↓

Police personnel are sensitized about role and value of enforcement and benefits to society

↓

Police to enforce law in a uniform and visible manner

↓

Judiciary to support law

↓

Hospitals & police to monitor injury and crash rates

↓

Scientific analysis of information

↓

Communicating to society about changes after introduction of laws

↓

Increasing safety awareness of people

↓

Strengthening law for continuation.

↓

Integrating with other policies & Programmes

↓

Surveillance and Research

Myth: It does not happen to me, and happens only to others.

Fact: Many people express this statement till it happens to them. Road Traffic Injuries can occur to any person at home, work, on road, in river and in any place. With regard to suicides everyone has a fleeting thought of ending their life in a crisis situation. When these thoughts and wishes become repetitive, progressive, and cumulative and interfere in one's activities, suicide will happen. While no definite numbers can be estimated, such thoughts are present in large number of people before committing suicide.

Similarly, implementing drink drive laws require several activities to be undertaken by individual partners for success of the intervention.

Basic drinking patterns of society to be understood

↓

Motor Vehicle Act to have necessary and updated components within the law

↓

Police, health, transport and legal professionals are made aware of law and their role to sensitize people

↓

Public are informed about laws, penalties and enforcement strategies.

↓

Equipping police with dedicated teams, breathalyzers and other supplies along with training.

↓

Information on law communicated to society

↓

Police to enforce law in a strict-visible-uniform manner

↓

Legal courts to make provision for acceptance

↓

Collected revenue as penalties to be ploughed back to road safety

↓

Police and hospital to monitor RTI rates before and after law by developing data

↓

Dissemination of information to society by multimedia channels

↓

Strengthening integrated measures like legal age of drinking, sale of alcohol, new technology promotion and others.

↓

Evaluation to make programme changes

With the above two examples, it is clear that for each intervention, efforts are required from health, police, transport, law, media, civil society, education and others. Unless these activities are coordinated adequately and integrated into broader framework of road safety policy, mere laws are unlikely to yield positive results.

14. ROAD SAFETY POLICIES AND PROGRAMMES: A SYSTEMS AND PUBLIC HEALTH APPROACH

Any health problem resulting in unnecessary and disproportionate deaths, hospitalizations and disabilities, causes of which can be delineated by scientific investigation and are amenable for preventive and corrective measures, thus helping the overall growth and development of societies should be considered a public health problem (WHO, 1991). By any analysis, RTIs meet these criteria. Road traffic injuries are undoubtedly a major public health problem as more than 1,00,000 people loose their lives and 1.5 million are hospitalized every year in India. Even though causes have not been clearly researched in India, existing knowledge reveals that substantial number of these deaths and injuries are preventable. There is need to develop a scientific systems approach to identify and implement remedial measures.

A "Systems Approach" helps in understanding how events are interrelated, connected into patterns, organized into a totality rather than being fragmented and unrelated happenings (Trinca et al, 1988; Ameratuga, 2004). This approach has essential five components of "Analysis, design, development, implementation and evaluation". Systems approach requires coordinated efforts of health, law, transport, police, politics and communities organized into a planned approach. The efforts of each sector should be channelized towards one specified goal with defined components. This can be a reality in India only with a comprehensive national road safety policy in a well-coordinated manner.

A "public health" approach emphasizes identifying the burden, understanding its determinants, designing specific programmes, implementing scientific interventions and evaluation to see how it works (WHO, 2002). This also forms the central pillar of road safety policies and programmes. Good quality information forms the essential foundation of any such programme. All four components require multidisciplinary inputs from both within and outside health sector. Within health sector, inputs are required from public health, Epidemiology, Orthopedics, Neurosurgery, General surgery, Psychology, and several others. Engineering, Transport, Police, Law, Social Sciences, Education, Information and Broadcasting, NGOs, Social Welfare, Urban Development and others are key players bringing in specific inputs for programmes to be operationalized – implemented and evaluated.

- **Identifying the public health burden and impact requires good qualify information from health, police and transport sectors.**

The current data from police sector provides only a trend and broad information on socio-demographic factors. Data on causation is virtually absent. Further, many of the RTIs are not investigated on a scientific basis due to lack of resources and skills with investigative authorities. The complexities in the interaction between human – vehicle – road factors require a change in data collection practices *"to identify critical*

data elements that would help in designing interventions for reduction of RTIs". The absence of surveillance on RTIs within the health sector compounds the issue further due to lack of information gathering practices. The transport and legal sector data have their own focus and do not undertake information analysis on safety in a systematic way. The advantages and limitations of data sources from various sources is given in Table 8 (annexure). This situation illustrates the need for developing scientific information systems within police and health sectors based on information gaps outlined earlier.

- Identifying causes requires a skillful approach to critically examine crashes on land and in laboratories. RTIs being non-random events can occur at any place, any time and for any person and under any circumstances. The causes could lie on roads, in vehicle or in people due to complexities of traffic environment and human behaviors. As several factors operate and no single cause being responsible, interventions also have to be multipronged. Research in road safety causation should focus upon:
  - Epidemiology of RTIs
  - Identification of prioritized risk factors
    Injury situation - context - mode of occurrence
  - Precise role of vehicle – road and human factors by independent and multisectoral agencies
  - Study of crash patterns and multidisciplinary crash investigations
  - Delineations on the presence or absence of specific protection/ prevention strategies
  - Emergency and trauma care
  - Systems and operational research covering transport, urban and rural development and law
  - Policy research in transportation, health, land use patterns, infrastructure development.
  - Cost effective & culture specific intervention and evaluatory research

At the national and state level, there is an immediate need to strengthen RTI surveillance and research from a multidimensional point of view. Intersectoral research groups needs to be established in leading institutions for joint and participatory research. Trauma registries and injury surveillance in selected institutions and communities should be established by leading research organization's like Indian Council of Medical Research. Independent studies of descriptive, analytical and intervention nature should be supported at local levels in selected and identified centres. Further, centers of excellence should be identified and supported across India for better networking and sharing of methodo-logies, experiences, and information and to examine culture specific issues. The current data collection practices need to be re-examined to assemble those elements which can be effectively used for understanding RTIs and developing interventions.

- Implementing interventions requires a careful understanding of systems and identifying cost effective, culture specific and sustainable interventions. A number of interventions outlined earlier can have a positive influence in reducing crashes and promoting safe transport and mobility. However,

interventions need to be considered from several dimensions of technological feasibility, cost effectiveness, political commitment, professional support and public cooperation. Critical areas required for identifying missing links and strengthening is crucial for bridging gaps. Most road safety interventions of the west cannot be merely transferred and implanted in India. Johnston (1993) has observed that this transfer of technology requires significant adaptation rather than simple adoption.

- Scientific evaluation of interventions are vital to measure the effect of resources that are spent, process of implementation, outcome in terms of achieving desired objectives and **impact by measured changes in deaths, disabilities and injuries,** crucial for success and mid course corrections. It also reveals the change in the safety culture of the society in the way human life is valued and the importance of saving lives and limbs. The evaluation activities reveal critical gaps in program implementation, identifies the missing links and develops mechanisms of bridging gaps with additional inputs. The indicators for evaluation should primarily be reduction in deaths, hospitalizations, disabilities, and economic losses and not merely change in knowledge and behavior of people over short period of time.

Road safety is an area today where we accept unscientific solutions – every one as a road safety expert – react in a knee jerk manner – implement on an adhoc and piecemeal approach. Formulation of programmes, coordination - implementation and evaluation of several interventions require development of scientific strategies. In India, so far, a systems approach to road safety has not been systematically developed. The need of the hour is to develop strategies based on scientifically developed information systems for comprehensive understanding and implementation of solutions.

15. MOVING FORWARD WITH STRATEGIC APPROACHES

In 2005, RTIs resulted in the deaths of an estimated 1,10,000 persons, hospitalization of 1,500,000 persons and minor care for >5 million from various health care institutions, resulting in an economic loss of approximately 55,000 crores. The problem has been increasing from year to year and the death of morethan 1,00,000 people every year should make everyone to think – IS this an acceptable price we need to pay? If no efforts are instituted on a war footing, this will lead to 1,85,000 deaths and more than 3.5 million serious injuries by 2015 with corresponding increases later. Every year, thousands of children become orphans, wives loose their husbands, parents mourn the loss of their children and government spends enormous resources on compensation, care and rehabilitation of injured. Children saved today from infectious and nutritional diseases are only becoming victims of this modern day epidemic at later stages of their life. This tragedy can definitely be reduced.

There is a national programme for cancer, blindness, diabetes, HIV/AIDS

and other public health problems. There are statutory bodies for many programmes to guide-monitor and coordinate efforts. It should make every conscious citizen and policy maker to think "Why is it that we do not have a policy or programme or a governing body for prevention and control of road traffic injuries?; why are we not investing in safety of people on our roads even though we have numerous laws and regulations? Why are we not trying to find innovative solutions to our problem in a country, which is a global leader for information technology? Many other questions should follow.

Road safety requires informed decision making by all sectors like - Health, Transport, Police, Law, Social Welfare, Information and Broadcasting, Vehicle manufacturing, Urban and Rural Development, NGO's and civil societies for a scientific approach. The strategies that need to be developed should be focused on short term, medium term and long term basis with clearly defined goals and measurable objectives.

- A leading national empowered agency needs to be established to guide - supervise – develop - coordinate - monitor road safety issues with multidisciplinary inputs and participation. A recent report submitted to planning commission, Government of India by a working group has recommended establishment of a National Road Safety agency with defined roles and objectives (Planning Commission, 2003). Over the period of next 3 years, similar independent bodies should be set up in every state.
- There is an immediate need to develop a road map on RTI prevention with development of National Road Safety Policy and an Action Plan. The plan should outline various short term, medium term and long-term programmes with clearly achievable targets. It should also outline efforts required from different sectors and coordination mechanisms with allocation of resources at various levels. Similar actions should follow in all states and union territories.
- Apart from macroplans at national level, there is need for cost effective and sustainable programmes in individual states, cities and districts. This needs to be developed by responsible local teams based on understanding of local data on an intersectoral approach. Further, it needs to include specific and time bound objectives, activities and indicators.
- India spends enormous resources on traffic management and trauma care. However, no resources are available for continuous, yearlong prevention programmes at district and peripheral levels. Resources are required for enforcement, road engineering, research and informing society about MVA rules and health benefits to safety. Augmenting resources for exclusive prevention and safety programs is very vital.
- All specific, known and proven counter measures in road safety needs to be implemented in India as outlined in earlier sections. These must be implemented on a visible - uniform basis in all states. Interventions likely to provide immediate and positive

results within short and specified time period need to be prioritized and implemented. Some examples are -

- Speed control on all arterial roads, inner city areas and national highways.
- Traffic calming in all urban areas and on highways at villages and towns.
- Separation of traffic into slow and fast moving categories on all possible roads with provision for safe travel of pedestrians, bicycles, motorcycles and buses.
- Encouraging use of peripheral lights, reflectors and use of white/orange colours (uniformly in standard ways as applicable to each category of vehicles) of reflective nature for all vehicles to increase visibility of vehicles.
- Improving safety standards of buses and trucks.
- Mandatory helmet laws to be notified and enforced in every state for two wheeler drivers and pillions and should be strictly enforced.
- Random breath testing for alcohol should be implemented and enforced by police in all states with the use of breathalyzers.
- Daytime headlight usage by vehicles should be notified and slowly implemented to improve visibility.
- Enforcement of seatbelt laws across the country along with availability of seat belts in cars.
- Compulsory notification and actions that all hospitals must provide basic life support for road accident persons.
- Initiate first aid and basic life support training for all health personnel, police, drivers and teachers along with general information to public.
- Designate all district hospitals as integrated trauma care centres with improved facilities and resources. Each district should develop local trauma management plans depending on their need.
- Improve compensation mechanisms for injured persons and for families with an RTI death
- Mandatory road safety audit in all road improvement projects.
- National Trauma Council should be set up in the Ministry of Health with a nodal officer along with inputs from different specialists. Minimum standards of care, protocols and guidelines must be established in all health care institutions.

Suraksha Sanchara: Public – Private Partnership

A programme to demonstrate road safety based on public – private partnership approach was initiated in Bangalore, India during 2000. Bangalore Agenda Task Force lead the programme by bringing together police, transport, Bangalore Mahanagar Palike, NGO's, Academic institutions (NIMHANS and others), health and others to jointly develop and initiate road safety activities. Global Road Safety Programme (GRSP) joined the initiative by bringing best practices to the team. The focus was on safe roads, safe people, safe vehicles and safe systems. Some of the initiatives taken up under the drive are reducing drinking and driving, setting up accident data base system, automated enforcement centres, driver training, improving pedestrian facilities and urban safety management (Bangalore Agenda Task Force, 2005).

- ❖ Surveillance & research need immediate beginning in India. The existing data indicates only the trends and does not focus on elements to identify burden and impact, causation or changes due to interventions. In this direction it is essential to -
  - * change / revise existing data collection systems to obtain information on crash characteristics with a clear focus on modifiable factors. Minimum and optional data elements to be collected by police and health should be developed by an expert group.
  - * centres of excellence should be promoted along with increasing support in apex institutions and selected medical colleges to develop injury (including RTI) surveillance and trauma registries as per methodology recommended by WHO (2002).
  - * surveillance of highway traffic crashes for specific road; vehicle and human factors operating on highways with professional inputs from various sectors.
  - * sentinel surveillance institutions should be designated in each state to investigate crashes.
  - * multidisciplinary crash investigations should be promoted at local levels.
- ❖ Human Resource development and capacity building activities in road safety across police, transport, law and health sectors needs urgent attention. At present there are no investments made to develop road safety professionals in health, police, transport and other sectors. Institutions of excellence must be identified and funded to develop long term and short term training programmes to instill scientific principle and to undertake research. Teaching of undergraduate and postgraduate students in all academic programmes of health, transport, police training institutions and law colleges should be strengthened with a clear focus on road safety.
- ❖ Revisiting the Indian Motor Vehicles Act is crucial at this juncture. The Indian MVA formulated initially in 1939 has undergone several amendments and changes from time to time. The revised act of 1988 and amendments in 1990 suggest large number of measures but implementation is notably weak. However, as transport scenario is undergoing rapid changes, the act needs to keep pace with changing realities. Since this is the binding force for many sectors, there is need to introduce specific technical inputs to strengthen road safety issues.
- ❖ Involvement of industry, private sector and civil societies is crucial for success of road safety as it is no more a task restricted to police, transport or health sectors alone. A public-private partnership with active involvement of citizens will help in better compliance with laws.
- ❖ Interlinking urban and rural development, transport, mobility and safety require vision for today and tomorrow. Investing in safe, efficient and reliable mass transport systems, efficient urban land use policies and safer vehicles for tomorrow needs

serious discussion and implementation at different levels.

- Lastly and most significantly, all road safety activities needs support of professional (trained and qualified) road safety teams. This requires developing such teams at national and state levels in collaboration with national and international agencies.

Road traffic deaths and injuries need not be the dark side of our growth and development amidst chaotic transportation growth. Many of the RTIs can be predicted - prevented and lives can be saved, if we give road safety a greater priority with investments and implementation. Implementing scientifically driven policies and programmes will pave the way for decreasing the endless pain, suffering, agony and anxiety associated with RTIs in the coming years. Indian society with policy makers and professionals from various sectors, automobile industry, road building and transport organizations, media, civil societies and international agencies needs to act now. It is time to move from pessimistic – fatalistic and unscientific approaches to positive, optimistic and scientific solutions. It can happen if we develop the vision and mission and ACT.

Myth: Road traffic injuries are a problem of America, Europe and Japan and not of India.

Fact: RTIs and deaths are a problem in every developing country and more so in India. Due to absence of good information and reporting systems the precise magnitude of RTIs in all its dimensions is not clearly known. As India is going through a rapid motorization phase, RTIs are already a major public health problem and will continue to increase in the coming years

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