Road safety management needs to be strengthened with vision, direction, coordination, management, funding, interventions, advocacy, monitoring and evaluation. Many countries need to be strengthened with sustainable, cost effective and scientific policies. The five pillars of the Decade of Action on Road Safety 2011–2020 including safe roads, safe vehicles, people, post-crash care and efficient management need to be implemented in all Member States. Information through good research is an important building block for all these activities with strong, robust and quality data that can drive activities in future. The report provides an overview of the road safety information systems in the South-East Asia Region, the current knowledge scenario on road safety in the Region, priorities for research, research methods and recommendations.
Research Framework for Road Safety in the South-East Asia Region
# Contents

List of Acronyms ........................................................................................................... v  
Acknowledgement ........................................................................................................ vi  
Executive summary ....................................................................................................... vii  
1. Introduction ................................................................................................................. 1  
2. Epidemiological transition and changes in health ................................................. 2  
3. Motorization patterns ............................................................................................... 3  
4. Burden of injuries ........................................................................................................ 4  
5. Road traffic injuries ................................................................................................... 6  
5.1 Characteristics of RTIs in the South-East Asia Region ........................................... 7  
6. Decade of road safety ................................................................................................. 11  
7. Regional resolution on road safety ........................................................................... 13  
8. Understanding road crashes ....................................................................................... 14  
9. Road safety management .......................................................................................... 17  
10. Road safety research ............................................................................................... 18  
11. Role and scope of road safety research in the Region ............................................ 19  
11.1 Information requirements for road safety .............................................................. 20  
11.2 Data for health and related sectors .......................................................................... 21  
12. Current road safety research scenario in the Region .............................................. 23  
12.1 Gaps in road safety research in the Region ............................................................. 27
13. Road safety information systems in the Region ......................... 29

14. Priorities for research .................................................................. 31
   14.1 Road safety management ......................................................... 31
   14.2 Safer roads ............................................................................. 31
   14.3 Safer vehicles ......................................................................... 32
   14.4 Safer road users ..................................................................... 33
   14.5 Post-crash response ................................................................. 34

15. Research methods ........................................................................ 36
   15.1 Surveillance ............................................................................. 36
   15.2 Trauma registries ...................................................................... 37
   15.3 Community-based surveys ....................................................... 37
   15.4 Risk factor(s) studies ................................................................. 37
   15.5 Evaluation research ................................................................. 37
   15.6 Road safety policy research ..................................................... 38
   15.7 Translational research ............................................................. 38
   15.8 Economic research ................................................................. 38
   15.9 Qualitative research ............................................................... 38
   15.10 Knowledge-attitude-belief-and practice research ................... 38

16. Conclusion .................................................................................. 40

17. Recommendations ....................................................................... 41
   17.1 Member States ........................................................................ 41
   17.2 WHO ..................................................................................... 42

References ........................................................................................ 43
List of Acronyms

BRSIPP  Bangalore Road Safety and Injury Prevention Programme
CDs    cardiovascular diseases
DALYs  disability adjusted life years
GBD    global burden of diseases
GDP    gross domestic product
HICs   high income countries
ICD    International Classification of Diseases
IRTAD  International Road Traffic and Accident Database
NCDs   noncommunicable diseases
RTI    road traffic injuries
RTIRN  Road traffic Injuries Research Network
SEAR   South-East Asia Region
WHO    World Health Organization
Acknowledgement

This regional strategy is based on information available in the internet and on expert opinions. Grateful thanks are extended to Dr G. Gururaj for conducting literature review, communicating with the road safety experts around the globe for their opinions and drafting this strategy. Our sincere thanks to Dr Adnan Hyder, Dr Rebecca Ivers and other board members of the Road Traffic Research Network (RTIRN) and participants of the WHO-RTIRN regional workshop on public health research on road traffic injuries held on 26 – 27 October 2011, in Jakarta, Indonesia, for sharing information about capacity building activities for this document. We are also grateful to Dr Pichai Taneerananon, Prince of Songkla University, Thailand for reviewing the document and providing feedback.

This document has also benefited from the contribution of several staff Members from the WHO Regional Office for South-East Asia, in particular, Dr Chamaiparn Santikarn, Regional Adviser, Disability, Injury Prevention and Rehabilitation and Dr Salim Mahmud Chowdhury, Temporary International Professional (Technical Officer).
Executive summary

Road Traffic Injuries (RTI) are a leading cause of death, hospitalization, disability and socioeconomic loss in countries of the South-East Asia Region. It is estimated that road traffic crashes accounted for 334,815 deaths in the Region during 2010. Deaths are only the tip of the iceberg as hospitalizations are 30–50 times more than deaths. A majority of those killed and injured are men in the 5–44 years age group, pedestrians, two-wheeler riders and pillion riders as well as cyclists. The societal costs are estimated to be phenomenal. RTIs are also equity-related issues as they have a major impact on survival and livelihood of people and contribute to the growing cycle of poverty in the Region. The problem is likely to increase, if urgent actions are not initiated. The Decade of Action for Road Safety 2011–2020, provides an excellent opportunity to develop policies and programmes that can control and reduce the problem.

Road safety management is a critical component that needs to be strengthened with vision, direction, coordination, management, funding, interventions, advocacy, monitoring and evaluation. The current situation in many countries needs to be strengthened with sustainable, cost effective and scientific policies. The five pillars of safe roads, safe vehicles, people, post-crash care and efficient management needs to be implemented in all Member States. Information through good research is the building block for all these activities with strong, robust and quality data that can drive activities in future. Road safety research is required for:

- Prioritizing road safety as a public health problem.
- Estimating the burden, risk factors, characteristics and impact of road traffic deaths and injuries.
- Delineating populations and areas that are at high risk.
- Developing country-specific road safety policies and programmes or strengthening / modifying existing policies and programmes.
- Allocating requisite resources.
- Selecting appropriate, cost effective and culture-specific interventions.
- Promoting understanding of perceptions on road safety amongst different stakeholders including policy-makers, programme managers and people.
- Undertaking advocacy for road safety.
● Evaluating road safety interventions, activities and programmes.
● Guiding planning, developing and implementing road safety activities/programmes.
● Providing long-term vision for development of road safety.

Road safety research in the Region is piecemeal, fragmented, not continuous and disconnected. The current status of research does not provide answers to the problem and requires innovative approaches and solutions in each country. There is no national road safety research agenda in any Member State of the Region. There is a severe shortage of dedicated road safety research institutions, trained human resources, funding and training programmes, despite the increasing number of deaths and injuries on the roads. Collaborative mechanisms to translate research into policies and action programmes are very poor and decisions made are unscientific and ad hoc in nature.

There is a need for strategic research to focus on the five pillars of road safety in the Region as specified in the decadal action plans. Research should focus on better understanding on the contribution of roads, vehicles and human behaviour along with post-crash elements. Post-crash care, in terms of availability, accessibility and affordability needs to be examined in the context of huge social and economic diversities. Road safety management needs to be systematic and scientific, based on a critical understanding of barriers and challenges in each country. Road safety research is required from health, transport, road engineering, police and other partners for education, engineering, enforcement and emergency care. Research should extend beyond descriptive studies to identify and modify risk factors in different traffic environments and populations. Research in a number of these areas needs to be strengthened by governments, international organizations, the vehicle industry and others with institutional mechanisms. Improving human resources, funding, and coordination along with interdisciplinary research should be addressed in all Member States. Most importantly, research information should be applied for interventions, programmes and policies to reduce deaths and injuries on the roads.
1. Introduction

The South-East Asia Region has been going through significant demographic, social, economic and epidemiological transition in the last two decades. The Region, with 11 Member States has 5% of the total land area and nearly 26% of the global population\(^1\). Countries like India, Bangladesh and Indonesia have large populations, while Maldives and Timor-Leste have smaller populations. The Region has also recorded significant economic growth and prosperity in the last decade though there have been variations across and within countries.

The changing demographics combined with the effects of globalization, urbanization, and industrialization has resulted in changing health patterns and profiles. With a marginal decline of communicable, infectious and nutritional disorders, noncommunicable diseases (NCDs) and injuries have been on the increase. The health policies of successive governments in all countries along with greater availability of health-care facilities and increasing use of technology have contributed to this changing health scenario. With a further decline in communicable diseases, the burden of NCDs and injuries is likely to increase in the Region during the coming years.
2. Epidemiological transition and changes in health

In the Region, life expectancy has increased significantly in all countries. The maternal mortality rates though declining in some countries are still a matter of concern in other countries. Large inequities in health and economic conditions within and across countries persist and pose significant challenges for governments and policy makers.

Figure 1: Proportion of adolescents (10 – 19 years) in SEAR, 2005

Two major characteristic features of the Region are its relatively young population and large rural communities. Figure 1 shows that nearly 15 – 26 % of the population in Member States comprise adolescents in the age group of 10 – 19 years\(^1\). Urbanization and industrialization have also led to an increase in motorization with the addition of a large number of personalized modes of transport and increasing infrastructural development activities. These observations have enormous implications for the health and safety of people in the Region as injuries continue to increase in Member States.
3. Motorization patterns

Due to rapid economic progress, increasing purchasing power of people and deficient public transportation system, motorization has been on the increase in all Member States of the Region. A significant aspect of this motorization has been the increase in the number of motorized two-wheeler motorcycles in many countries of the Region. The number of motorized two-and three-wheelers varies roughly between 60.05% in Bangladesh to as high as 82.75% in Indonesia, with only Bhutan having 15.78% of its vehicle fleet as motorized 2/3 wheelers (WHO, 2013) as shown in Table 1. In the Region, Thailand and Indonesia have the highest number of vehicles per 1000 population which is 412.1 and 303.2 respectively (Table 1). This motorization pattern has direct relevance to road traffic injuries (RTIs) in the Region and in Member countries.

Table 1: Proportion of registered vehicles (%) in Member States of the South-East Asia Region

<table>
<thead>
<tr>
<th>Country</th>
<th>Motor cars</th>
<th>Motorized 2/3 wheelers</th>
<th>Heavy trucks</th>
<th>Buses</th>
<th>Others</th>
<th>Total registered vehicle 1000 population</th>
<th>Reporting year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>32.6</td>
<td>60.1</td>
<td>5.0</td>
<td>2.3</td>
<td>0.0</td>
<td>10.9</td>
<td>2010</td>
</tr>
<tr>
<td>Bhutan</td>
<td>65.2</td>
<td>15.8</td>
<td>12.4</td>
<td>0.5</td>
<td>6.2</td>
<td>79.4</td>
<td>2011</td>
</tr>
<tr>
<td>India</td>
<td>13.3</td>
<td>71.7</td>
<td>5.3</td>
<td>1.3</td>
<td>8.5</td>
<td>93.9</td>
<td>2009</td>
</tr>
<tr>
<td>Indonesia</td>
<td>11.2</td>
<td>82.8</td>
<td>4.5</td>
<td>1.5</td>
<td>0.0</td>
<td>303.2</td>
<td>2010</td>
</tr>
<tr>
<td>Maldives</td>
<td>13.1</td>
<td>82.1</td>
<td>4.6</td>
<td>0.2</td>
<td>0.0</td>
<td>158.4</td>
<td>2011</td>
</tr>
<tr>
<td>Myanmar</td>
<td>11.6</td>
<td>82.1</td>
<td>2.8</td>
<td>0.9</td>
<td>2.5</td>
<td>48.5</td>
<td>2011</td>
</tr>
<tr>
<td>Nepal</td>
<td>11.4</td>
<td>75.6</td>
<td>4.1</td>
<td>3.0</td>
<td>6.0</td>
<td>39.4</td>
<td>2011</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>15.7</td>
<td>66.5</td>
<td>7.5</td>
<td>2.1</td>
<td>8.2</td>
<td>189.6</td>
<td>2010</td>
</tr>
<tr>
<td>Thailand</td>
<td>34.7</td>
<td>60.8</td>
<td>2.9</td>
<td>0.5</td>
<td>1.1</td>
<td>412.1</td>
<td>2010</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>17.4</td>
<td>76.3</td>
<td>6.1</td>
<td>0.2</td>
<td>0.0</td>
<td>8.6</td>
<td>2010</td>
</tr>
</tbody>
</table>

Source: Global Status Report on Road Safety 2013, WHO,
4. Burden of injuries

Injuries commonly referred to as group III conditions include unintentional injuries like road traffic injuries (RTIs), falls, burns, drowning, poisoning, fall of objects, disaster situations, occupational injuries and intentional injuries like suicides and interpersonal violence. Injuries in the Region have been increasing at a rapid pace due to urbanization, globalization, industrialization, changing value systems of people with increasing impact of both print and visual media along with absence of safety policies and programmes.

The morbidity and mortality profile of the South-East Asia Region indicates that the Region accounts for nearly 29% of deaths and 31% of disease burden as measured by DALYs in 2002. In terms of mortality, nearly 11% of deaths are due to injuries while 14% of DALYs are due to injuries (Figures 2 and 3).

**Figure 2:** Estimated proportion of total deaths in the Region by major cause groups, 2005 (Estimated total number of deaths in the South-East Asia Region = 14 588 809)

<table>
<thead>
<tr>
<th>Group</th>
<th>% of Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Communicable diseases, maternal and perinatal conditions and nutritional deficiencies)</td>
<td>35%</td>
</tr>
<tr>
<td>Group II (Noncommunicable conditions)</td>
<td>54%</td>
</tr>
<tr>
<td>Group III (Injuries)</td>
<td>11%</td>
</tr>
</tbody>
</table>

**Figure 3:** Disease burden in terms of DALYs in the Region by major cause groups, 2005 (Estimated total DALYs lost in the South-East Asia Region = 412 171 270)

<table>
<thead>
<tr>
<th>Group</th>
<th>% of Total DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Communicable diseases, maternal and perinatal conditions and nutritional deficiencies)</td>
<td>39%</td>
</tr>
<tr>
<td>Group II (Noncommunicable conditions)</td>
<td>47%</td>
</tr>
<tr>
<td>Group III (Injuries)</td>
<td>14%</td>
</tr>
</tbody>
</table>

Source: WHO, SEARO. 2008

Injury-related mortality though high in the age group of 60+ years is also a major cause of concern among children less than 15 years. Undoubtedly, injuries are a major cause of mortality and morbidity in the productive age groups of 15–44 years in both genders. Injuries begin to increase from the 10th year of life and reach a peak in later age groups (Table 2). However, in absolute numbers, the highest number of deaths and disabilities are seen in the age groups of 15–44 years and more among men.
Table 2: Injury-related mortality rates (per 100 000 population) in the world and the South-East Asia Region by age group and sex, 2004

<table>
<thead>
<tr>
<th>Age groups (Years)</th>
<th>World</th>
<th></th>
<th></th>
<th>South-East Asia</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Both sexes</td>
<td>Male</td>
<td>Female</td>
<td>Both sexes</td>
</tr>
<tr>
<td>Under 1</td>
<td>106.3</td>
<td>110.6</td>
<td>108.4</td>
<td>111.1</td>
<td>113.6</td>
<td>112.3</td>
</tr>
<tr>
<td>1-4</td>
<td>57.0</td>
<td>54.0</td>
<td>55.6</td>
<td>73.0</td>
<td>91.8</td>
<td>82.0</td>
</tr>
<tr>
<td>5-9</td>
<td>45.3</td>
<td>38.0</td>
<td>41.8</td>
<td>63.7</td>
<td>61.0</td>
<td>62.4</td>
</tr>
<tr>
<td>10-14</td>
<td>36.0</td>
<td>26.3</td>
<td>31.3</td>
<td>44.1</td>
<td>44.6</td>
<td>44.4</td>
</tr>
<tr>
<td>15-19</td>
<td>78.9</td>
<td>46.5</td>
<td>63.1</td>
<td>84.7</td>
<td>87.5</td>
<td>86.0</td>
</tr>
<tr>
<td>20-29</td>
<td>133.3</td>
<td>50.8</td>
<td>94.4</td>
<td>135.6</td>
<td>95.8</td>
<td>116.3</td>
</tr>
<tr>
<td>30-44</td>
<td>139.7</td>
<td>52.4</td>
<td>96.7</td>
<td>162.3</td>
<td>87.9</td>
<td>126.3</td>
</tr>
<tr>
<td>45-59</td>
<td>155.3</td>
<td>70.3</td>
<td>112.8</td>
<td>183.2</td>
<td>127.1</td>
<td>155.6</td>
</tr>
<tr>
<td>60-69</td>
<td>171.4</td>
<td>93.0</td>
<td>130.6</td>
<td>221.4</td>
<td>184.2</td>
<td>202.1</td>
</tr>
<tr>
<td>70-79</td>
<td>229.9</td>
<td>144.9</td>
<td>182.6</td>
<td>378.9</td>
<td>317.9</td>
<td>346.2</td>
</tr>
<tr>
<td>80+</td>
<td>449.8</td>
<td>307.5</td>
<td>359.2</td>
<td>769.2</td>
<td>581.9</td>
<td>666.1</td>
</tr>
</tbody>
</table>

Source: WHO, SEARO. 2008

The major causes of injury deaths are RTIs (18/100 000 population), suicides (15/100 000 population), burns (11/100 000 population) and drowning (6/100 000 population) in the Region\(^3\) (Figure 4).

Figure 4: Injury–related mortality in the South-East Asia Region, 2004

Source: WHO, 2009
5. Road traffic injuries

RTIs are increasing at an alarming rate in countries of the Region. As per WHO, nearly 16000 people die in road crashes globally every day accounting for nearly 10% of deaths and 12.3% of the global burden of disease. Every year 1.3 million people are killed in road crashes, a majority of whom are men and young people in productive years of life. As per the 2004 global burden of disease (GBD) update, RTIs will move from the 9th leading cause of death to the 5th leading cause by 2030. Most notably, nearly 3/4 of these road deaths occur in low-and middle-income countries and affect poor and vulnerable groups. If urgent actions are not initiated, RTI will be a major cause of death and disability in the South-East Asia Region.

It is estimated that road traffic crashes accounted for 334 815 deaths in the South-East Asia Region during 2010. The estimated road traffic death rate in the Region is 18.5 per 100 000 population. Thailand has the highest rate of 38.1 per 100 000 population followed by Timor-Leste (19.5), India (18.9), Indonesia (17.7) and Nepal (16.0). Maldives had the lowest rate with only 1.9 per 100 000 population. The rate is higher in middle- (19.5) than low-income countries (12.7) (Table 3). RTI deaths are only the tip of the iceberg as 30 to 50 times this number are hospitalized for varying periods of time. The number of people with minor injuries seeking emergency care is not known precisely and could be in the range of 9–10 million. India alone contributes 73% of the total deaths in South-East Asia in absolute numbers followed by other countries (WHO, 2009).

The cost of RTIs in the Region is huge though unmeasured. Globally, it is estimated that the annual economic losses due to RTIs are to the tune of US$ 518 billion each year, approximately 1–5% of GDP in low- and middle-income countries. The direct and indirect costs of RTIs ranging from immediate property damage to long-term rehabilitation costs are huge and impose a major burden on individuals, families and governments. As RTIs primarily affect the young and productive persons the impact on the families is significant. The studies done in Bangladesh and India on the costs of RTIs revealed that nearly 1.5% to 2% of GDP is lost as per conservative estimates. RTIs also had a significant impact on poor households due to their greater exposure to unsafe traffic environment and inability to afford care.
### Table 3: Estimated road traffic fatality per 100 000 population in countries of the Region during the Second Global Status Survey on Road Safety, 2006 - 2011

<table>
<thead>
<tr>
<th>Country</th>
<th>Population(^a)</th>
<th>Estimates of road traffic deaths</th>
<th>Estimated death /100 000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>148 692 128</td>
<td>17 289</td>
<td>15 415 - 19 164</td>
</tr>
<tr>
<td>Bhutan</td>
<td>725 940</td>
<td>96</td>
<td>88 - 104</td>
</tr>
<tr>
<td>DPR Korea*</td>
<td>24 346 229</td>
<td>2 614</td>
<td>2 378 - 2 850</td>
</tr>
<tr>
<td>India</td>
<td>1 224 614 272</td>
<td>231 027</td>
<td>-</td>
</tr>
<tr>
<td>Indonesia</td>
<td>239 870 944</td>
<td>42 434</td>
<td>37 195 - 47 673</td>
</tr>
<tr>
<td>Maldives</td>
<td>315 885</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Myanmar</td>
<td>47 963 010</td>
<td>7 177</td>
<td>6 187 - 8 166</td>
</tr>
<tr>
<td>Nepal</td>
<td>29 959 364</td>
<td>4 787</td>
<td>4 206 - 5 367</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>20 859 949</td>
<td>2 854</td>
<td>2 602 - 3 105</td>
</tr>
<tr>
<td>Thailand</td>
<td>69 122 232</td>
<td>26 312</td>
<td>-</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>1 124 355</td>
<td>219</td>
<td>193 - 244</td>
</tr>
<tr>
<td>SEAR (All)</td>
<td>1 783 248 079</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**

*Democratic People’s Republic of Korea

Apart from economic losses, the social and psychological impact is significant. RTIs affect education among children, productivity in young and middle-age groups and quality of life, especially among the elderly\(^6\). Several psychosocial problems that interfere with memory, speech, intelligence, and other vital activities have been reported as post-traumatic consequences of RTIs\(^8\).

### 5.1 Characteristics of RTIs in the South-East Asia Region

The epidemiology of RTIs is not known clearly in the Region due to lack of quality reporting systems, surveillance, registries and related research. A recent report from the Region provides insights based on country reporting through intersectoral consensus building mechanisms\(^9\). Some important observations include:
- An increase in the burden and impact of injuries has been observed in all countries of the Region except in Thailand where a slight decline has been seen since 2005.

- The ratio between death and injury is estimated to be 1:5 in the Region as per official national police reports. Independent studies indicate the ratio of deaths to hospitalizations to be 1:30\textsuperscript{10}. The number of minor injuries that may or may not come in contact with health care institutions will be large.

- Males are 3–4 times more likely to die and get hospitalized in road crashes than females, varying slightly from country to country.

- Young people in the age group of 15–44 years are affected more as compared to other age groups. Data also show that children less than 15 years are also involved in a greater number of crashes in South-East Asia Region\textsuperscript{11}. Data from the National Crime Records Bureau of India (Figure 5) and three years of the Bangalore Road safety programme confirm this observation for both fatal and nonfatal injuries in both urban and rural areas\textsuperscript{10}.

**Figure 5: Age distribution of fatal RTI injuries, India, 2010**

![Age distribution of fatal RTI injuries, India, 2010](image)

Source: National Crime Record Bureau, India, 2010

- In sharp contrast to many high-income countries, the vulnerable road users like pedestrians, motor cyclists, and pedal cyclists are affected in large numbers\textsuperscript{12,13}. These vulnerable road users account for nearly 80% of road deaths and injuries (Figures 6 and 7). However, as per official
reports, these vulnerable road users are not adequately represented in national reports due to deficiencies in reporting systems. For example, epidemiological studies in India clearly show this pattern, while national reports show a preponderance of heavy vehicle drivers.

**Figure 6:** Distribution of road traffic deaths by type of road users in seven South-East Asia Region countries, for most recent year reported – between 2009 and 2010

Source: Global Status Report on Road Safety 2013

**Figure 7:** RTI deaths as per road user categories, India, 2010

Source: National Crime Record Bureau, India, 2010
The new infrastructure development in many countries is often found to be deficient in safety aspects and highways contribute to a significant number of deaths and injuries\(^4\).

A few studies have shown deficient trauma care services in most countries of the Region\(^{14}\).

A significant observation from the WHO Regional Status Report on Road Safety is the poor status of implementation of safety laws with regard to helmets, seat belts, child restraints, drunken driving, cell phone use and pedestrian safety practices\(^{9}\) (WHO, 2009).

Even though an institutional framework in terms of a national agency within the governments exists, the accompanying components of national strategies, policies, targets, funding and coordination mechanisms have not clearly evolved (Table 4).

The global road death toll is likely to increase due to accelerated motorization and economic growth. Countries like India are expected to record a massive increase in road fatalities by 142\% compared to a decline of 28\% in HICs\(^{15}\). A similar trend is likely to be seen in other South-East Asian countries as well.

There are significant variations in the pattern of RTIs both within and outside countries, often linked to exposure issues.

### Table 4: Road safety management in the South-East Asia Region, 2010–2011

<table>
<thead>
<tr>
<th>Country</th>
<th>A lead agency is present</th>
<th>Has a national strategy</th>
<th>Strategy has measurable targets</th>
<th>Strategy is funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partially</td>
</tr>
<tr>
<td>Bhutan</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partially</td>
</tr>
<tr>
<td>DPR Korea**</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>–*</td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Partially</td>
</tr>
<tr>
<td>Indonesia</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Partially</td>
</tr>
<tr>
<td>Maldives</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Myanmar</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partially</td>
</tr>
<tr>
<td>Nepal</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Thailand</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Partially</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Partially</td>
</tr>
</tbody>
</table>

Source: Global Status Report on Road Safety, 2013

\(^*\)No information available

\(^{**}\)Democratic People’s Republic of Korea
6. Decade of road safety

Considering the global burden of RTIs and its significant impact on developing societies and emerging economies, the United Nations Road Safety Collaboration developed the Global Plan for the Decade of Action for Road Safety 2011 – 2020 to support countries to save lives during the 10-year period\(^\text{16}\). The vision of the decade is one in which mobility should be safe for everyone using the roads. This global plan outlines a course of action to ensure that this vision becomes a reality. The overall goal is to halt or reverse the increasing trend in road traffic fatality through:

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

Categories or “pillars” of activities are:

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

The details of activities are:

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

In September 2010, the Sixty-third Session of the Regional Committee noted the report of the technical discussions and adopted a resolution on the subject (SEA/RC/63/R2). The resolution urges Member States to advocate for establishment of a national mechanism or authority at the highest level and declare injury prevention as a national agenda; establish or strengthen the injury unit in the ministry of health; strengthen national injury surveillance; address local priorities; integrate injury prevention into the public health programmes and policies; strengthen emergency medical services and rehabilitation, and create a network of those who practice injury prevention.
8. Understanding road crashes

Road crashes are complex events occurring due to the interaction of human beings, vehicles, and the road environment. Since these interactions occur at any time and any place, it is crucial to develop a proper understanding of the mechanisms to find appropriate solutions. This process requires a scientific approach to evolve remedial measures as there are many factors that can be modified. The science of road safety has grown tremendously over time and several models and interventions have been developed. This scientific approach has resulted in reduction of road deaths in many high-income countries (Figure 8).

Figure 8: Public health approach

The classical epidemiological approach in road safety examines road crashes from an agent, host and environmental perspective which has been used in understanding communicable and noncommunicable diseases over time. The agent is the mechanical energy developed in a crash, vector being the vehicle involved, host is the individual and the environment is the situation – context – circumstances of a crash. As road crashes are complex events influenced by many factors within and outside a motor vehicle this approach has certain limitations.
In 1970, William Haddon, Jr., developed the much acknowledged Haddon Matrix that has contributed enormously in reducing road crashes\(^{18}\). The matrix delineates various factors that could have contributed before, during and after the crash in relation to the person, vehicle and the environment (Table 5). Analysis of road crashes provides an excellent opportunity to identify these factors and to develop preventive strategies.

**Table 5: Example of Haddon’s matrix**

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Vehicle</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-event</strong></td>
<td>Increase awareness about helmet, drunken driving, seat belts, safe driving, etc.</td>
<td>Increase visibility of vehicle.</td>
<td>Implement safety features on roads.</td>
</tr>
<tr>
<td><strong>Event</strong></td>
<td>Early transfer to hospital and required care.</td>
<td>Better braking systems of two wheelers.</td>
<td>Crash protective roadside stationary objects.</td>
</tr>
<tr>
<td><strong>Post-event</strong></td>
<td>Rehabilitate and improve health care services.</td>
<td>Improve safety technologies and components.</td>
<td>Facilities for early rescue of injured persons.</td>
</tr>
</tbody>
</table>

Source: Haddon, 1968

The public health approach helps in understanding the magnitude of the problem, identification of risk factors, developing and implementing interventions and evaluating them for their effectiveness in reducing road crashes. Analysis of risk factors is a crucial requirement to develop appropriate interventions\(^{19}\). The most significant component is the evaluation of interventions to see the efficacy and effectiveness for change.

The safe systems approach developed in recent years recognizes that people in any traffic environment are likely to make mistakes that can lead to crashes and deaths. As the human body is vulnerable to injury, crashes can result in damage to various body parts. With this understanding the emphasis has shifted from addressing individual issues to develop larger systems that are safe which can accommodate human vulnerability and fallibility. This approach requires developing a common goal with a unified vision in the entire society as it considers multiple interactions and the role of several factors to make traffic environments less hazardous and people safer\(^{20}\) (Figure 9).
**Figure 9: Safe systems approach**

Admittance to system (condition for entry/exit of vehicles and road users)

Safer travel

Understanding crashes and risks

Alert and compliant road users

Safer speeds (lower speeds more forgiving of human error)

Human tolerance to physical force

Safer vehicles

Safer roads and road-sides (more forgiving of human error)

Education and information supporting road users

Enforcement of road rules

Safer travel

Safer speeds (lower speeds more forgiving of human error)

Human tolerance to physical force

Safer vehicles

Safer roads and road-sides (more forgiving of human error)

Education and information supporting road users

Enforcement of road rules

Alert and compliant road users
9. Road safety management

Reducing road crashes requires building effective mechanisms through road safety policies and programmes that include development of a lead coordinating agency, coordination within and outside ministries, legislative frameworks, resource mobilization, strong advocacy, capacity strengthening of policy makers, human resource development, intersectoral approaches for developing and implementing interventions, leadership and monitoring and evaluation\textsuperscript{21}. Strong political commitment is extremely important for driving the agenda of road safety amidst rapid motorization and increasing mobility. Review of all these strategies is beyond the scope of this report and has been dealt with in other places.
10. Road safety research

An important tool that drives the road safety agenda is the availability of strong, robust and good quality information to formulate road safety policies, programmes and interventions. Road safety research is the scientific and objective study of road and transport systems with the aim of reducing the suffering and losses due to road crashes. A strong information base through good reporting systems and research is the stimulus to develop and implement evidence-based interventions. Research is also crucial to measure the impact of interventions as seen by changes in road crashes, deaths and injuries. Research benefits society by taking an evidence-based road to decision making. Road safety research is required for:

- Prioritizing road safety as a public health problem.
- Estimating the burden, risk factors, characteristics and impact of road traffic deaths and injuries.
- Delineating populations and areas that are at high risk.
- Allocation of requisite resources.
- Selecting appropriate, cost-effective and culture-specific interventions.
- Understanding perceptions on road safety amongst different stakeholders including policy makers, programme managers and people.
- Strengthening the process of road safety policies and programmes and other areas by providing feedback to all stakeholders.
- Undertaking advocacy for road safety.
- Evaluating road safety interventions, activities and programmes, and
- Guiding planning, developing, and implementing road safety activities/programmes including monitoring and evaluation.
11. Role and scope of road safety research in the Region

With the growing burden of RTIs in the South-East Asia Region, there is a need to develop strong policies and programmes in the Region that are evidence-based, culture-specific and cost-effective. Strong research inputs are required to support national leaders, policy makers and programme managers to develop evidence-based and data driven policies, programmes and interventions. It can provide a framework against which informed decisions can be made by all sectors involved in road safety and also the national coordinating bodies.

Many times, countermeasures developed in high-income countries (HICs) are not applicable to the South-East Asia Region because of the differences in basic education on road safety, traffic environments, motorization patterns, social culture, enforcement behaviours and prevailing economic circumstances. Thus, it is necessary to carry out country-specific research to identify counter measures that are more applicable to individual countries. At the same time, lessons learnt from HICs will be very helpful in understanding the pathways and the process for reducing road crashes.

Research is also required at national and local levels and both will be complementary to each other. National level data is required for developing policies and programmes and for obtaining funding support, while local data is crucial for activities related to implementation. Road safety research is also required from a variety of perspectives due to its multifactorial nature. Road safety research from all sectors of transport, health, judiciary, police, welfare, urban and rural development, insurance, academic institutions, vehicle industry and many others are essential to guide different components. Each sector has to develop a road map for research within their area that is relevant to a particular country. These activities need to focus on crash data, characteristics of road users and modifiable risk factors, road environment, vehicle safety and post-crash care as outlined in the five pillars of the decade of action for road safety.

The World Bank Road Safety Management “How-to manual” for developing a public health approach for prevention and control of road traffic injuries emphasizes that research and knowledge transfer are crucial to guide the development and...
implementation of national strategies\textsuperscript{21}. Several other organizations across the world have identified research as a core component of road safety development strategies by identifying modifiable risk factors.

To understand the mechanisms of road crashes, research is an essential tool. With the understanding that road crashes are predictable and preventable, understanding the multifactorial causation and risk exposures has occupied centre-stage in road safety research. It has moved from human errors and driver’s mistakes to making safe systems with the central concept of reducing energy production – transfer – absorption and protection of people.

### 11.1 Information requirements for road safety

The world report on Road Traffic Injury prevention highlighted the importance of collecting accurate, reliable and good quality data on the magnitude of the road traffic injury problem in all countries and recommended that data systems should be put in place to develop evidence-driven road safety policies\textsuperscript{6,17}. Good quality data is required to identify the burden and characteristics of the road safety problem, risk factors and priority areas, and to formulate policies and programmes along with setting targets and monitoring the performance. This also enables allocation of required resources by avoiding duplication of resources and appropriate action.

Data systems are crucial for road safety programmes. Road safety data systems are a process of gathering data, taking action and then evaluating interventions. Without ongoing data-driven diagnosis and management of road injury problems, there will be no significant and sustainable improvement in road safety\textsuperscript{22}.

Road crash data systems should\textsuperscript{20}:

- Capture all crashes that result in death and a significant proportion of those resulting in serious injuries.
- Provide details on the characteristics of the vehicle, road user and the road environment to assist in identification of risk factors for selection of counter measures.
- Include accurate crash location information.
- Provide timely outputs for facilitating evidence-based solutions.

There are four types of data that are required for effective road safety management as shown in Figure 10. These include information on:

- outcomes like crashes, injuries and deaths,
- exposure measures like demographic, traffic volumes, infrastructure and other areas,
- performance indicators like information on protective devices, road infrastructure, trauma care etc., and
- process indicators like road safety policies, programmes and interventions and costs of RTIs of both a direct and indirect nature.

**Figure 10: Outcomes of road safety management**

Among the 178 countries that participated in the Global Status Report on Road Safety; only 22% were able to provide comprehensive information in these areas. Most of the Member States in the South-East Asia Region do not have ample information about these road safety outcome indicators.

### 11.2 Data for health and related sectors

The health sector is one of the major stakeholders in road safety with the focus on preventing injuries and to minimize injury consequences after the crash. Apart from trauma care services, the health sector is also involved in capacity building and training, advocacy, supporting development of policies and programmes and for monitoring the impact of interventions. As the health sector comes in direct contact with injured persons, there is a greater responsibility to collect direct data for estimating the magnitude of fatal and non-fatal injuries, identifying risk factors for targeted interventions, evaluating the effectiveness of injury prevention programmes, to plan for trauma care and rehabilitation services and to advocate for policies and legislation.
Apart from the health sector, road safety-related data is also required by other sectors like transport and law enforcement agencies. For effective enforcement there is a need for data on monitoring the occurrence of traffic violations, implementation of road safety laws and to take an evidence-based approach for enforcement. Similarly, the transport sector needs data for identifying the nature of road crashes, delineate the role of human factors, identify risk-prone highways, select high risk locations, and to plan and advocate appropriate policies.

The WHO data systems manual provides an in-depth understanding of designing and implementing the system for road safety information\textsuperscript{17}. The minimum data elements that are required with situational examples are provided in the manual. Most importantly it is crucial to see that the collected data is used effectively for monitoring road safety performance and to assess the impact of interventions. Thus, it needs to be looked at as a comprehensive system for building road safety.
12. Current road safety research scenario in the Region

Bibliometric analysis on injury in the South-East Asia Region has highlighted the need for more research in developing countries\textsuperscript{27}. Recently, The WHO Regional Office for South-East Asia undertook a situation analysis of the current status of injury and violence research in the Region using the available literature from safety Lit\textsuperscript{28}. The objectives were to carry out a rapid assessment of the current status of road safety and injury research during the period 2000 – 2011 to help Member States in developing a roadmap for future activities. The specific objectives were to identify the areas of research, identify the national research institutions and also to assess strengths and limitations of research.

The limited amount of research in the Region was highlighted by the fact that the Region accounted for less than 1% of the global research in the area of injury and violence whereas the Region has over 25% of the global population. Notably, there were no public studies available from Bhutan, Democratic People’s Republic of Korea and Maldives. In Thailand and India road safety research was comparatively better than violence research. Nearly 40% of the research was from India, the highest contribution from any Member State in the Region. Among the five pillars of road safety as suggested by the UN Road Safety Collaboration, 39% was on road safety management followed closely by 27% on road user behaviour (Figure 11). Very limited research was documented in the areas of safer vehicles and post-crash response.

Road safety research in the Region is undertaken in several ways by different agencies. Research is carried out by academicians and researchers from health, transport, engineering, vehicle safety, law, welfare and other agencies at both national and regional levels. In addition, many international agencies like WHO, United Nations bodies, UNESCAP, World Bank, Asian Development Bank, and the UN Commission on Road Safety undertake road safety research projects in specified areas and final reports are available with specific bodies (only a few are available in the public domain). In addition, at country level, national ministries also commission specific research projects in focused areas (e.g. road research by the
Ministry of Transport, Government of India). Vehicle manufacturers (e.g. Automobile Research Association of India) are involved in research even though the extent and areas of research are not clearly known. Detailed reviews of the current status of road safety research are beyond the scope of this report and require independent and comprehensive initiatives by an interdisciplinary team. Further, such reviews need to be undertaken in each country to obtain a comprehensive picture. A brief review of the current status is given below:

- Recent national level data on current road safety scenario is available from the Global Status Report on Road Safety and from the South-East Asia Regional Report on Road Safety\(^2,28\). National reviews on road safety are limited. In India, a few reports have assessed road safety research and identified information gaps in recent years\(^12,29-34\). Similarly, in Bangladesh and Thailand, national reviews have been undertaken\(^35,36\). Similar reports are not available from other countries in the Region. For many other countries, police data published as annual reports are the only source of information and limitations of this data has been highlighted earlier. Most countries in the Region do not have a nationally representative surveillance programme, except Thailand\(^36\). Myanmar is the second country to have a national injury surveillance system. India, Nepal and Indonesia have completed pilot injury surveillance
programmes and plans are in place to expand the same. Surveillance also has major limitations as it collects large amounts of good quality data on fixed variables depending on the feasibility of data collection methods and appropriate system management. Hence, critical information on risk factors that can lead to specific and targeted interventions may be missing in surveillance data.

- A few independent studies have highlighted the burden and impact of RTIs in Member States. Most often, these are based on police reports or on small studies in health care institutions and a few are from population sources. All these studies have reported underreporting of RTIs in both sources. The burden on the health sector is largely unknown in the Region. Recent data from the Bangalore Road Safety and Injury Prevention Programme has shown that nonfatal injuries reported by the police are underestimated by nearly four times. Population-based studies have been extremely limited in the Region.

- The profile and characteristics of those killed and injured in road crashes has been examined by a few researchers, but more from injury surveillance systems. Injuries among young children especially who are bicyclists, or young motorcycle riders or pedestrians have been reported by the studies and injury surveillance systems. A majority of the studies have identified the younger age of occurrence, especially in those between 5–44 years with the peak at 15–29 years, and notably among the vulnerable road user categories of two-wheeler riders, pillion riders, pedestrians, and pedal cyclists.

- The situation–context–circumstances of road crashes have not been understood clearly in the Region. There is limited research in the Region on the role of a wide variety of vehicles, diversity of roads with variations across and within countries, travel and transportation modes and heterogeneous traffic environments that requires a better understanding to design safe road environments. With infrastructure development, highways contribute to nearly 35–40% of fatal road crashes in India and the situation is similar in other countries as well. However, the crash characteristics on these highways are not clearly known. The black spot location on highways and in urban areas has been a major focus of research among road safety road engineers. The recent Internal Road Assessment Report (iRAP) programme has just completed a few surveys in the Region, including three states of India. Several road engineering studies have identified unsafe road conditions and recommended provision of unobstructed footpath, installation of cycle tracks, speed limit, and road safety education methods.
In most countries of the Region, human error, carelessness, negligent and rash driving is reported to be the major causes as per official reports. Most significantly, research on factors like helmets, seat belts and child restraints, drunken driving, speeding and pedestrian safety has been minimal. Crash investigation and analysis is still not a regular practice.

Studies have shown that improving pedestrians’ access along with provision of safe walking and crossing facilities combined with education will be helpful in reducing road crashes. Recent studies looking at behavioural factors with regard to the use of seat belts, helmets and child restraints have revealed the poor usage rate among road users. The study in Delhi showed that 79% of drivers and 58% of passengers use seat belts\(^\text{41}\), while the data from Bangalore show only 27% to be using seat belts\(^\text{13}\).

In Thailand, a study examined the use of seat belts in four cities and revealed a decline in compliance after six months of enactment of law and reflected problems in uniform and consistent law enforcement practices\(^\text{42}\). Similarly, the use of helmets also varies ranging from 50–70% depending on the rate of implementation\(^\text{43,44}\). A study from Khon Kaen hospital revealed that enforcement of the helmet act increased the usage of helmets\(^\text{45}\). Not using helmets was also associated with increased occurrence of brain injuries in road crashes and suggested combined use of education and enforcement\(^\text{46}\). A study showed helmets were extremely effective in preventing brain injury and death in 97% of the crashes\(^\text{47}\). Studies on cell phone use behaviour showed that a majority of the people use cell phones during driving\(^\text{48}\).

Drinking and driving has been recognized as a major risk factor in a few of the Indian studies as data from Bangalore have shown that nearly 1/3 of the crashes occurred during night time and a third of these were linked to consumption of alcohol\(^\text{13}\). There is a lack of understanding on several subcomponents of each of these risk factors (e.g. helmets – their use, public perceptions, legislation, standards, enforcement, impact, etc.) requiring further research.

Vehicle safety research has been undertaken by the motor vehicle industry and selected engineering institutions. The data on safety assessments and impacts is not clearly known. Further, with greater technology transfer from high-income countries (HICs) to low- and middle-income countries (LMICs), this area requires better understanding in terms of manufacture, sales, standards and compliance. Safety with
regard to locally manufactured vehicles is not clear requiring further investigation.

- With regard to trauma care issues, several factors have been identified contributing to poor outcome from crashes. These include lack of availability of first aid, unsafe transportation, delayed care seeking, improper reference, absence of triage, medico-legal issues, absence of preparedness of hospitals, lack of facilities and manpower, absence of trauma audits and quality control mechanisms are some of the recognized factors in the absence of national standards and guidelines along with pre-hospital trauma care policies\textsuperscript{49-51}. The poor status of trauma care has also been reported from Nepal\textsuperscript{52-55}. The studies reported lack of safe transport facilities and also recommended the use of village health practitioners in improving trauma care.

- The impact of RTIs on the nation and affected families is still not clearly known, both due to lack of research and complexities in methodologies. The South-East Asia Region report mentions that six of the 11 Member States have a study on the economic impact\textsuperscript{9}. There is need for better understanding of the overall impact (economic, physical, and psychological) of RTIs in Member States. The economic costs of RTIs in Thailand were estimated from five provinces by using the human capital method and identified the cost to be US$ 3460 million in 2004\textsuperscript{56}. In India, the annual economic losses are to the tune of Rs 55 000 crores per year equivalent to 3 % of GDP\textsuperscript{13}.

- Most importantly, there is a lack of operational and translational research in the Region in terms of what works, what makes a few interventions work, what technology is feasible, possible, and viable, the process of translating research into action and the impact of interventions. Several social, economic, cultural, technological, legal and political barriers are known to exist in road safety and these need to be understood to promote road safety in the Region. Even though many countries invest heavily on providing information to road users, the impact of these efforts is not known.

- Lastly, research is lacking on the impact of economic growth and road transport and infrastructure development policies on the changing pattern of road crashes. These need to be better understood in the long run to design and develop safe transport environments for all citizens.
12.1 Gaps in road safety research in the Region

While the need for road safety research has been highlighted, research cannot be undertaken in a vacuum. It requires developing mechanisms for promotion, conduct, and utilization of research for strengthening policies and programmes. Some important observations for the Region can be summarized as follows:

- Road safety research is not a continuous agenda in Member States of the Region and it is piecemeal, fragmented with major gaps in understanding the multidimensional aspects of road safety. No country has a defined road safety research agenda for the future.

- Road safety research should be carried out by researchers or professionals trained in research normally working in academic institutions or by some working in ministries and departments. In the Region, there is a great paucity of human resources and researchers with continuous interest in road safety.

- An institutional mechanism for road safety in general and research in particular is missing in the Region. Given the magnitude of the problem, there are only a handful of institutions that are involved in road safety research.

- Human resources in the form of trained manpower to carry out research is extremely limited in the Region as there are no regional or in-country training programmes. Institutions that can conduct interdisciplinary training are also limited in the Region.

- Research carried out by academic institutions is in the departments of road or vehicle engineering, transportation, health care and public health, vehicle industry and others. As there are no established linkages between these organizations, there is no continuity in work and limited exchange between disciplines.

- Road safety itself does not have dedicated funding in Member States and hence, there are no resources for road safety research.

- Coordination between sectors is crucial for road safety research for exchange of information. In the absence of a lead coordinating agency, each sector has its minimal independent agenda.

- Most importantly, the capacity of policy makers and programme managers for evidence-based decision still has room for improvement as most often decisions and policies are made on a populist basis and are ad hoc in nature.
13. Road safety information systems in the Region

In the South-East Asia Region, basic and limited information on road crashes, deaths and injuries are collected by the national and local police agencies as road crashes are medico legal events in all countries. Even though the health sector has the responsibility for care and management of RTI victims, there is no information system within the health sector on all aspects of road crashes. The available information in most countries indicates the numbers along with providing information on trends, some demographic characteristics and regional distributions. This information will not be of help for identifying risk, selecting interventions, or measuring the impact of interventions and even the collected information is not processed, analysed and disseminated.

Most significantly, there is gross underreporting of RTIs in all countries of the Region. Studies from India have shown that fatal RTIs are underreported by 5–20% and serious injuries by more than 50 %, thus undermining the extent of the problem\textsuperscript{24-26}. Some of the reasons for underreporting are:

- Absence of formal reporting agreements and sharing of information between the police, hospitals and other agencies.
- Some type of injuries like collisions with fixed and stationary objects, skid and fall and collision between smaller vehicles are not reported to the police.
- Agreement between individuals involved in a crash is often found to be a suitable method between the parties, as involving the police would lead to additional costs.
- Not all RTIs are reported to the police uniformly in all parts of the country.
- Individuals do not feel the need to report to the police unless the injury is serious, results in legal proceedings and influences the compensation process.
- Even when injured persons go to the 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 the 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 socio-cultural practices discourage families to get involved with the police as this can delay the rituals.

• Limited manpower and facilities among the 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 fully available within the health sector.

In view of these limitations in the police, health and transport sectors, good quality national and local data is not available in most countries of the Region. Coupled with this is the absence of research in most countries due to lack of manpower, institutions, funding and other issues.
14. Priorities for research

14.1 Road safety management

For safer mobility that aims at reducing crash risks, a scientifically-based road safety management approach is required. This approach requires a clear understanding based on multidisciplinary research that unravels the complexities of traffic environments. It is crucial to identify mechanisms for establishing delivery of road safety programmes and also to measure performance of interventions\textsuperscript{58}. In a recent issue of Scientific Research on Road Safety Management, a number of issues from a policy perspective have been outlined for road safety across countries and research as an important domain\textsuperscript{59}. For road safety policies to be effective, “data-driven problem identification and the development of evidence-driven countermeasure packages formalized in a strategy for effective implementation, with ambitious, quantitative targets and transparent lines of institutional accountability are the critical success factors”\textsuperscript{60}. Within a road safety management system, a mix of adequate and efficient strategies, tools and measures should be developed and implemented. To ensure that the chosen means are efficient they should be derived from research evidence. Further, research is also needed to regularly monitor the impact of road safety management tools, serving as a “controlling instrument” for the appropriateness of safety management efforts\textsuperscript{61}. There is need for good quality research through management-and-evaluation-based techniques to measure the progress in safety, performance and outcomes in countries of the Region.

14.2 Safer roads

In Member States, a wide variety of road hierarchies are seen ranging from national and state highways to interior village roads. Research is vital to delineate the characteristics of roads based on traffic volumes and densities that contribute to road deaths. It is essential to identify hazardous locations, high-risk areas and crash locations to design safer roads in Member States. Data from the health and police sectors can identify the locations and micro-analysis needs to be undertaken by road engineers and related departments. The mobility of people needs to be considered and given high priority especially for the safety of vulnerable road users in heterogeneous traffic environments that are a risk factor for road crashes. Given the exceptionally high number of fatalities and injuries among motorcycle users in
this Region, more research into the provision of a safer environment, e.g. motorcycle lanes, for this user group must be a priority.

Data from India shows that nearly 40% of deaths occurred on highways in 2010. The design, location, traffic patterns, speeding issues, visibility, standards for highways are all important research questions to be addressed by transportation planners along with highway road engineers and public health specialists. In a review, it is observed that “standards should be initiated on a demonstrated need-based approach with scientific documentation of the problem that needs to be addressed. Establishment of future standards will need a great deal of background work, research and experimentation as road safety needs will have to be specially tailored for our needs”. Designing safe transport environments has not received much importance amidst rapid motorization and infrastructure expansion. This complex area needs an intersectoral research approach to consider needs of vulnerable road users including children and the elderly.

14.3 Safer vehicles

There is a significant increase in the number of vehicles and people using these vehicles as travel has become a necessity in today’s life. It is common to see a wide variety of vehicles with different size, engine capacities and power plying on the roads.

Vehicle safety features are crucial to minimize the amount of energy transferred to people in road crashes\(^6\). Developments in the past few years like anti-breaking systems, airbags, seat belts, speeding controls, tyre width, and laminated windshields are all components of new vehicle safety features that have contributed to safer motor cars. However, this area of research is left mainly in the hand of the manufacturers. There is inadequate monitoring and control over the safety standards concerned.

It is important to note that certain types of vehicles imported by countries in the Region are adhering to international safety regulations, even though doubts have been raised about technology transfer. However, a majority of the motorcycles, passenger vehicles, three-wheeled vehicles and buses are manufactured within countries. The safety performance of these vehicles needs to be ascertained and research is required to identify what components can be strengthened with further research. Special importance should be given to two-wheelers as they account for nearly 60–75% of total registered vehicles in the Region. Reports of two workshops attended by academia and authorities from different sectors was conducted by WHO-SEARO in 2011 and the MoPH, Thailand in 2013, revealed the differences in specifications of motorcycles sold particularly in the ASEAN countries compared with
those manufactured in the home country of the companies. Some specific models which are produced in the ASEAN countries have certain specification of longer wheel diameter, narrower tyre width and higher speed, which may affect longer braking distance and stability of the motorcycles. This enhances the necessity in research to look at the tyre, brakes, lights, speeding capacity, proximity warning systems and other safety aspects of these vehicles and also standards for manufacturers to meet with.

Buses used for public transportation are a major mode of transport in the Region due to the limited ability of people to afford cars or pickups. It is essential to make these vehicles safer in all countries as they carry a large number of passengers and are in road environments with heterogeneous traffic. Recent study findings from the BRSIPP reveal that 95% of persons killed and injured were outside buses; crashes between vulnerable road users and buses resulted in a higher number of deaths and severe injuries\textsuperscript{52}. Transportation engineers, urban planners, and vehicle manufacturers should identify research priorities to strengthen vehicle design systems and related policies and programmes for safe fleets.

In addition, vans are increasingly being used for public transport in urban areas, e.g. Bangkok, where they are very popular due to their much faster speed compared to a bus and the much cheaper fare compared to taxi; but their safety records are doubtful, as highlighted in a toll-way accident in Bangkok which killed nine van passengers in 2010. In intercity-transport, vans have also been replacing buses, especially for travel distance in the 300–500 km range. However, its safety records are also problematic, a national in-depth crash investigation study (over 60 cases were conducted nationwide) shows that intercity van was completely unsafe in a collision, the paper highlighted a case where a van collided with a 6-wheel truck resulting in 8 fatalities and 14 injuries. As most vans used CNG (compressed natural gas) as fuel, there is a need to convert the petrol or diesel engines to use CNG which, in addition, requires the installation of three large gas tanks. The stability of the vehicle is called into question. Structural integrity of the vehicle is doubtful, in a collision, it is often totally mangled. In all the cases studied, vehicle defects contributed to 27% of the crash and crash severity. This calls for research into the suitability of vans as public transport\textsuperscript{66}.

14.4 Safer road users

Road users are the major participants in road environments and are exposed to interactions with vehicles and traffic resulting in road crashes. The heterogeneous traffic environments in the Region are specific to the countries resulting in traffic conflicts and road crashes. Data from all countries indicate that pedestrians,
two-wheeler riders and pillion riders and cyclists account for nearly 80% of deaths and injuries in the Region\textsuperscript{9}. It is essential to undertake research on these road user categories to make them safer in traffic environments. At the same time there are also research issues with regard to use of helmets, seat belts, child restraints, drinking and driving, speeding, and others which are behavioural aspects contributing to an increase in road crashes.

Every road user is a pedestrian in the course of his travel. In competing heterogeneous environments, pedestrians are the main victims in road crashes. Making pedestrians safer requires a combination of different techniques like design of roads, provision of footpaths, availability of crossing areas, increasing visibility, speed control mechanisms, traffic calming measures, separation of pedestrians from high speed traffic zones, control of drunken driving and several others. Implementing these mechanisms requires a judicious combination of road engineering, vehicle safety and education to protect pedestrians in traffic. Research from the health sector can indicate the magnitude and nature of pedestrian deaths and injuries, while research from other sectors can help in finding and implementing solutions.

With an increasing number of two-wheeler vehicles, two-wheeler occupants are at a greater risk of road injuries. With greater availability, massive advertisements and increase in purchasing power of people, these vehicles are often family vehicles in South-East Asia. Protecting two-wheeler riders and pillion riders can be achieved through increasing the use of helmets by a combination of legislation – enforcement – education, increasing visibility of two-wheelers, better speed control mechanisms, providing separate access and other mechanisms. Research is required in a number of areas to identify the problem and in making known solutions to work.

Children and adolescents are the vulnerable sections of society and are increasingly involved due to their greater involvement in traffic. The limitations of size, vision, reflexes, judgement, and others make them vulnerable to road traffic injuries. The parental and societal perceptions of childhood RTI injury need a better understanding along with research to identify mechanisms for making them safer.

\subsection*{14.5 Post-crash response}

The fifth pillar of action in the decade of road safety is developing appropriate post-crash response that is affordable, available, and accessible considering societal equity issues. Research is required for understanding critical areas of pre-hospital care in terms of first aid services, absence of triage, deficient safe transport methods, improper referrals, delay in availability of care, lack of preparedness of the hospitals, non-availability of services and other issues.
Even though significant progress has been achieved in acute hospital care in some countries of the Region, there is need to research quality components of trauma care and reasons for nonexistence of a trauma team and care concepts. Rehabilitation needs of the injured have not been addressed effectively and require research.

Most importantly, as a majority of the deaths and injuries occur in the poorer sections of society due to their greater exposure, a majority find it difficult to access quality care in the absence of universal healthcare insurance in the Region. This scenario results in negative outcomes and poor quality of life among the injured. There is need for greater research for measuring the impact of road crashes on poor people in the Region.
15. Research methods

Road safety research is a very broad area encompassing different methods and techniques. Ranging from quantitative to qualitative research, it also includes a number of sectors like health, transport, police, welfare, insurance and others. Research that provides good quality information from all sectors is crucial for road safety management.

Road safety research also needs to move beyond numbers to understand processes and mechanisms. Both quantitative and qualitative methods are required and serve different purposes and are complementary to each other. For example, while helmet use or non-use rates are important to strengthen legislation and enforcement, understanding community perceptions are crucial to enhance helmet use. Understanding helmet policies are required from a system perspective to bring required policy changes. A combination of all these methods is important to reduce brain injuries and associated deaths. A detailed description of research methods from a wide range of disciplines is beyond the scope of this report and a few methods used in public health research are illustrated below as examples.

15.1 Surveillance

RTI and injury surveillance is a public health activity referring to ongoing, continuous and systematic collection, analysis, interpretation and dissemination of information for the overall purpose of developing policies and programmes. It includes gathering information on individual cases or assembling information from records and is a continuous activity with inbuilt feedback mechanisms and an action component. Surveillance generates data that helps in understanding the magnitude of the problem and its characteristics, changing trends, populations at risk, general risk factors and the impact of interventions. A surveillance programme should be operational and sustainable and should be simple, acceptable, sensitive, reliable, timely, and cost-effective in nature. RTI surveillance provides broad information and should be supplemented with data from focused studies. RTI surveillance can be built within existing systems depending on availability of resources and nature of the system. Collecting small amounts of good quality information from both police and hospitals is the hallmark of RTI surveillance. Surveillance systems should use ICD classification systems to provide appropriate classification. Surveillance data needs
to be supplemented with focused research studies for in-depth understanding of issues.

15.2 Trauma registries

Trauma registries are useful to collect in-depth information on defined and specified components of RTIs to examine specific factors. In this approach detailed information is collected from patients seeking care in hospitals. Data from registries can supplement surveillance activities in specific areas. Registries can be established in major academic institutions which have the expertise for conducting registry work.

15.3 Community-based surveys

Community-based surveys provide the most reliable data on RTIs and other injuries. However, these surveys are expensive, time consuming and require large resources. There are very few surveys conducted in the Region at the population level and these studies indicate the huge burden of RTIs as compared to data from the national reporting systems or hospital-based studies. Community-based surveys are a real indicator of the injury burden in the society. RTIs can be integrated with ongoing or proposed national or community-based surveys.

15.4 Risk factor(s) studies

For effective prevention of RTIs, information on risk factors like helmets, seat belts, child restraints, drinking and driving, speeding, cell phone use, pedestrian behaviour and components of trauma care are crucial. However, this information is not routinely available in the national information systems with both the police and the health sector. Hence, a combination of quantitative and qualitative studies need to be employed to obtain reliable information on focused risk factors. Observational surveys, roadside interviews, focused group discussions, in-depth interviews and other techniques help in developing data on risk factors.

15.5 Evaluation research

The impact of all interventions should be evaluated for sustainability, cost effectiveness and for their impact on changing trends of road crashes, deaths and injuries. Evaluation should focus on inputs, processes and outcome and can use a combination of quantitative and qualitative research methods. However, evaluation is not generally included in most of the studies or programmes and should be an inbuilt component of all road safety activities.
15.6 Road safety policy research

The policies and programmes in related sectors of transport, infrastructure development and other areas are known to have an impact on the burden of road traffic injuries in every country. The health sector has a major responsibility in examining the impact of policies and programmes on the health and safety of people. Policy research is very crucial for developing and revising road safety policies.

15.7 Translational research

In road safety, there are several solutions known to provide results, but difficulties exist in translating this knowledge to action. Translational research focuses on conducting scientific research to make the results applicable to the society or population under study. Translational research is considered an important tool to identify missing components between what is known and what is implemented and aims at finding solutions to develop strategies for effective implementation and to overcome barriers.

15.8 Economic research

The economic impact of RTIs is huge and data is not available to quantify the impact in Member States of the Region. There is need to better understand the economic burden of RTIs. In addition, there is need to understand the efficacy and cost-effectiveness of interventions. It is essential to measure the monetary costs and results of interventions in terms of lives saved for every intervention at both national and local levels.

15.9 Qualitative research

It is important to know that quantitative data alone will not be able to bring total insights into the problem of RTIs. However, this data can be supplemented with qualitative research using focused group discussions and in-depth interviews to get more insights into the problem. These discussions can be held with a variety of stake-holders in society ranging from policy makers to members of the community. It provides an in-depth understanding of issues that contribute to road safety.

15.10 Knowledge-attitude-belief-and practice research

KAP studies are descriptive, qualitative studies that measure changes in human knowledge, attitudes and practices in response to a specific intervention, done before or after to measure effects of the intervention. KAP studies inform what people know
about certain things, how they feel, and how they behave. This is a useful technique to understand societal perceptions on specific issues. It is important to undertake such research before introducing any intervention and repeat studies can provide information on people’s opinion after the intervention.
16. Conclusion

With increasing motorization, RTIs are on the increase in all Member States of the Region. It is estimated that nearly 300 000 persons die every year in road crashes with the highest numbers reported from India, Indonesia and Bangladesh. More than 10 million people sustain different grades of injury from road traffic crashes. The economic and psychosocial impact of RTIs is huge, though unmeasured.

Despite the increasing burden, efforts to address road safety are far from satisfactory in the Region. A limited number of dedicated national lead coordinating agency, in countries, lack of policies and programmes, coordination, funding, commitment for enforcing existing laws, trained human resources are some of the major barriers.

Good quality research is an essential prerequisite to strengthen road safety and this is lacking in the Region. Lack of road safety institutions, absence of trained professionals, limited or no funding, limited understanding of country requirements and capacity to use data for policies and programmes are some of the major gaps in the Region. In the absence of research, data and evidence, little progress can be made in future.
17. Recommendations

Considering the burden and impact of RTIs and other injuries in the Region, Member States should develop and implement strategic national road safety management mechanisms to control, stabilize and reduce the growing problem in the Decade of Action for Road Safety. Road safety research is an effective tool in this process. The following recommendations are placed herewith to strengthen this mechanism in the Region:

17.1 Member States

- All Member States should give importance to strengthen national RTI and injury information systems using research as an essential tool to overcome current limitations. The national information systems should focus on essential data components.

- All countries should designate or establish one or more national centres of excellence in road safety research based on the extent of the problem. While there is need for one or more institutions in each sector (transport, health, police), there is a need for a National Road Safety Research and Resource Centre that promotes, conducts, integrates and facilitates application of research.

- The Ministry of Health in collaboration with other sectors should formulate a country-specific research agenda for identifying key areas of research that can make an impact in reducing road crashes. This agenda development should be based on situation analysis, in accordance with national priorities and with the participation of key sectors.

- Academic institutions should be supported and funded to develop a research agenda, develop human resource in the country, conduct and disseminate research on an intersectoral basis. Collaboration between international organizations and universities in countries that have been successful in reducing road crashes should be strengthened.

- Apart from a national centre(s), existing national research organizations or academic institutions or universities in health, transport, automobile engineering, urban planning, road engineering should be strengthened and adequately funded to support and strengthen road safety research.
● All existing centres working in road safety should be supported with funding and trained human resources to conduct research and disseminate findings to all stakeholders in key areas. The centre should be able to coordinate with all related stakeholders in conducting intersectoral research and translational research.

● Member States should urgently develop short-term road safety courses for professionals working in various disciplines to bridge the existing gaps. Existing institutions of excellence in each country should be allowed to carry out this task with support from respective ministries in national governments.

● National capacity building activities should be undertaken for policy makers of all ministries and departments that are engaged in road safety activities through sensitization activities for developing evidence-based intervention programmes.

● Mechanisms should be developed for dissemination of research findings and to facilitate application of research findings in policies and programmes through capacity building programmes.

17.2 WHO

WHO should:

● Support Member States by providing technical knowhow to establish, develop and strengthen national and regional centres for road safety research.

● Extend technical support to Member States to develop human resources for road safety research by promoting exchange of professionals, knowledge and cooperation across countries.

● Support Member States to strengthen national road safety information systems in police and surveillance programmes in health care institutions along with identifying and promoting key areas of road safety research.

● Support regional or national intersectoral training programmes by networking with existing centres of excellence and WHO collaborating centres.

● Help Member States with methodological inputs for conducting research in population-based studies, risk factor studies, setting up registries, economic impact studies and in other key areas.
References


(49) Joshipura MK, Shah HS, Patel PR, Divatia PA, Desai PM. Trauma care systems in India. Injury. 2003;34:686–92.


(55) Shah RK, Thapa VK, Jones DH, Jones R. Improving primary orthopedic and trauma care in Nepal. Education for Health: Change in Learning and Practice. 2003;16(3):348-56.


Road safety management needs to be strengthened with vision, direction, coordination, management, funding, interventions, advocacy, monitoring and evaluation. Many countries need to be strengthened with sustainable, cost effective and scientific policies. The five pillars of the Decade of Action on Road Safety 2011–2020 including safe roads, safe vehicles, people, post-crash care and efficient management need to be implemented in all Member States. Information through good research is an important building block for all these activities with strong, robust and quality data that can drive activities in future. The report provides an overview of the road safety information systems in the South-East Asia Region, the current knowledge scenario on road safety in the Region, priorities for research, research methods and recommendations.