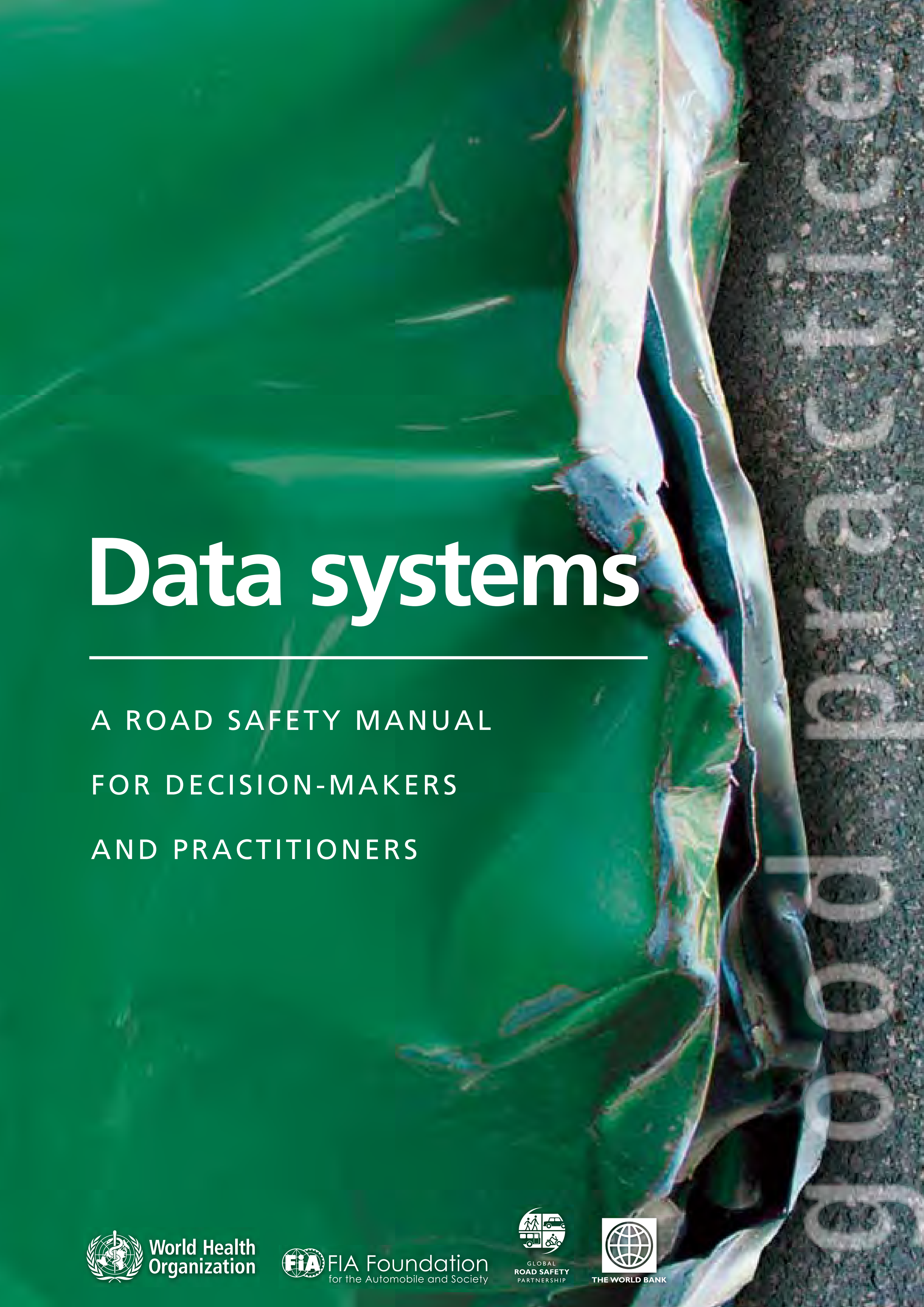

Data systems

A ROAD SAFETY MANUAL

FOR DECISION-MAKERS

AND PRACTITIONERS

World Health Organization

FIA Foundation for the Automobile and Society

Global Road Safety Partnership

The World Bank

Data systems

A road safety manual for decision-makers and practitioners

World Health Organization

FIA Foundation for the Automobile and Society

GLOBAL ROAD SAFETY PARTNERSHIP

THE WORLD BANK

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Table of contents

Preface

Road traffic injuries are a major public health problem and a leading cause of death and injury around the world. Each year nearly 1.3 million people die and millions more are injured or disabled as a result of road crashes, mostly in low- and middle-income countries. As well as creating enormous social costs for individuals, families and communities, road traffic injuries place a heavy burden on health services and economies. The cost to countries, many of which already struggle with economic development, may be as much as 1–2% of their gross national product. As motorization increases, preventing road traffic crashes and the injuries they inflict will become an increasing social and economic challenge, particularly in developing countries. If present trends continue, road traffic injuries will increase dramatically in most parts of the world over the next two decades, with the greatest impact falling on the most vulnerable citizens.

Appropriate and targeted action is urgently needed. The *World report on road traffic injury prevention*, launched jointly in 2004 by the World Health Organization and the World Bank, identified improvements in road safety management and specific actions that have led to dramatic decreases in road traffic deaths and injuries in industrialized countries active in road safety. The use of seat-belts, helmets and child restraints, the report showed, has saved thousands of lives. The introduction of speed limits, the creation of safer infrastructure, the enforcement of limits on blood alcohol concentration while driving, and improvements in vehicle safety are all interventions that have been tested and repeatedly shown to be effective. The *World report on road traffic injury prevention* also identified the importance of collecting accurate, reliable data on the magnitude of the road traffic injury problem: it highlighted the need for data systems to be put in place to collect the information needed to allow countries to develop evidence-driven road safety policies.

The international community must now take the lead to encourage good practice in road safety. To this effect, the United Nations General Assembly adopted a resolution on 14 April 2004 urging that greater attention and resources be directed towards the global road safety crisis. Resolution 58/289 on 'Improving global road safety' stressed the importance of international collaboration in the field of road safety. Two further resolutions (A/58/L.60 and A/62/244), adopted in 2005 and 2008 respectively, reaffirmed the United Nations' commitment to this issue, encouraging Member States to implement the recommendations of the *World report on road traffic injury prevention*.

In November 2009, ministers and heads of delegations to the First Global Ministerial Conference on Road Safety echoed these calls with the adoption of the Moscow Declaration, resolving to take a number of actions to improve road safety, including improvements to national data collection systems and international comparability of data.

To contribute to the implementation of these resolutions and the Moscow Declaration, the World Health Organization, the Global Road Safety Partnership, the FIA Foundation for the Automobile and Society, and the World Bank have collaborated to produce a series of manuals aimed at policy-makers and practitioners. This manual on developing road crash data systems is one of them. Each manual provides step-by-step guidance to countries wishing to improve a particular aspect of road safety, according to recommendations outlined in the *World report on road traffic injury prevention*. These steps can save many lives and reduce the shocking burden of road traffic crashes around the world. We encourage all to use these manuals.

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Executive summary

Road transport is vital to development. Unfortunately, inadequate attention to safety has meant that road transport systems have developed in ways that have led to significant loss of lives, health and wealth. Reliable and accurate data are needed to raise awareness about the magnitude of road traffic injuries, and to convince policy-makers of the need for action.

Reliable and accurate data are also needed to correctly identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance. Ongoing, data-led diagnosis and management of the leading road traffic injury problems enables appropriate action and resource allocation. Without this, there will be no significant, sustainable reductions in exposure to crash risk or in the severity of crashes.

Data relevant to road safety are collected every day in most countries, but for these data to be useful for informing road safety practice, they must be properly coded, processed and analysed in a computerized database system. The purpose of this manual is to give practical guidance on establishing data systems that produce timely, reliable data on road traffic injuries that can be used to inform road safety management.

The manual begins with a discussion of why good data are important for road safety management, and what kinds of data are required for effective planning and monitoring. It guides users through the process of conducting a situational assessment to identify relevant stakeholders, existing data sources and systems (along with their strengths and limitations), the needs of end-users, and relevant political factors and resource availability. It then describes the steps needed to establish a working group and use the situational assessment to choose the best course of action.

The manual also describes a range of strategies for improving data quality and strengthening the performance of systems already in place, and describes the steps needed to plan, design and implement a new system – noting that there is no single approach that will be right for every country or jurisdiction. A common dataset with minimum data elements and definitions is proposed. Finally, the manual guides the user on how to disseminate road safety data and maximize the likelihood of its use, and on how to use the data to improve road safety, monitor results and assess the impact of interventions.

In preparing the material for this manual, the writers have drawn on case studies from around the world. Whenever possible, examples from low- and middle-income countries have been used to illustrate various issues. While the focus of the manual is on national-level data systems, the strategies presented can be applied at the local level. It is hoped that the modular structure of this manual means it can be easily adapted to suit the needs and problems of individual countries.

Introduction

Background to the series of manuals

The World Health Organization (WHO) dedicated World Health Day 2004 to the issue of road safety. Events marking the day were held in more than 130 countries to raise awareness about road traffic injuries, stimulate new road safety programmes and improve existing initiatives. On the same day, the WHO and the World Bank jointly launched the *World report on road traffic injury prevention*, highlighting the growing pandemic of road traffic injuries. The report discusses in detail the fundamental concepts of road traffic injury prevention, the impact of road traffic injuries, the main causes and risk factors for road traffic crashes, and proven and effective intervention strategies. It concludes with six important recommendations that countries can follow to improve their road safety record.

Recommendations of the World report on road traffic injury prevention

1. Identify a lead agency in government to guide the national road traffic safety effort.
2. Assess the problem, policies, institutional settings and capacity relating to road injury.
3. Prepare a national road safety strategy and plan of action.
4. Allocate financial and human resources to address the problem.
5. Implement specific actions to prevent road traffic crashes, minimize injuries and their consequences, and evaluate the impact of these actions.
6. Support the development of national capacity and international cooperation.

The report stresses that any actions taken by countries to prevent road traffic injuries need to be based on sound scientific evidence, and should be culturally appropriate and tested locally. However, in its fifth recommendation, the report makes it clear that there are several 'good practices' – interventions already tried and tested – that can be implemented at low cost in most countries. These include strategies that address some of the major risk factors for road traffic injuries, such as:

- setting and enforcing laws requiring installation and use of seat-belts and child restraints for all occupants of motor vehicles;
- requiring riders of motorcycles to wear helmets;
- establishing and enforcing low blood alcohol concentration limits;
- setting and enforcing speed limits;
- managing existing road infrastructure to increase safety.

A week after World Health Day, on 14 April 2004, the United Nations General Assembly passed a resolution calling for greater attention and resources to be directed towards road safety efforts. The resolution recognized that the United Nations system should support efforts to tackle the global road safety crisis. At the same time, it commended WHO and the World Bank for their initiative in launching the *World report on road traffic injury prevention*. It also invited WHO, working in close cooperation with the United Nations Regional Commissions, to act as coordinator on road safety issues within the United Nations system.

Following the mandate conferred on it by the United Nations General Assembly, WHO has helped develop a network of United Nations and other international road safety organizations – now referred to as the 'United Nations Road Safety Collaboration'. The members of this group have agreed common goals for their collective efforts, and are initially focusing attention on the six recommendations of the *World report on road traffic injury prevention*.

A direct outcome of this collaboration has been the establishment of an informal consortium consisting of WHO, the World Bank, the FIA Foundation for the Automobile and Society and the Global Road Safety Partnership (GRSP). This consortium is working to produce a series of 'good practice' manuals covering the key issues identified in the *World report on road traffic injury prevention*. The project arose out of the numerous requests made to the WHO and the World Bank by road safety practitioners around the world, especially those working in low and middle-income countries, asking for guidance in implementing the report's recommendations.

The manuals are aimed at governments, non-governmental organizations and road safety practitioners in the broadest sense. Written in an accessible manner and to a common format, they provide practical steps to implement each recommendation in a way identified as good practice, while also making clear the roles and responsibilities of all those involved. Although primarily intended for low and middle-income countries, the manuals are applicable to a range of countries and adaptable to different levels of road safety performance. Each manual includes case studies from developed and developing countries.

The *World report on road traffic injury prevention* advocates a comprehensive systems approach to road safety – one that addresses the road, the vehicle and the user. Its starting point is that to effectively tackle road traffic injuries, responsibility needs to be shared between governments, industry, non-governmental organizations and international agencies. Furthermore, to be effective, road safety must have commitment and input from all the relevant sectors, including those of transport, health, policy-making and law enforcement. These manuals also reflect the views of the report; they too advocate a systems approach and – following the principle that road safety should be pursued across many disciplines – they are targeted at practitioners from a range of sectors.

Background to the data systems manual

Why was the manual developed?

The *World report on road traffic injury prevention* calls on governments to assess the problems, policies and institutional settings relating to road safety. It works on the premise that effective road safety management is based on a systematic approach that includes the collection, analysis, interpretation and application of good data. In reality, however, road traffic data collection systems are not well developed in low and middle-income countries, where the majority of road traffic injuries occur. The findings of WHO's *Global status report on road safety* (2009) confirmed the need for a manual dedicated to the collection and use of data for the prevention and control of road traffic injuries.

It is essential that each country puts in place a scientific and consistent system to collect, store, analyze, disseminate and apply road crash data. This manual is designed to support countries in doing this.

Who is the manual for?

This manual provides practical advice for professionals working in road safety. It aims to help them develop or improve national or local mechanisms to systematically collect, process, analyse and use road crash data, with the ultimate aim of reducing road traffic injuries through data-led road safety management. It is primarily intended to guide the decision-making of mid-level managers responsible for road safety data management in low and middle-income countries, and may also be useful for policy-makers, politicians, non-governmental organizations and researchers advocating for data systems.

Every effort has been made to ensure that the recommended steps and processes can be implemented in settings where resources are limited. Though the manual describes steps to implement a 'gold-standard' crash database with linked data sources, it is recognized that this is not always possible, and so the manual advises on what can be done with existing data to start to build a more robust system.

What does the manual cover?

In most countries the agencies that interact with road crash victims – primarily police departments and hospitals – collect information about road traffic crashes. Many jurisdictions however lack mechanisms that allow them to make use of that data to formulate effective road safety action. Achieving reductions in road traffic injuries requires that road safety data are not just collected, but also systematically processed, analyzed and disseminated to relevant stakeholders to take corrective action. This manual provides practical guidance for developing data systems that can expose a jurisdiction's road traffic injury problem, help choose evidence-based interventions, and monitor progress in road traffic injury prevention and road safety promotion.

Module 1 explains **why road safety data systems are needed**. It presents a conceptual framework for data-led road safety management and describes what data are needed by various sectors involved in road safety.

Module 2 guides the user through the process of **assessing a country's situation in relation to road safety data**. It covers identification of stakeholders, data sources, and databases in use, and provides guidance for assessing data quality, resource availability and the policy environment, and using the resulting assessment for decision-making.

Module 3 offers guidance for **improvements to existing road crash data systems**, and outlines steps for the **design and implementation of a new road crash data system**. Topics include mobilizing stakeholders, defining objectives, identifying user requirements, strategies for improving/ensuring data quality, and strategies for improving/ensuring system performance. Minimum data elements are defined. The module focuses primarily on the implementation of a crash database derived from police records, while identifying steps that can be taken to utilize other existing data sources (e.g. hospitals).

Module 4 **explores the use of data for action to improve road safety**. It covers dissemination of data and road safety indicators, and the use of data system outputs to develop interventions and policies and assess prevention measures.

Case studies from a range of countries are included in the manual.

How should the manual be used?

The manual is not intended to be prescriptive, but rather adaptable to particular needs. Each module contains tools to help readers determine what level their country/region is at in relation to road safety data systems, and to take steps that offer the greatest potential for improvement. It is not possible, however, to develop a decision chart that will accommodate the situation and options of all manual users. Road safety data systems have myriad objectives, data sources, designs and uses. Users of this manual will need to apply its principles to their local situation and use their best judgement.

Users are encouraged to read the entire manual. However, individual sections may be more relevant to some countries than others, depending on the situation. We encourage users to adapt the manual to local conditions. While the manual refers mainly to data systems at a national level, it is recognized that national data will not be reliable if good data collection systems are not in place at the local level. The principles and strategies presented here for designing or improving a national road safety data system should also be applied in local jurisdictions.

What are the limitations of this manual?

Using this manual to design or improve a road safety data system should lead to more reliable data on road traffic deaths, the crashes that cause them and the characteristics of those crashes, and possibly more reliable data on non-fatal road traffic injuries. Different systems are required to capture data for safety performance indicators and costs. Though these data are no less important, guidance on those topics is not included in this manual.

This manual is not intended to be an exhaustive 'state of the art' review. The references it contains are those found useful in its development, or that can provide more in-depth information. Similarly, the case studies – used to illustrate processes, good practice and practical constraints – are not meant to be exhaustive but rather to illustrate points presented in the main text.

How was the manual developed?

Planning for the manual was done in consultation with experts from health, transport and police departments, coordinated by the World Health Organization. Contributions for different sections of the manual came from experts in various disciplines and the whole manual was edited by staff at the World Health Organization and submitted for review. Much of the manual is based on practical experience resulting from existing road traffic safety data, much of which comes from high-income countries. In light of this, the recommendations in the manual have been made to accommodate the realities of low and middle-income countries too.

Dissemination of the manual

The manual will be translated into a number of languages, and countries are encouraged to translate the document into local languages. The manual will be disseminated widely through the distribution network used for the *World report on road traffic injury prevention*. Various partner organizations will plan training workshops to assist countries with implementation of the manual.

The manual will also be available in PDF format to be downloaded free from the websites of all four partner organizations.

This manual is downloadable from
http://www.who.int/roadsafety/projects/manuals/en/index.html

How to get more copies

Further copies of the manual can be ordered by e-mailing **traffic@who.int**, or by writing to:

Department of Violence and Injury Prevention and Disability
World Health Organization
20 Avenue Appia, CH-1211
Geneva 27, Switzerland

1

Why are road safety data systems needed?

This module explains why data systems are important for road safety practice. Road safety related data are used by a variety of stakeholders – the police, transport departments, health facilities, insurance companies – as well as policy-makers and practitioners. Reliable data for a country are important in persuading political leaders that road traffic injuries are a priority issue. These data can also be used in the media to make the general public more aware of legislation and changes in behaviour that will improve their safety. Road traffic crash data are key to identifying risks, developing strategies and interventions to address those risks, and evaluating the impact of interventions.

The module is divided into three sections:

- **1.1 Data systems are important for road safety:** This section presents road safety as a key public policy issue requiring data-led action. It emphasizes that while road traffic crash data are collected every day in most countries, these data can only benefit road safety practice if they are processed, analyzed and made available through a good data system. Characteristics of good road crash data systems are discussed.
- **1.2 Data requirements for comprehensive assessment of road safety performance:** This section briefly describes what type of data are needed (beyond crash statistics) to monitor all aspects of road safety performance.
- **1.3 The roles and data needs of different sectors:** This section discusses the roles of law enforcement, transport and health sectors in road safety, and their related data requirements.

1.1 Data systems are important for road safety

Road transport is vital to development. In facilitating the movement of people and goods, it improves access to education, health care, employment, and economic markets. Multilateral development banks invest billions of dollars each year to build and repair road networks in low- and middle-income countries, thereby generating economic growth and employment (*1*). Unfortunately, in the absence of adequate attention to safety, an emphasis on maximizing the efficiency of road transport systems has led to significant loss of lives, health and wealth.

An estimated 1.3 million people die each year as a result of road traffic crashes (see **Box 1.1** for definitions of standard terminology), and a further 20 to 50 million people suffer non-fatal injuries (*2*). These crashes and injuries have devastating economic and social costs, for families and for society. Policies and programmes in the transport, law enforcement, health and other sectors have a direct impact on the safety of road transport, making road safety a critical public policy issue. Thanks to advocacy efforts and improvements in data, governments and the international community increasingly recognize that the magnitude of road traffic injuries constitutes a crisis requiring immediate action.

BOX 1.1: **Standard terminology**

This manual uses definitions of common terms that have been negotiated internationally, mostly drawn from the UNECE *Glossary of Transport Statistics* (4th ed, 2009) and the *World report on road traffic injury prevention* (WHO 2004).

Road: Line of communication (travelled way) open to public traffic, primarily for the use of road motor vehicles, using a stabilized base other than rails or air strips.

Included are paved roads and other roads with a stabilized base, e.g. gravel roads. Roads also cover streets, bridges, tunnels, supporting structures, junctions, crossings and interchanges.

Road network: All roads in a given area.

Road vehicle: A vehicle running or drawn on wheels intended for use on roads.

Road motor vehicle: A road vehicle fitted with an engine providing its sole means of propulsion, which is normally used for carrying persons or goods, or for drawing (on the road), vehicles used for the carriage of persons or goods.

Road traffic: Any movement of a road vehicle on a given road network.

Road transport: Any movements of goods and/or passengers using a road vehicle on a given road network.

Road traffic crash: A collision or incident involving at least one road vehicle in motion, on a public road or private road to which the public has right of access.

Included are: collisions between road vehicles; between road vehicles and pedestrians; between road vehicles and animals or fixed obstacles and with one road vehicle alone. Included are collisions between road and rail vehicles. Multi-vehicle collisions are counted as only one crash provided that any successive collisions happen within a very short time period.

Injury: Physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy. It can be a bodily lesion resulting from acute exposure to excessive energy or impairment of function resulting from lack of vital elements.

Road traffic injury (or casualty): A person who has sustained physical damage (i.e. injury) as a result of a road traffic crash.

Road user: a person using any part of the road system as a non-motorized or motorized transport user.

Road traffic fatality: Any person killed immediately or dying within 30 days as a result of an injury crash, excluding suicides.

For countries that do not apply the threshold of 30 days, conversion coefficients are estimated so that comparisons on the basis of the 30 day-definition can be made.

Injury crash: Any road traffic crash resulting in at least one injured or killed person.

Fatal crash: Any road traffic crash resulting in a person killed immediately or dying within 30 days as a result of the crash.

Sources: (*3, 4, 5*)

Many people have opinions about what should be done to make roads safer, often based on personal experience or anecdotal information that may misrepresent the true priority issues.

By contrast, reliable and detailed data help practitioners accurately identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance (see (*6*) and **Figure 1.1**). This cycle of gathering data, taking action and then evaluating is fundamental for any road safety strategy, including the Safe System approach to road safety (see **Figure 1.2**). Without ongoing, data-led diagnosis and management of the leading road injury problems, there will be no significant, sustainable reductions in exposure to crash risk or the severity of crashes.

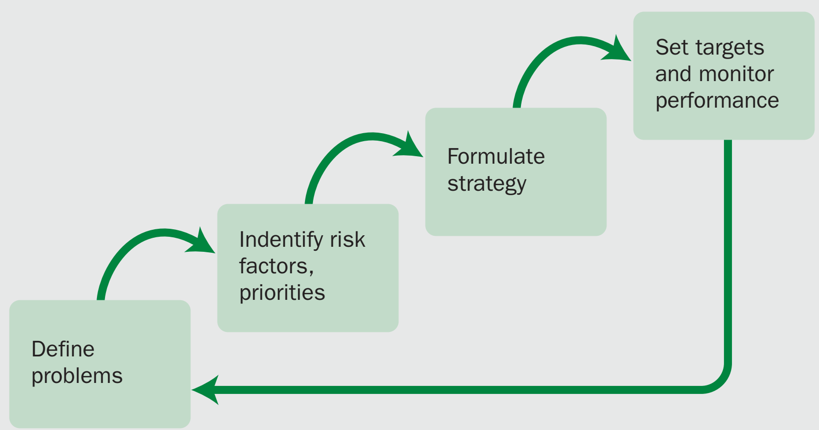
Reliable, accurate data can also help build political will to prioritize road safety by:

- documenting the nature and magnitude of the road traffic injury problem;
- demonstrating the effectiveness of interventions that prevent crashes and injuries;
- providing information on reductions in socio-economic costs that can be achieved through effective prevention.

The use of reliable data to identify problems and target resources more effectively is a key element of the Safe System approach to road safety – an approach increasingly recognized as the most effective way to make road transport systems safer for all users.

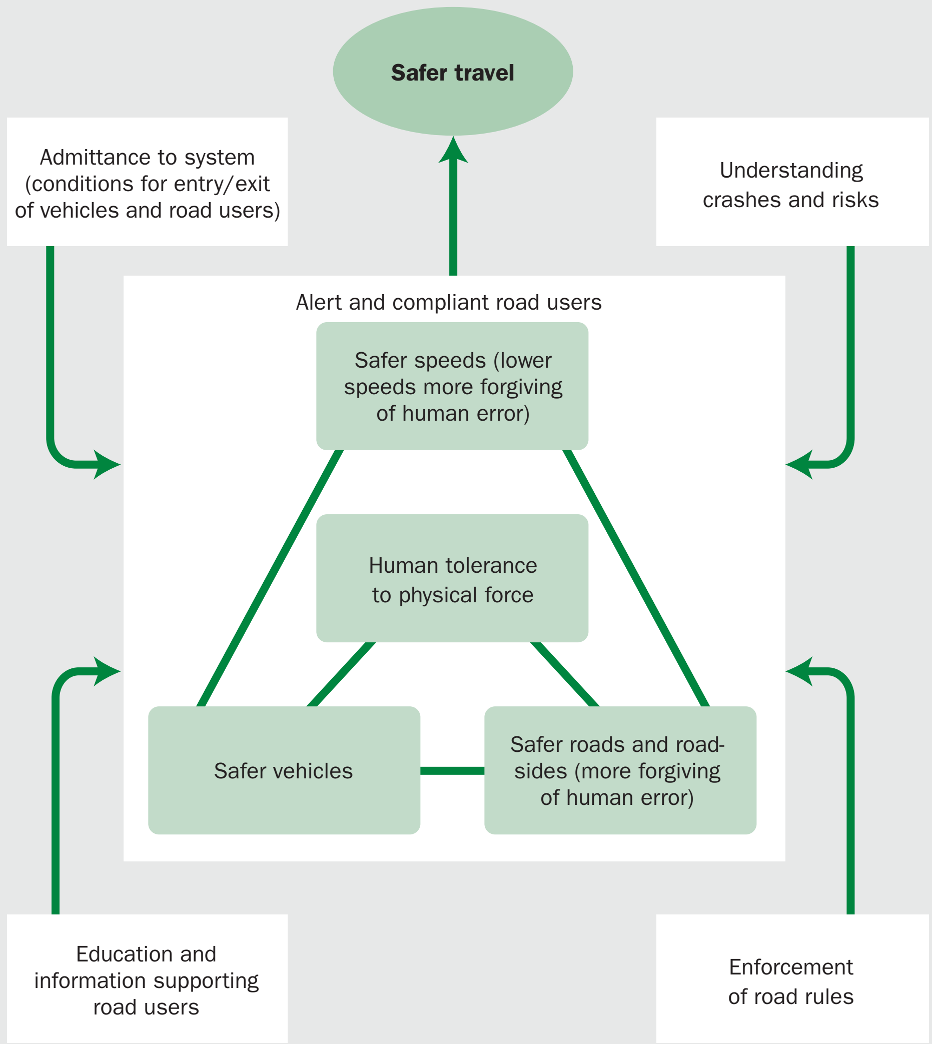
This approach aims to develop a road transport system that is better able to *accommodate* human error and take into consideration the vulnerability of the

Figure 1.1 **Use of data for public health approach to road safety**



Source: based on (6, 7)

Figure 1.2 The Safe System model



Source: (8)

* The phrase Safe System approach refers to a broad category of strategies for road safety management, as described in *Towards zero: Ambitious road safety targets and the Safe System approach* (9). While the Safe System approach has influenced strategies in several countries, the term itself does not refer to the road safety programme of any single country.

human body, rather than maintaining a primary focus on *preventing* human error. It requires recognition that road safety is a shared responsibility of designers of the road transport system as well as users of that system. The goal of the approach is to prevent fatal and severe injuries by identifying and addressing the major sources of error and the design flaws that contribute to them (*4, 9*). Road users, vehicles and the road network/environment are addressed in an integrated manner, through a wide range of interventions, with greater attention to speed management and vehicle and road design than in traditional approaches to road safety.

Quality of road crash data systems

Basic information on road traffic crashes and injuries is collected every day in most countries. Police officers write reports on reported crashes. Insurance companies document client crashes. Health workers keep medical records on road traffic injuries they have treated. The main purpose of documenting this information is usually to assist an agency in carrying out its specific function – investigation, law enforcement, provision of health care. While such information may be useful to individual agencies, it cannot be used for identifying risks, selecting interventions, or measuring outcomes at an aggregate level unless is it properly coded, entered in a computerized database system, processed, analysed and disseminated.

In this manual, the term *road crash data system* refers to the people, processes, hardware and software involved in collecting and managing information related to road traffic crashes. Road crash data systems should process information in a way that allows for analysis at an aggregate level and facilitates data-driven action. At a minimum, good road crash data systems should:

- capture nearly all crashes that result in death and a significant proportion of those that result in serious injuries;
- provide adequate detail on the vehicle, the road user and the road/environment to assist with identification of causes, and selection of countermeasures;
- include accurate crash location information;
- provide reliable output in a timely manner to facilitate evidence-based decisions.

HIB-Cambodia

Most countries have some kind of mechanism for counting road traffic deaths and injuries. WHO's *Global status report on road safety* (*2*) used a core set of indicators and a standardized methodology to assess the status of road safety worldwide. Of the 178 countries and areas that participated, all but one reported on the number of road traffic fatalities. Most countries were able to provide some information on non-fatal road traffic injuries as well, though the quality of this information was highly variable. Counting deaths and injuries (the accuracy of these counts aside) is just the beginning, however.

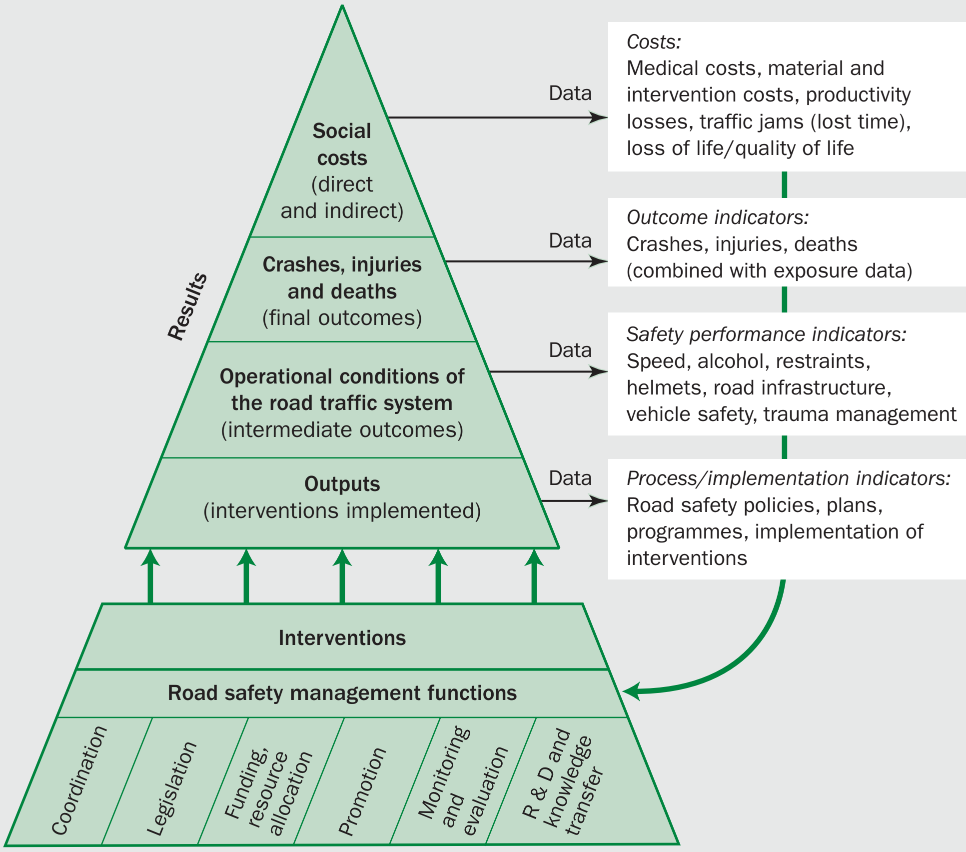
Summary crash statistics can be useful for describing the magnitude of the problem and monitoring programmes and policies, but more detailed information is required for evidence-based intervention and management. In the *Global status report on road safety* (*2*) many countries did not provide data on the distribution of road traffic deaths among road user categories, or trend data. Some countries noted discrepancies between the number of deaths recorded by different sectors, and few indicated use of data linkages across sectors. The results of that report support what international road safety experts have said for years based on experience – that most jurisdictions need to take measures to improve their road crash data system (or implement a new system) so that it meets the criteria listed above, and ultimately so that it is useful for reducing road traffic deaths and injuries.

1.2 Data requirements for comprehensive assessment of road safety performance

There is growing recognition in the international community that effective road safety management requires more data than the crash data described above. Crash statistics do not provide a complete picture of the road safety situation. Crash data must be interpreted in light of other information that cannot usually be derived from police records, such as population size, or the number of vehicles on the road. Crash data do not capture information on risk factors such as helmet use or speeding among the general population, and therefore other road safety related data are important for monitoring performance and achieving results (*8*).

Road safety management involves all institutions, their strategies and interventions, and the results of such strategies and interventions (*10*). Results, or *outcomes*, occur at different but related levels (see **Figure 1.3**). The most visible results are the *outputs* that result from policies and programmes implemented by various institutions: random breath testing checks, campaigns to promote helmet use, legislation, installation of speed cameras. Through such outputs, policies and programmes influence how the road traffic system operates: e.g. the proportion of people wearing helmets, average travel speeds, safety of vehicles admitted to the system (also

Figure 1.3 Outcomes of road safety management



Source: Based on (*10, 11, 12, 13*)

known as *intermediate outcomes* or *safety performance indicators*). These 'operational conditions' directly influence the likelihood of deaths and injuries from road crashes, or *final outcomes,* that road safety practice aims to prevent. Finally, the ultimate result of effective road safety management is the reduction of *social costs* (such as medical costs, property damage) associated with road traffic deaths and injuries.

A true understanding of road safety performance requires information for each of these outcomes. A comprehensive road safety data system would therefore encompass data collection and analysis mechanisms that cover (*8*):

- final outcomes – including at least deaths and serious injuries to road users, and characteristics of the crashes that result in them;
- exposure measures – e.g. demographic data, number of licensed drivers, traffic volume data, infrastructure factors, to help interpret of crash data and measure indicators;

- intermediate outcomes – e.g. mean traffic speeds, seat-belt and helmet wearing rates, drink–driving, and vehicle and infrastructure safety ratings;
- socio-economic costs associated with road traffic injuries;
- outputs – including various enforcement efforts.

Very few countries however, have all these types of information available for road safety planning. Of the 178 countries and areas that participated in the *Global status report on road safety*, only 22% were able to provide information on road traffic fatalities, non-fatal injuries, economic impact, and some kind of data on selected intermediate outcomes (*2*).

1.3 The roles and data needs of different sectors

The work of the transport, law enforcement and health sectors directly influences the risk and outcomes of road traffic crashes, whether or not that work is consciously considered to be 'road safety work'. These sectors require a variety of road safety related data for their day-to-day functioning. As background to conducting a situational assessment on road safety data systems, it is helpful to understand the function of these sectors, what data they require and what data they may have.

Law enforcement

The role of the police is to ensure the personal safety of citizens in all aspects of daily life and in all places, which includes when travelling on the roadway. This protection is provided through the enactment and enforcement of legislation governing safe and appropriate use of the roadway. In many countries there is a legal requirement to report a road crash to the police if it involves personal injury, and for the police to document key information about the crash. It is therefore the police who most often maintain databases on the number and characteristics of road traffic crashes at both a national level and in local or regional jurisdictions. In addition, the police are charged with the responsibility of investigating all road traffic crashes to


K. Rajam / WHO

determine if laws have been broken, and to identify culpability. As a result they generally collect information on the vehicles and drivers involved, the vehicles' movements prior to the collision, on road users involved and also on environmental conditions, such as the weather or road surface. Police officers may be responsible for follow up with crash victims admitted to hospital.

In many jurisdictions, attending road traffic crashes is just one aspect of a police officer's multifaceted job, alongside responsibilities for crime, violence, and public safety. There are therefore usually competing priorities for a police officer's time and attention. When an officer is responding to a road traffic crash, the primary objective for data collection is not to generate data to improve road safety. The officer may be concerned instead with issuing citations, fulfilling legal requirements or with filing the paperwork required by their precinct. Often police officers are required to write crash reports and fill in data collection forms. Good road crash data systems cannot be built without an acknowledgement of the pivotal role of police officers as data collectors. A critical strategy for ensuring reliable road traffic crash data is working with the police to demonstrate how aggregate data can be useful for their own enforcement work, and how careful and complete data collection can lead to reductions in road traffic injuries (see Case study 1.1 and Module 3).

CASE STUDY 1.1: **Strengthening road traffic injury data collection by police, Ethiopia**

The Traffic Police Department of Addis Ababa city has been working since 2002 to strengthen its road traffic injury data management capacity. The activities include:

- developing an easy-to-use data collection form;
- setting up a computer-based data analysis system;
- training the traffic police officers on data management;
- developing a small resource centre;
- promoting collaboration among key stakeholders in road traffic safety.

At the beginning of the project, the traffic police did not have a standard form to use to record data at the scene of a crash. Information was collected on a piece of paper which would be transferred to a logbook that was manually filed. Developing a standard data collection form and training traffic police officers on how to use it were key activities of this project. A draft form was developed, based on the logbook used by police, as well as examples from other countries (Kenya, India and South Africa) and Injury Surveillance Guidelines published by WHO. The draft form was piloted, revised and adopted. Amharic, Ethiopia's national language, was used.

The data collected covers:

- site and location of collision;
- weather conditions at time of crash;
- vehicles and other road users involved;
- insurance status of vehicle;
- vehicle inspection status;
- number of persons injured or killed at the scene;
- demographic data of casualties (name, age, sex, occupation);
- whether first aid was given.

In addition, manual data entry, processing and analysis were computerized. A database was developed in Amharic for data entry and analysis. Based on the experience of the Addis Ababa Traffic Police Department, the traffic data management system has been scaled-up to six major regions in the country and 22 traffic police officers (10 from Addis Ababa and 12 from the other regions) have been trained on computer-based data entry, processing, analysis and report writing.

The police, and indeed the internal security ministry/justice sector, along with its legislative arm, need data that can identify the causes and magnitude of road traffic crashes. This is particularly relevant in relation to risk factors that can be reduced by legislation and its enforcement; for example, driving under the influence of alcohol and drugs, speeding, and use of safety equipment such as helmets, seat-belts and child restraints. Sufficient data can assist the police in identifying areas and locations that require greater enforcement efforts.

In summary, the police need data in order to:
- monitor the occurrence of traffic law infringements;
- keep track of legal proceedings such as court appearances, and outcomes such as fines and sentences;
- enable an intelligence-led approach to enforcement, such as identifying where speed traps and cameras should be located, and when and where alcohol testing should occur for maximum effect.

Transport

The transport sector's role is the provision of an efficient system that allows the safe transport of people and goods. Therefore, the sector is responsible for:
- the condition, design and construction of the road environment that promotes or inhibits safe travel;
- the roadworthiness and registration of road vehicles;
- the management of examinations to test/establish a driver's ability to operate different vehicle types safely on the road.

Transport sector activities focus on ensuring the safe and efficient operation of the road traffic system by encouraging the correct use of the network by road users. The transport sector requires data for the identification of hazardous locations (sometimes called hotspots or black spots), for analysis of crashes at these sites, and ultimately for the selection of appropriate countermeasures. In addition, crash data analysis can be used to identify hazardous routes and road design problems so that engineering standards are improved. One method of acquiring such information, shown in Case study 1.2, is through the application of a Geographic Information System. In many countries, the transport sector initiates improvements to or implementation of data systems and is the main user of the results.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CASE STUDY 1.2: **Geographic information systems (GIS) for injuries, Mexico**

Much can be learned about injury patterns using 'geographic information systems', which use geographical criteria to pinpoint locations, roads or regions in need of effective measures to achieve visible, short-term results.

The Spatial Diagnostics of Road Accidents project in Federal District, Mexico, helped gauge the magnitude and distribution of road traffic crashes in Mexico City, and to design interventions to prevent them. The project, coordinated and financed by the National Centre for Accident Prevention at the Mexican Ministry of Health, was developed in collaboration with scientists from the Geography Institute of the National Autonomous University of Mexico. It also utilized data from the National Institute for Statistics, Geography and Information, and the Federal District Ministry of Public Safety.

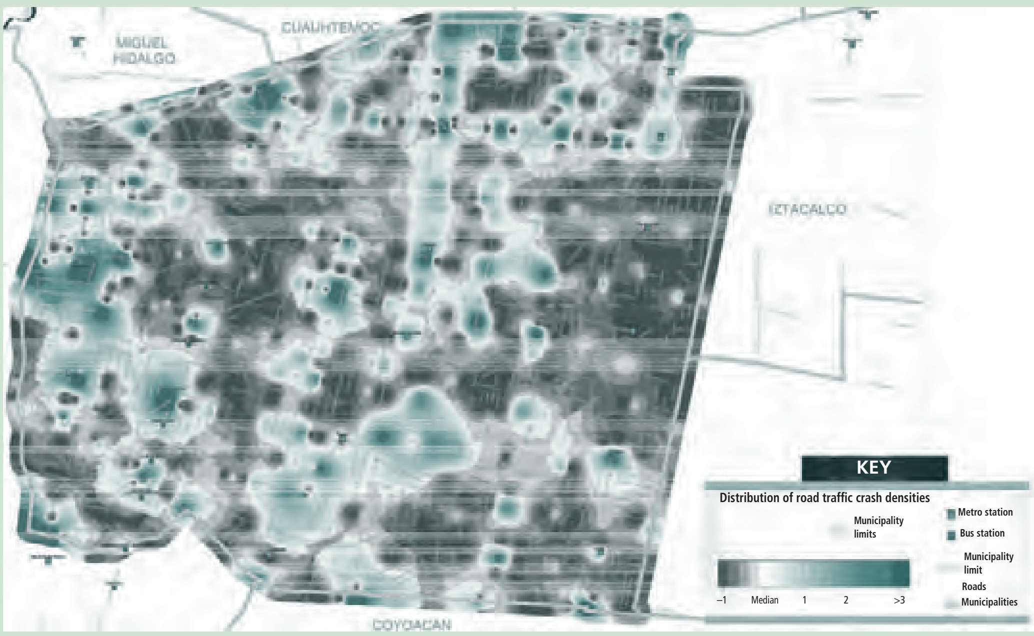
The first phase of the project identified public-sector institutions with road traffic injury data in Mexico City. The data were selected and processed to generate a relational database, structured to support a geographic information system.

The next phase involved the design and construction of mapping models showing the spatial concentration and dispersion of road crashes and their key characteristics, e.g. nature of crash, risk factors and socio-economic factors.

The data were processed using ArcGIS9 or ArcView 03 software. The most dangerous areas, corridors and intersections were identified using techniques such as *hot spots, hierarchical spatial clustering* and *road network analysis* (density and vicinity), making it possible to create a map of road crashes.

The data were integrated to create the *Spatial Diagnostics of Road Accidents in the Federal District,* which uses text, tables and maps, and includes conclusions and recommendations. The report is a useful tool for supporting situation analysis, investigation and epidemiological surveillance for road traffic injury prevention, though the data refer to one year only.

As a result of this project, an interactive geographic information system for the capture and geo-referencing of road traffic crashes has been developed. The system allows the user to enter data and update content in real time. Photographs may be uploaded showing current conditions at any given location. The sensitivity of the system is such that it can supply information at the street/intersection level, and in the case of roads, via map coordinates. Users can generate reports, thematic maps and graphics.



In summary, the transport sector needs data in order to:

- identify locations, time periods and road types or segments with high frequencies of different types of road traffic crashes, according to severity, and the environmental factors which may have contributed to them;
- determine the human factors that may have contributed to road traffic crashes and for which corrective measures should be applied;
- identify vehicles at relatively higher risk of involvement in crashes and vehicle-related technical/mechanical factors of the vehicles that contribute to the crashes;
- select appropriate treatments for high-risk locations and monitor the effects;
- plan and advocate for appropriate policies and legislation.

Health

The health sector's aim in relation to road traffic crashes is to prevent injuries, and where they occur, to minimize the severity of the injury and its consequences. Pre-hospital care, hospital emergency room and in-patient care, and physical and psychosocial rehabilitation are the responsibility of the health sector, although the latter may also be undertaken by the agency responsible for social services.

The health sector usually keeps data on most types of injuries, covering the whole spectrum of injury from exposure to death. Data on fatal road traffic injuries may be extracted from 'vital registration' data (derived from death certificates completed by medical doctors, which state the cause and underlying cause of death) or where these do not exist, from verbal autopsy surveys (*14*). Information on non-fatal road traffic injuries is kept in hospital in-patient records, trauma registries (see Case study 1.3), and may be collected by ambulance services or other emergency services. Some health agencies develop injury surveillance systems for ongoing and systematic collection, analysis, interpretation and dissemination of health information on injuries, and it is possible to extract road traffic injury data from these systems – for more information see (*5*). Minor injuries, which usually don't present to hospitals or health facilities, are the most difficult to quantify and these are usually captured through community-based surveys (*15*).

Information about the health services required for managing injuries, the cost of treating patients, and outcomes are collected either as an ongoing activity or through sample surveys. These data are particularly important to policy-makers as they can guide hospital staffing and doctor and nurse training, as well as the allocation of funds for hospital admissions and rehabilitation as a result of road traffic crashes.

In addition to basic epidemiological data on who was injured, when, where and why, the health sector or partners in academic institutions may undertake risk factor analysis for indicators such as helmet use or seat-belt wearing. This helps them better target health promotion or injury prevention interventions and messaging to the general public. The health sector and its partners also conduct research on prevention and management of injuries, including studies to evaluate the impact

CASE STUDY 1.3: **Injury surveillance system, Argentina**

In 2003, Argentina's Ministry of Health established the 'injury sentinel surveillance system'. The system gathers data on injuries presenting at hospital emergency departments (the 'sentinel sites'), using a standard data collection form completed by the doctor or nurse treating the injury. Data are transmitted electronically to the Ministry of Health.

Hospital participation is voluntary, and so the data cannot provide a complete national picture. However, participating hospitals are comparable with each other, and over time, data gathered by the system can offer a useful profile of injuries. The system can also be tailored to address local situations needing specific attention, and hospital staff can access the data and analysis, which are updated automatically.

An analysis of Argentina's non-fatal road traffic injuries was made using the sentinel system during 2007 and 2008. The system records data relating to sex, age, type of vehicle, helmet use, seat-belt use and blood alcohol levels. A total of 12 844 road traffic injuries were collected in 2007 in 33 'sentinel units', and in 2008 the total was 11 564 in 25 sentinel units. Young people were the most affected, and 67% were male. Motorcyclists and cyclists accounted for 70% of the injuries – only 5% of these were using a helmet. Fewer than 1% of the injured people used a seat-belt, and 11% had evidence of alcohol consumption.

To improve the quality and utilization of road safety data, the Ministry of Health will conduct a national workshop with relevant partners, including the Ministry of Health, the National Road Safety Agency and delegates from all provinces (epidemiology, health services and police). The workshop will focus on integration of vital statistics, hospital and police data for road traffic injury surveillance, and on using data captured by the existing sentinel surveillance system to plan road safety interventions. A new web-based information system integrating all information systems into one coherent system with common identifiers and definitions is being piloted and will be launched, along with a standard operations procedure manual, in this workshop.

The 2007 analysis has been published on the Ministry of Health website and shared with transport institutions and organizations working in road traffic injury prevention (see www.msal.gov.ar/htm/site/sala_situacion/boletin_BEP37_Completo.pdf).

of interventions. These data are useful to all sectors to advocate for more attention to be given to road safety, and to provide input into an evidence-based Safe System approach to road safety, which includes post-crash care.

In summary, the health sector requires data in order to:
- estimate the magnitude of fatal and non-fatal road traffic injuries;
- identify the risk factors involved so that health promotion programmes can target them;
- evaluate the effectiveness of injury management and treatment;
- ascertain current trends and the impact of prevention programmes;
- plan effectively for trauma care and rehabilitation services;
- plan and advocate for appropriate policies and legislation.

Other sectors

The insurance sector offers financial security against the costs of damages and medical treatment incurred either by, or levied against, clients involved in road crashes. Except where no-fault insurance is the practice, insurance companies must determine who is primarily responsible for the incident and therefore whose insurance is liable for covering the damages. The reality in many countries is that the insurance companies do not conduct independent investigations, but rely on the findings of police, which usually involves the purchase of a copy of the case file, or part of it. The information actively maintained by the insurance companies relates primarily to its clients – their age, sex, the type of vehicle, location of the crash and the damage to persons and property.

Insurance companies across a country may have fairly detailed and complete data on the number of crashes, especially numerous damage-only incidents, which they use to set premiums. The companies usually regard this data as commercially sensitive, however, and thus it is not typically widely available to other road safety stakeholders.

Summary

- Road safety is a critical public policy issue. Good data are needed to raise awareness about the magnitude of road traffic injuries and to convince policy-makers of the need for action.
- Effective road safety management requires data that users can rely on for accuracy, to define road safety problems, identify risks, formulate strategy and develop interventions, set targets and monitor performance.
- Data relevant to road safety are collected every day in most countries, but these data are not useful for informing road safety practice unless they are properly coded, processed and analysed in a computerized database system.
- Road crash data systems should process information in a way that allows for analysis at an aggregate level and facilitates data-driven action. At a minimum, good road crash data systems should:
  - capture nearly all crashes that result in death and a significant proportion of those that result in serious injuries;
  - provide adequate detail on the vehicle, the road user and the road/environment to assist with identification of causes, and selection of countermeasures;
  - include accurate crash location information;
  - provide reliable output in a timely manner to facilitate evidence-based decisions.
- Comprehensive assessment and monitoring of road safety performance requires mechanisms for data collection and analysis that cover not only road traffic deaths and injuries (final outcomes), but also exposure measures (e.g. traffic volume, number of licensed drivers), intermediate outcomes (e.g. seat-belt wearing rates), outputs (e.g. number of citations issued for traffic violations, population covered by seat-belt wearing campaign) and socio-economic costs associated with road traffic injuries.

- Various sectors require road safety related data for their daily functioning. Understanding the roles and data needs of each of the main sectors involved (law enforcement, transport, health) is helpful background information for conducting a situational assessment.

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2

How to conduct a situational assessment

Module 1 explained why good data systems are required for effective prevention of road traffic injuries and efficient targeting of resources. Module 2 provides users with guidance on how to assess what data and systems are currently available in their country, and where the gaps are. This information is important for choosing the appropriate course of action and for persuading political leaders to support the development, strengthening or adaptation of data systems. This will enable the true scale of road traffic injuries to be assessed, and countermeasures and strategies to be developed and evaluated.

The sections in this module are structured as follows:

- **2.1 Why do you need to assess the situation?** A thorough and well-planned assessment of the current data situation is a prerequisite for arguing the case for improved road safety data, and for informed decision-making about what action to take.
- **2.2 Steps for conducting a situational assessment:** This section provides guidance on identifying road safety data stakeholders; identifying data sources and systems and their characteristics; assessing data quality; identifying the needs of end-users; and identifying political factors that help or hinder the process.
- **2.3 Use the situational assessment to prioritize actions:** This section provides brief guidance on determining the next steps, with more detailed guidance provided in module 3.

2.1 Why do you need to assess the situation?

Before starting to improve or build road safety data systems, a well-planned and thorough situational assessment is necessary. It is often preferable to build on existing data systems rather than create something entirely new, so it is critical to have a solid understanding of what is already available, and the limitations thereof.

The main objectives of a situational assessment are to identify:

- people and agencies involved in the collection, processing and use of road safety data;
- data sources and systems already in place, and their strengths and limitations;
- the needs of end-users;
- political factors that will help or hinder the improvement of road safety data systems.

Information gained through the situation assessment is critical for arguing the case for improved road safety data, and for choosing the appropriate course of action (see section 2.3 and module 3).

2.2 Steps for conducting a situational assessment

This section sets out a series of steps designed to provide a thorough picture of the road safety data situation. These steps can be taken at national or local level. Situational assessments are often time-consuming and can be complex in large jurisdictions with many road safety stakeholders, so assistance from a consultant or academic institution may help the process.

The steps for conducting a situational assessment are:
- stakeholder analysis
- assessment of data sources and existing systems
- end-user needs assessment
- environmental analysis.

Module 1 summarized the main types of information required for monitoring road safety performance. They are:
- final outcomes (e.g. deaths and serious injury resulting from road traffic crashes);
- exposure measures (e.g. demographic data, information on vehicle fleet and traffic volume);
- intermediate outcomes (e.g. helmet-wearing rates, mean traffic speeds);
- socio-economic costs;
- institutional delivery output.

Where time and resources permit, a situational assessment should cover data sources, systems and end-user requirements relevant to each of these. However, such an undertaking is not always feasible. Many jurisdictions begin their quest to improve road safety data by focusing on final outcomes. In recognition of this, the guidance in this manual for situational assessment (this module) and follow-up actions (module 3) focuses on data related to final outcomes, and touches on exposure measures – these are useful aids for interpreting final outcome data. Guidance for assessing data related to intermediate outcomes can be found in other manuals in this series (helmets, drinking and driving, speed management, seat-belts and child restraints) and in the *SafetyNet manual on road safety performance indicators* (*1*).

The World Bank Global Road Safety Facility has recently published guidelines that outline detailed steps for assessing road safety management capacity. These guidelines contain a series of checklists and strategies that are complementary to the steps for situational assessment described in this manual (*2*).

2.2.1 Step one: stakeholder analysis

The *primary function* of a stakeholder analysis is to identify organizations and individuals who have an interest in the collection and/or use of road safety data, including potential partners and those who might initially oppose efforts to improve or implement a data system.

Stakeholders most involved with road safety data are the police, health authorities and transport bodies. Within these sectors, road safety is of particular relevance to:

- traffic police who enforce traffic legislation and investigate road traffic crashes;
- trauma specialists and other doctors who deal with those injured in road traffic crashes, and epidemiologists/public health specialists in injury prevention;
- transport and civil engineers who construct roads, and whose remit includes identifying and remedying road defects and errors in traffic patterns that contribute to road traffic crashes.

Other stakeholders may include representatives of the national statistics office, the insurance industry, non-governmental organizations working for road safety, academic institutions, international donor agencies that fund road building and maintenance initiatives, the automobile industry, and media and policy-makers who might utilize or facilitate better road safety data systems.

The *second function* of stakeholder analysis is to examine the roles and activities of all stakeholders. A careful analysis should be made of the influence and interests of all major stakeholders (e.g. their expectations in terms of benefits, changes and adverse outcomes), as this will help in designing appropriate ways to approach them. It is especially important to identify supporters and opponents, and, moreover, to appreciate the reasons for their respective positions, so as to be able to develop a solution that satisfies all concerned.

A *third function* of the stakeholder analysis is to decide how stakeholders should be involved in the process to ensure the best chance of success for the programme, in particular:

- the nature of their participation (e.g. as advisers or consultants, or as collaborating partners);
- the form of their participation (e.g. as a member of a working group or as an adviser);
- the mode of their participation (e.g. as an individual participant or as a representative of a group).

The results of the stakeholder analysis (see Box 2.1 for checklist) should give you a clear idea of who your potential partners and opponents are, possible conflicts of interest, and some of the challenges that might arise. You may wish to convene a working group now to ensure that stakeholders are engaged in a positive manner at an early stage. Be sure to include those involved in existing data collection mechanisms, whose daily work will be affected substantially by any changes. Building a good relationship with key stakeholders will facilitate other steps of the situational assessment (e.g. understanding the data and systems that each is working with, and identifying end-user data needs).

BOX 2.1: Checklist for stakeholder analysis

- Have you identified all stakeholders in the law enforcement, transport and health sectors?
- Have you identified other types of stakeholders (e.g. insurance industry, NGOs, academic institutions, automobile industry)?
- Have you identified the activities and roles of each stakeholder in relation to road safety data?
- Have you identified the stakeholders who will be key supporters or opponents?
- Have you convened a stakeholder meeting, including supporters and opponents, data collectors and data users?

2.2.2 Step two: assess data sources, systems and quality

When considering road crash data systems, it is important to know what information is already collected and by whom, how it is managed, and the coverage and quality of the information. Different institutions collect information about the same road traffic crash using various techniques, via interview and/or direct observation and measurement. There may already be mechanisms in place to aggregate these data within or across sectors. In most cases it is more efficient to build on an existing system than to create something new.

Rarely will one person, or even one agency, be able to answer all the questions raised by this step of the situational assessment, so a stakeholder working group may be needed.

Assess data sources

The first step is to identify what information on road traffic injuries is already collected (see Box 2.2). For each data source, you need to describe:

- what information or **variables** are collected (particularly specific location data, road user type and transport mode);
- the **format** of the data (is it hard-copy only or are there electronic records. How is it coded?);
- the **system** used to store the data (can range from a filing cabinet of paper reports to a complex electronic database) and to process the data (ranging from tallies done by hand to computerized analysis).

In many countries, police records constitute the main (and sometimes only) source of information on road traffic injuries. Start with an inventory of police data, next consider death certificate and medical examiner data, then move on to hospital data, BOX 2.2: **Data sources for fatal and non-fatal road traffic injuries**

Data sources for fatal road traffic injuries may include:
- death certificates or other means of vital registration
- police collision reports
- autopsy/pathology reports
- verbal autopsy studies
- insurance records
- media reports.

Data sources for non-fatal road traffic injuries may include:
- police collision reports
- accident and emergency department records
- trauma registries
- hospital in-patient records or discharge data
- ambulance records.

Other data sources may include:
- vehicle and driver insurance company records
- surveys and scientific studies.

and finally insurance data. Each of these sources has its own set of strengths and limitations (see Table 2.1).

If there is no systematic aggregation of existing routine data sources, then much more attention should be given to assessing the information available from surveys and scientific studies. While information from these sources is generally not detailed and reliable enough to form the basis of a road crash data system, it can be used to get a 'snapshot' of the road safety situation, or to help improve estimates from other sources, such as vital registration or police data. Road traffic injuries may be the primary topic of these surveys, or there may be questions related to road safety included in more general surveys. Sources may include recurring national surveys (e.g. national demographic and health surveys, national income and expenditure surveys), verbal autopsy studies, community-based surveys, or scientific studies on specific aspects of road safety (see Case study 2.1).

NOTE

If data collected through conventional methods are hard to find, then newspaper reports can be used to give you a rapid overview of the situation, as many severe crashes are published or appear on television. However, the information may be limited or biased. Nonetheless, assessing newspaper reports may provide an important opportunity for road safety practitioners to influence the accuracy and coverage of these reports in their country in order to better inform the public (*3*).

Table 2.1 Key sources of road traffic injury data

Source	Type of data	Observations
Police	Number of road traffic incidents, fatalities and injuries Road users involved Age and sex of casualties Vehicles involved Police assessment of causes of crashes Use of safety equipment (e.g. helmets) Location and sites of crashes Prosecutions	Level of detail varies from one country to another. Police records can be inaccessible. Under-reporting is a common problem. Precise location data (e.g. map coordinates) may not be available.
Health settings (hospital in-patient records, emergency room records, trauma registries, ambulance or emergency technician records, health clinic records, family doctor records)	Fatal and non-fatal injuries Age and sex of casualties Costs of treatment Alcohol or drug use	Level of detail varies from one hospital to another. Cause of injury may not be properly coded, making it difficult to extract road traffic injury data for analysis. Difficult to define catchment population.
Vital registration	Fatal injuries Age and sex of casualties Type of road users involved	Cause of death may not be properly coded, making it difficult to extract road traffic injury data for analysis. Population coverage may be poor.
Insurance firms	Fatal and non-fatal injuries Damage to vehicles Costs of claims	Frequently regarded as commercially sensitive, so access to these data may be limited.
Other private and public institutions, including transport companies	Number of fatal and non-fatal injuries occurring among employees Damage and losses Insurance claims Legal issues Operational data	These data may be specific to the planning and operation of the firms.
Government departments and specialized agencies collecting data for national planning and development	Population estimates Income and expenditure data Health indicators Exposure data Pollution data Energy consumption Literacy levels	These data are complementary and important for analysis of road traffic injuries. The data are collected by different ministries and organizations, though there may be one central agency that compiles and produces reports, such as statistical abstracts, economic surveys and development plans.
Special interest groups (research institutes, advocacy nongovernmental organizations, victim support organizations, transport unions, consulting firms, institutions involved in road safety activities, and others)	Number of road traffic incidents, fatal and non-fatal injuries The type of road users involved Age and sex of casualties Vehicles involved Causes Location and sites of crashes Social and psychological impacts Risk factors Interventions	The various organizations have different interests. Data collection and research methods may not be sound.

Source: Based on (*4*)

CASE STUDY 2.1: Road traffic injury data from surveys, Mozambique, Cambodia, Uganda and India

Community surveys

A community survey* was conducted in Uganda to describe and contrast injury patterns in urban and rural areas. Community health workers used a standardized questionnaire (*5*) to interview adult respondents representing households selected through a sampling procedure. About 1 600 households were surveyed in one rural district, and about 2 300 in one of the five divisions of Kampala.

Fatal injury rates were extremely high in both areas: 92 deaths per 100 000 people in the rural district and 217 per 100 000 in the urban district. Road crashes were the second leading cause of fatal injury (18%) and the leading cause of disabling injury (35%) in the rural district. In the urban district, road crashes were the leading cause of fatal injury (46%) and (along with burns) of non-fatal injury, accounting for 39% of disabling injury. Road crashes were the most important cause of severe injury in all age groups beyond 20 years (*6*).

Injury questions in population-based surveys on other topics

A 15-question section on injuries and violence was included in the *Mozambique Demographic and Health Survey 2003*. The section contained questions on fatal and non-fatal injuries, associated disability and health seeking patterns of injured patients. The result showed that road traffic injuries were the leading cause of injury-related deaths in the country. Around 12% of the population also reported that someone in the household had suffered a road traffic injury in the 30 days before the survey. The survey demonstrated that road traffic injuries are a serious public health issue, accounting for 42% of injury-related deaths among males and 24% among females (*7*).

In 2005 a series of questions about general injuries was included in the *Cambodia Demographic and Health Survey*. The results showed that road traffic crashes were the leading cause of injuries (46%) and injury-related deaths in the previous 12 months. The survey also captured data on gender, age, place of residence, province in which the road traffic injury was sustained, and physical impairment resulting from road traffic crashes (*8*).

Verbal autopsy studies

Verbal autopsy is an interview carried out with the deceased's family members and/or caregivers, using a structured questionnaire to elicit signs and symptoms and other pertinent information that can later be used to assign a probable underlying cause of death (*9*). Verbal autopsy has become the primary source of information on causes of death in populations lacking vital registration and medical certification (*10*).

Verbal autopsy was used to collect mortality data for residents of 45 villages in the state of Andhra Pradesh, India, where routine vital registration is not kept (*11*). Results showed that injury was the second leading cause of death for all age groups – accounting for 13% of all deaths – and that 13% of all injury-related deaths were due to road traffic crashes.

*A community survey is a population-based study where a cross-section of a population is surveyed by, for example, a questionnaire. For more information on how to develop and conduct a community survey, see the *WHO Guidelines for conducting community surveys on injuries and violence*, or download a copy from http://whqlibdoc.who.int/publications/2004/9241546484.pdf.

Assess data systems

If there are electronic systems for processing police records, injury surveillance or hospital data and vital registration information, the next step is to describe the characteristics of those systems, beginning with national-level systems. This can be done through a preliminary assessment, or through the type of in-depth evaluation described in Module 3.

The objective is to understand:

- the jurisdiction of the system
- the processes by which data move through the system
- the system's strengths and weaknesses
- the accessibility of the data.

NOTE

Access to data is often problematic, as agencies that collect data may be reluctant to release information because of privacy concerns, fear of compromising clients' interests, fear of loss of control or fear that their performance will be judged if they share data. Formal and informal mechanisms for communication should be explored. The latter may be achieved through moral persuasion, compromise and stakeholder involvement. For the former, legal instruments and infrastructure may have been established to facilitate sharing of information while addressing the concerns of contributing agencies. Understanding access issues pertaining is key for identifying the action steps that follow the situational assessment.

Better understanding of these systems and their functionality can be gained by identifying reporting requirements for both police and health workers (who are responsible for follow-up with victims after the crash), and discussions with data collectors, data managers and data users about the strengths and limitations of road safety data systems. Box 2.3 contains a checklist for determining the characteristics of existing data systems.

BOX 2.3: **Checklist to assess data systems**

For each data system you need to determine:

- What population or geographical area (jurisdiction) is covered?
- Does it provide a census of incidents among a whole population, or does it include data from a sample of the population only?
- Are there estimates of population coverage/completeness?
- What events are captured (i.e. fatalities, non-fatal injuries, damage-only crashes)?
- What definitions are used?
- Which variables are included?
- How are data transferred from the crash scene to the database (including reporting requirements)?
- What are the existing and potential linkages with other databases?
- What are the formal/informal data-sharing mechanisms with other agencies/ sectors?
- What format are data stored in (as case-level records, tabulations provided to customized specifications, or only as pre-tabulated results)?
- How accessible are the data?
- Who are the responsible agencies and key contacts?
- What are the funding mechanisms?

Assess data quality

The output of road safety data systems will be used to define road safety interventions and policies, and to determine resource allocation. It is therefore important to understand the quality data going into the system.

Data quality is affected by the data collection and management process (*12*). Factors that can compromise quality include:

- **definitions** that determine which events are included/excluded from the system, and how injuries and crashes are classified;
- **reporting/under-reporting of crashes or injuries to and by authorities** – this affects the accuracy of counts, and therefore the degree to which the statistical output of a data system reflects the reality on the roads;
- **missing data** – if data are missing systematically for certain fields or types of crash, data analysis becomes problematic;
- **errors** – measurement and response errors, data recording, coding and entry errors affect the accuracy and reliability of data.

These issues must be assessed for all data sources identified.

Along with assessments of definitions and under-reporting levels (see discussion below), Box 2.4 contains a checklist of questions to assess the degree to which the each data source is representative of all incidents, and to assess the reliability of recorded data.

BOX 2.4: **Checklist to assess data quality**

How reliable and representative are the data?

- Does the system capture all crashes (or injuries if that is the defining criteria)?
- If not, what kind of bias is created by the exclusion of some events?
- How does that affect utilization of the data?
- For the events captured, are the data complete and accurate? What validation procedures are in place?
- What is the frequency with which missing data occurs?
- Are data systematically missing for certain variables or certain types of crashes – i.e. is there a bias in what does and does not get recorded?

Various statistical techniques are available to help answer these questions, see (*12*).

How data quality is affected by definitions

Definitions affect data quality by determining which incidents are counted as road crashes, and by determining injury and crash severity classifications. Standard definitions of road traffic crashes and fatal and non-fatal road traffic injuries are not universally applied. This has implications for the international comparability of road safety data. Furthermore, when jurisdictions and sectors or agencies within a country do not use the same definitions, it is difficult to compile road safety data that is useful for planning.

Some definitions of *road traffic crashes* exclude non-motorized vehicles, and crashes that occur on private roadways such as on farms, driveways or unsurfaced roads. Such exclusions may result in artificially low estimates of crashes and injuries in low- and middle-income countries, where animal-drawn and non-motorized transport is the norm, and a substantial portion of traffic is not on surfaced roadways.

NOTE

The recommended definition of road traffic crash/accident is "a collision or incident involving at least one road vehicle in motion, on a public road or private road to which the public has right of access".

According to the *UNECE Glossary for Transport Statistics 2009,* 'road vehicle' includes both motorized and non-motorized vehicles running or drawn on wheels, and the definition of 'road' includes unpaved roads with stabilized bases, such as gravel roads *(13).* Note that some countries have started to collect information on road traffic crashes regardless of the event location, and therefore include incidents that occur off roadways, for example on private farm roads. Jurisdictions may wish to consider this as they choose or refine definitions.

The classification of the *severity* of injuries and crashes is also subject to inconsistent definitions. *Injury severity* refers to the extent of physical damage sustained by the injured person as a result of the crash. The range of injury severity categories that may be used by health professionals or police officers includes slight/minor, moderate, serious/severe, and fatal. Definitions of these categories vary among countries and sectors.

The scientific classifications health workers use to distinguish between these categories may not be easily understood or applied by police officers, who are called upon to determine road traffic injury severity without clinical training or knowledge of trauma care practice. Injury severity can also change over time, for example internal injuries not apparent at the crash scene can become a life-threatening emergency on the way to hospital. While there is no single internationally accepted classification of injury severity, there is international consensus on the definition of a road traffic fatality.

NOTE

The recommended definition of a road traffic fatality is "any person killed immediately or dying within 30 days as a result of a road traffic injury accident, excluding suicides" (*13, 14*)**.**

Research has shown that most people who die as a result of a road crash do so within 30 days of sustaining injuries in the crash. If only deaths at the scene or within seven days are counted, a significant proportion of all road traffic deaths is overlooked (*14*). Countries should take steps towards adopting this definition, or at least adjust reported road traffic fatalities to a 30-day definition using relevant conversion techniques (see *15* and Box 2.5). The legal requirement of the 30-day definition is that the injury severity level, and possibly the crash severity level, must be updated to fatal if an injured person dies from his injuries within 30 days. Operationally, this requires follow-up by a dedicated police officer or arrangements for regular notification from the hospital or the community.

Crash severity is determined by the most severe injury resulting from a crash, requiring police officers to make judgments about injury severity. Figure 2.1 shows the relationship between injury severity and crash severity.

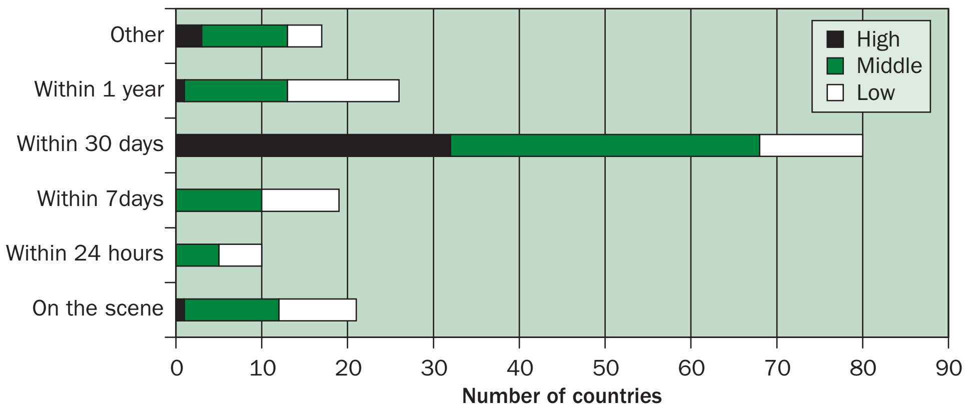
It is important to address the following questions when assessing the impact of definitions on data quality:

- What events are excluded by the definition of a road traffic crash, and what kind of bias does this create? Has anyone estimated the number of crashes that are excluded from the data because of definition?

BOX 2.5: **Definitions and adjustment factors for road traffic fatalities**

WHO's *Global status report on road safety* found that less than half of the 178 countries and areas participating in the report use the recommended definition of a road traffic fatality – the '30-day' definition – for their official statistics (*14*).

Time period used to define a road traffic fatality, by country/area income level



Source: (*14*)

When a road fatality is not defined as someone who has 'died within 30 days of the crash', the reported number of fatalities can be made more accurate by multiplying the reported number by the appropriate adjustment factor, depending on the definition used. The European Conference of Ministers of Transport has recommended the following standardized 30-day road crash fatality adjustment factors (*14*):

Time period specified in road fatality definition	30-day total	Adjustment factor
At the scene or within 24 hours	77%	1.30
3 days	87%	1.15
6 days	92%	1.09
7 days	93%	1.08
30 days	100%	1.00
365 days	103%	0.97

These adjustment factors may not always be appropriate. Survival times following road crashes depend on many factors, including the type of road user and access to (and quality of) post-crash care (*15, 16, 17*). For instance, in countries where vulnerable road users comprise a high proportion of road traffic deaths, and/or post-crash care is scarce or of poor quality, a larger proportion of road fatalities will die at the scene or within 24 hours of the crash. To address this issue, an adjustment factor of 1.15 (rather than 1.30) is sometimes used to adjust data from low- and middle-income countries that use a definition of 'at the scene' or 'within 24 hours' (*15*). Though determining the appropriate adjustment factor can be complicated and requires careful consideration, guidance is available from researchers, institutions and published reports (see *14, 15, 16*).

Figure 2.1 **Injury severity and crash severity: definitions and relationships**

Injury Severity	Crash Severity
Fatal Person killed immediately or dies within 30 days as a result of a road traffic injury accident	**Fatal** Any road traffic crash resulting in a person killed immediately or dying within 30 days as a result of the crash
Serious/severe Injury that requires admission to hospital for at least 24 hours, or specialist attention, such as fractures, concussions, severe shock and severe lacerations	**Serious/severe** Any road traffic crash resulting in at least one serious injury, and no fatalities
Slight/minor Injury that requires little or no medical attention (e.g. sprains, bruises, superficial cuts and scratches)	**Slight/minor** Any road traffic crash resulting in at least one minor injury, and no serious injuries or fatalities
No injury	**Damage-only** Any road traffic crash which does not result in any injuries

- Are police required to judge injury severity? Is this done at the crash scene only, or through follow-up with the victim and health services? Are the definitions for injury severity straightforward enough for police officers to understand and apply? Do police receive training to determine injury severity? Have comparisons been made with hospital data to evaluate the accuracy of police-reported injury severity?
- Are definitions used by various sectors harmonized? Are there opportunities to harmonize?

How data quality is affected by under-reporting

Under-reporting refers to the situation where not all crashes and injuries that occur are documented in the data system. It has long been recognized that a problem exists with under-reporting of road crashes, particularly those that result in slight injury or are property-damage only (*12, 18, 19*). Under-reporting affects the degree to which the statistical output of a data system reflects reality on the roads. The level of under-reporting in a road safety data system should be evaluated so that appropriate adjustments can be made to ensure more accurate estimates are available to inform policy development and resource allocation.

Where it has been studied, the degree of under-reporting varies according to crash severity, transport mode, road user type, victim age and place of crash (see Case study 2.2

and also (*12, 20*). Reporting rates are generally highest for road traffic fatalities, and become less representative with decreasing severity (*12, 21*).

A review of international road crash data by the International Road Traffic and Accident Database (IRTAD) Group identified several factors contributing to **under-reporting in police data** (*21*):

- **The police may not be informed when a crash occurs.** This is particularly likely if the persons involved are unaware of any obligation to report the incident to the police, or if there are no injuries or only minor injuries. If there are no reporting

CASE STUDY 2.2: **Estimates of under-reporting in Pakistan, Viet Nam, New Zealand and Europe**

Research on under-reporting of road traffic injuries has grown steadily in recent decades, yielding useful estimates and insights from a variety of countries.

A study in Pakistan using the capture-recapture methodology to compare traffic police records and a non-government ambulance service's logs estimated that official statistics counted only 56% of road traffic deaths and 4% of serious injuries (*22*).

In Thai Nguyen City, Viet Nam, traffic police records were compared to hospital records for the period 2000-2004 using the capture-recapture methodology. Results estimated that official statistics include only 22% to 60% of all non-fatal road traffic injuries (*23*).

Under-reporting is not only an important issue for low-income countries. While many high-income countries estimate reporting rates for road traffic fatalities to be greater than 90%, research has shown that non-fatal injuries are significantly under-reported even in countries with 'state-of-the-art' road crash data systems.

A New Zealand study compared police reports with hospital discharge records to determine the validity of police-reported information on the severity of non-fatal road traffic injuries (*24*). The study found that overestimation and underestimation of injury severity by police were both common: less than half (48%) of injuries classified as 'serious' in police records were similarly classified by an objective standard using the hospital records, while 15% of those classified as 'minor' injury in policy records were actually judged to have an injury with a significant threat to life. Pedestrians were more likely to have the severity of their injuries underestimated compared to vehicle occupants.

Extensive research on many aspects of road safety data were conducted as part of *SafetyNet,* a project funded by DG-TREN of the European Commission. *SafetyNet* ran from 2003 to 2008 with the goal of building a framework for a European Road Safety Observatory (see www.erso.eu/safetynet/content/safetynet.htm). One *SafetyNet* study compared and linked police and hospital road crash records in eight European countries with the aim of estimating the under-reporting level of fatal and non-fatal road traffic injuries, and developing a common measurement unit to estimate and compare non-fatal injuries more accurately (*25*).

Results comparing national data in the Netherlands found that the police reporting rate for hospitalized casualties (as classified by police) was about 62%. In the Rhône, France, the police reporting rate for non-fatal road traffic injuries was found to be 38%. The reporting rate varied according to injury severity, generally increasing as severity rose.

Results from the Czech Republic study (conducted in one town only), found that police data were more reliable than hospital data. Hospital statistics were found to focus more on medical aspects of the injuries, rather than documentation of circumstances of the crash that caused them. Police data captured 66% of all road traffic injury records, while hospital data captured only 50%. Police data reporting rates were 90% for car occupants, 86% for motorcyclists, 61% for pedestrians, and 32% for pedal cyclists – higher than hospital data reporting rates for all categories except pedal cyclists (*25*).

agreements in place, police may not be informed when only emergency services are called to the crash scene.
- **The police do not always go to the scene** when a crash is reported. Their availability depends on competing priorities and proximity.
- **The police may go to the crash scene, but not formally register the crash**. This may happen if the crash is minor and the persons involved agree to coordinate follow-up themselves, if no injuries are apparent at the time of the crash, or if administrative procedures are too burdensome.
- **Formal registration does not ensure complete data collection**. Due to lack of training, expertise, interest or time, the attending officer may not record all relevant details of the crash, or may record incorrect information (for example, injury severity may be incorrectly classified).
- **Crash data recorded at the scene do not always get entered into the crash database**, and sometimes errors are introduced during data entry.
- **Data may be lost in the process of transfer** from a decentralized location to a central location, where data processing and collation occur.

Vital statistics refer to summary measures of events such as births, deaths and marriages, and are derived from vital registrations systems that record such events through legal certificates or other, informal means. Whatever the mechanisms for registering vital events, production of vital statistics is often the responsibility of the national statistical office, with technical support from the Ministry of Health *(26)*. Cause-of-death statistics – a subset of vital statistics – are usually compiled by assigning codes to causes of death according to the *International Classification of Diseases (ICD)* (*27*). These statistics can be an important source for estimating the magnitude of road traffic fatalities by sex, age and geographic or administrative area.

However, **reporting rates of road traffic deaths in vital statistics** are influenced by factors such as (*28*):
- **coverage** – percentage of general population covered by medical certification of cause of death;
- **completeness** – percentage of all deaths assigned a medically certified cause of death;
- **missing data** on death certificates;
- **misclassification** of cause of death – doctors must be sufficiently trained to record and code correctly the underlying cause of death;
- **inadequate coding** – the external cause of the injury must be properly recorded to distinguish road traffic injuries as a cause of death. Coding deficiencies may arise from lack of training, use of older versions of ICD, or use of non-standard cause-of-death codes.

Currently about 40% of WHO Member States report vital registration data coded with sufficient sensitivity to use for monitoring road traffic deaths, and very few countries have national data on non-fatal injuries (*14*). For more information on assessing the strengths and weaknesses of the vital registration system, see (*28, 29*).

NOTE

The *International Classification of Diseases* does not specify any time period for classification of road traffic deaths. This means that vital statistics for a given year may over-count road traffic deaths compared to police statistics, since they include deaths occurring beyond the 30-day window after the crash.

Health facility level (e.g. hospital) data on road traffic injuries may also under-report road traffic injuries, although many studies have found that health data are more complete than police crash databases (*19, 25*). Like cause-of-death statistics, health facility statistics should be compiled by assigning codes to diseases and conditions according to the *International Classification of Diseases* (*27*). Table 2.2 presents the external cause-of-injury codes relating to road traffic crashes. Health records however may only record information on the nature of the injury (e.g. fractured femur) and not its external cause, therefore making it impossible to know if the injury was road crash-related.

Table 2.2 **International Classification of Disease version 10 — external cause codes for road traffic injuries**

Transport accidents*	
V01-V09	Pedestrian injured in transport accident
V10-V19	Pedal cyclist injured in transport accident
V20-V29	Motorcycle rider injured in transport accident
V30-V39	Occupant of three-wheeled motor vehicle injured in transport accident
V40-V49	Car occupant injured in transport accident
V50-V59	Occupant of pick-up truck or van injured in transport accident
V60-V69	Occupant of heavy transport vehicle injured in transport accident
V70-V79	Bus occupant injured in transport accident
V80-V89	Other land transport accidents
V90-V94	Water transport accidents
V95-V97	Air and space transport accidents
V98-V99	Other and unspecified transport accidents

*Note: the term 'accident' is still used in the current version of ICD, as opposed to 'crash'.

Source: *(27)*

Factors affecting **under-reporting of road traffic injuries in health facility data** include:

- people with minor injuries not seeking formal medical care;
- poor access to health facilities;
- injuries treated at private hospitals remaining unrecorded, as non-government hospitals may not participate in surveillance activities or be required to record injury data;
- the cause of the injury not being apparent or disclosed by the patient;
- lack of training, expertise, interest or time on the part of health workers, who may not record all relevant details of the injury;
- data being incorrectly coded by the health worker, or by the person responsible for data extraction or data entry.

For more information on assessing the strengths and weaknesses of health facility-based information, see (*29, 30*).

Information gained on data sources, systems and procedures in the preceding steps should provide insight into some of these under-reporting issues. For example, you should know by now whether the death certificates and hospital records are coded properly, and you should have an understanding of the procedures involved in formal registration of a crash report by police officers. The next step is to determine whether or not under-reporting levels have been estimated for any existing crash databases. If this has not been done in the previous five years, under-reporting should be estimated as part of the situational assessment (see Box 2.6 for methods to assess under-reporting).

BOX 2.6: **Methods for assessing under-reporting** (see *12, 21, 25*)

The factors that affect under-reporting change with time, as police and health sector practices evolve. Under-reporting levels should therefore be assessed regularly. A variety of methods is available to assess under-reporting, with varying degrees of complexity and accuracy:

- Compare the number of police reports filed on certain events to those captured in the database, to assess the proportion of attended crashes that are captured in the system.
- Compare the number of road traffic fatalities and/or injuries counted by one data source, usually the police database, to those counted in a survey. It may be a special road traffic injury survey, or a general survey that includes questions on road traffic injury. It is important to make the comparison for different severity levels, as well as by transport mode and road user type if possible.
- Compare the number of road traffic fatalities and/or injuries counted in the police database to the number counted in other databases – cause-of-death statistics, hospital admissions, accident and emergency records, trauma registries. It is important to make the comparison for different severity levels, as well as by transport mode and road user type if possible. When comparing police and hospital data at a local or regional level, it is important to consider the geographic area covered by each, and any overlap in records.
- Use linkage or capture-recapture methods to match records from different databases and identify the proportion of road traffic injuries appearing in one or both databases. Capture-recapture methods can also be used to estimate the number of records missing altogether – i.e. the number of incidents that are not captured in either database (*22, 23, 25*).

Assess exposure data

Information on the following factors is important for understanding road safety and developing effective interventions in any jurisdiction:

- road layout, design and environment
- traffic flows and characteristics
- vehicle fleet
- driver information.

These factors are most often monitored by the transport sector and usually not captured in police data systems. Table 2.3 presents the basic elements of transport data that should be collected regularly and made available for road safety management, and therefore should be considered in the situational assessment. Vehicle and driver data are most often collected and kept in central registry systems. Roadway data may be collected through road safety audits or other infrastructure

Table 2.3 Transport-related data elements

Roadway data	Traffic data	Vehicle data	Driver data
• Number, class and length of road • Road type, by number of lanes, median width • Number of lanes and lane width • Crossing type, intersection design • Type of traffic control (signals, roundabouts, stop or give way) • Alignment (horizontal and vertical curvature, grade, etc.) • Road surface (bitumen, concrete, unsurfaced) • Surface condition (roughness, rutting, potholes) • Shoulders: width, type and condition • Drainage • Speed limits • Lighting by type and location • Parking regulations	• Location data (*x,y* coordinates, route number and nearest km post or a node-link system) • Traffic volumes as vehicles per day, or short specific counts at given locations • Traffic composition by types of vehicles in the traffic mix • Traffic variation (as required by time of day, day of week, month or annually) • Turning movements at junctions • Vehicle speed data	• Details of ownership: date of birth, sex, name, address, year of ownership • Vehicle registration number together with chassis and engine number • Engine size and type, i.e. petrol or diesel • Seating capacity • Year of manufacture and year of first registration in country • Body type (car, van, pick up etc), number of doors, together with details of modifications • Roadworthiness certificate	• Full name and address • DOB, sex • Type of licence held, i.e. full or provisional, and type of vehicle for which licence is valid. • Year and place of issue • Year driving test was passed • Record of offences committed • Record of driving suspensions • Essential medical information

monitoring mechanisms. Traffic data may be collected through a national traffic census, automatic traffic counters, manual traffic counts and specialized surveys.

Exposure-related data such as passenger travel modes, vehicle-kilometres travelled, passenger-kilometres travelled, and results of origin-destination surveys, can be highly valuable for analysis and interpretation of the road safety situation. The situational assessment should consider their existence, but keep in mind that these data are rarely simple to collect and even many high-income countries are not able to provide them.

2.2.3 Step three: end-user needs assessment

It is important to conduct an end-user needs assessment when setting up and expanding a road safety information system, as this will enhance the usability of the system by the road safety community.

Why conduct an end-user needs assessment?

There are many users and suppliers of road safety information. A user needs assessment is important to (*31*):

- understand better the composition and diversity of users;
- understand better the kind of information intended users want or expect from an information system;
- determine financial and human resources required, and request or mobilize these resources from relevant sources;
- make better use of available financial and human resources;
- design a user-centred information system that adequately meets the needs of intended users.

What to assess

A road safety end-user needs assessment should reveal:

- who the users are – the stakeholder analysis should help you identify this group;
- circumstances or situations that lead them to require road safety information;
- the type of information different users require and expect from an information system;
- sources of information the users currently use;
- preferred format in which users would like to access information;
- factors that affect or determine their access to, and use of, road safety information.

How to gather information about user needs

Information about user needs can be gathered from potential users through:

- surveys
- in-depth interviews
- focus group discussions

- observation of user behaviour
- analysis of requests for information to libraries and agencies
- library reports
- a working group or committee review.

2.2.4 Step four: environmental analysis

Road safety is often the responsibility of the highway or transport authority or ministry, or a national road safety council. These bodies may be responsible for monitoring safety on the road network and improving safety through measures such as hazardous location improvements and safety audits. When these bodies initiate changes to a road crash data system, it is vitally important that they collaborate with the police. Crash data collection is primarily the responsibility of the police, who have responsibilities and priorities that compete with the need to collect information. Without dialogue and collaboration between the generators/collectors of road safety data and the end-users of that data, it is unlikely that improvements to the road crash data system will succeed.

The political environment may help or hinder improvements to road safety data and determine how improvements are made. The checklist in Box 2.7 will help provide an overall picture of the political situation. The World Bank Global Road Safety Facility guidelines contain a variety of tools that can be used to help answer the questions in this checklist (*2*).

BOX 2.7: **Checklist for overview of political environment**

- Is there a lead agency responsible for road safety? What is it and what is its main function?
- Which are the main government departments involved in road safety decision-making, and what role does each department play?
- What is the nature of inter-agency relationships?
- Is there a road safety strategy, and does it include a data component?
- What is the current budget for road safety in the country? Are there priorities in the budget for improvements in the field of road safety? Are there funds that might be accessed for road safety data systems?
- What are the existing policies in transport, law enforcement, health and finance that are relevant to road safety? Do they have data components?
- Which factors in the political environment will drive change, and which will oppose it?
- Is there adequate capacity for implementation/improvement of data collection, data processing, data analysis, and dissemination and use of data?

Financial requirements and possible funding sources

Without secure and consistent funding, no serious measures can be introduced to improve road safety in any country. Interventions in many countries have failed due to a lack of sustainable funding, including the introduction of improved data systems. It is therefore critical to identify possible funding sources for road safety data systems. Possible sources of funding include the following:

- General taxation to support public sector agencies, including the police, transport ministry etc. This therefore must be seen as the main source of funding for data collection, storage, analysis and dissemination activities.
- Specific taxes, including traffic fines, earmarked to support spending on road safety. In this way, additional funds can be raised to support police activities. This approach is relatively uncommon and only worth pursuing if earmarked fines can be clearly shown to generate extra income.
- Levies added to insurance premiums, which must be acceptable to both the insurance companies and the public. While useful, this approach is much less effective in countries where many vehicles are uninsured. In South Africa, this is avoided by applying third party insurance premiums through a fuel levy.
- Road funds which derive their income from road user charges, including a levy on fuel, vehicle registration fees, vehicle licence fees and on road user charges such as tolls. These funds can then be used to support specific road safety activities.
- Sponsorship from private companies, with funds used to support activities such as publicity campaigns or police activities – e.g. by donating funds to purchase specialist police vehicles. Funds used in this way can help police reach road crash scenes more efficiently. In all countries, the private sector should be encouraged to support road safety interventions, and police activities can be singled out as worthy of support.
- Funds from international donor governments or development agencies.

Funds provided by governments should constitute the main source of revenue for all road safety activities, including data collection and analysis. Rarely are government funds adequate, however, and some of the approaches outlined above may be necessary to boost them.

2.3 Using the situational assessment to prioritize actions

Once the situation has been assessed, the process of prioritizing actions can begin. The results of the situational assessment should give you a clear understanding of the stakeholders involved, including potential partners and potential opponents; the content, processes and quality of existing data sources and systems; what data are needed by end-users; and the political environment and resource availability. This will help you understand what is currently in place, what is needed, where the gaps are, and the level of interest in and commitment to addressing those gaps.

Although there is emerging consensus regarding some aspects of good practice in road safety data (e.g. definitions, some elements of a minimum data set), this consensus does not extend to processes. There are many different ways to build or improve a road crash data system, and what works well in one jurisdiction does not necessarily work well in another. You will need to consider the results of the situational assessment against the situation of your country and jurisdiction, and choose an appropriate course of action with your stakeholders. This should be done in the context of the working group described in Module 3.

Data systems that can accurately count injuries and fatalities, and provide information adequate for identifying road users at risk and hazardous locations, require investment funds, human resources and time. It may be years before this kind of system can be realized in some low- and middle-income countries. This does not mean, however, that such a system should be ignored. If it appears that the timeline for implementing a proper road crash data system will be long, intermediate measures should be adopted to strengthen existing national estimates of the scale of the problem to guide prioritization and road safety planning.

In some situations it will become apparent from the situational assessment that there are bits and pieces of data available, but no effective system, and yet political and/or financial support to implement a good road crash data system may be insufficient. In that case, consider working with existing data to improve estimates, for the purpose of raising awareness about the problem and increasing political will for data-led solutions. At the same time, convene a working group (see Module 3) and begin to lay the groundwork for a proper data system. Piecing data sources together to give a better picture of the problem is not a long-term solution.

To convince policy-makers of the need for greater investment in road safety data systems, you must find ways to show shortcomings of existing data systems. The methods used to assess under-reporting discussed in section 2.2 can be useful for this purpose, as are the results of the overall data quality audit. It may also be helpful to use various methods to combine multiple data sources to strengthen national estimates (see Box 2.8 for an example of how this can be done).

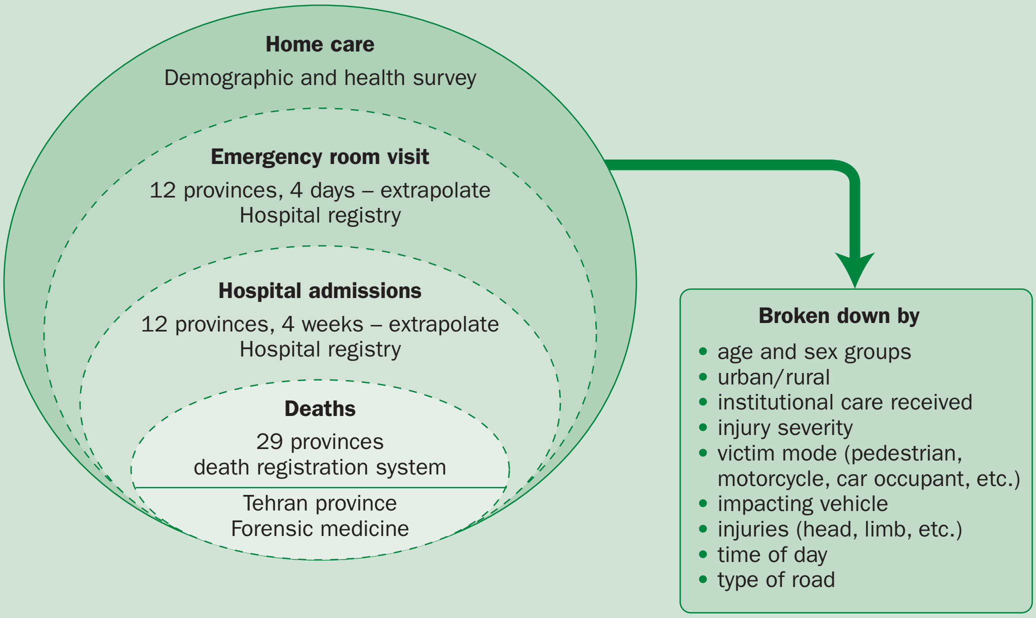
BOX 2.8: **Building national estimates from available data sources**

Road safety practitioners argue that effective road safety management over the long-term requires institutionalized, sustainable data systems covering the issues listed in Module 1. Some researchers believe that it could be decades before many low- and middle-income countries develop road safety data systems of sufficient quality to meet the requirements. Few countries, however, can afford to wait until these systems are functioning smoothly to take action. In the meantime, there is an urgent need for accurate national estimates to facilitate appropriate planning and resource allocation.

Researchers at the Harvard School of Public Health, in collaboration with the World Bank Global Road Safety Facility, have developed a methodology for collating multiple data sources and extrapolating information to generate national estimates of the burden of road traffic injuries. This methodology has been used in 18 low- and middle-income countries. The methods are now being extended for application in sub-Saharan Africa and other settings that are particularly information-poor. (For more information about methods and examples, visit www.globalburdenofinjuries.org).

The figure below shows the data sources used to estimate the burden of road traffic injuries in Iran (2005): vital registration data, forensic medicine data (Tehran province), hospital discharge data and emergency department data for 12 provinces, and the nationally representative Demographic and Health Survey *(32)*.

Sources of data on deaths and non-fatal cases in Iran



Source: *(32)*

Results estimate that in 2005, road traffic crashes resulted in 30 721 deaths in Iran (compared to official police statistics that report 4 441 deaths for the same year), amounting to an annual road traffic death rate of 44 per 100 000 people. About half (52%) of all deaths among males aged 15 to 24 years were due to road traffic crashes. In addition to these deaths, approximately 740 000 people received hospital care (inpatient or outpatient) for a road traffic injury.

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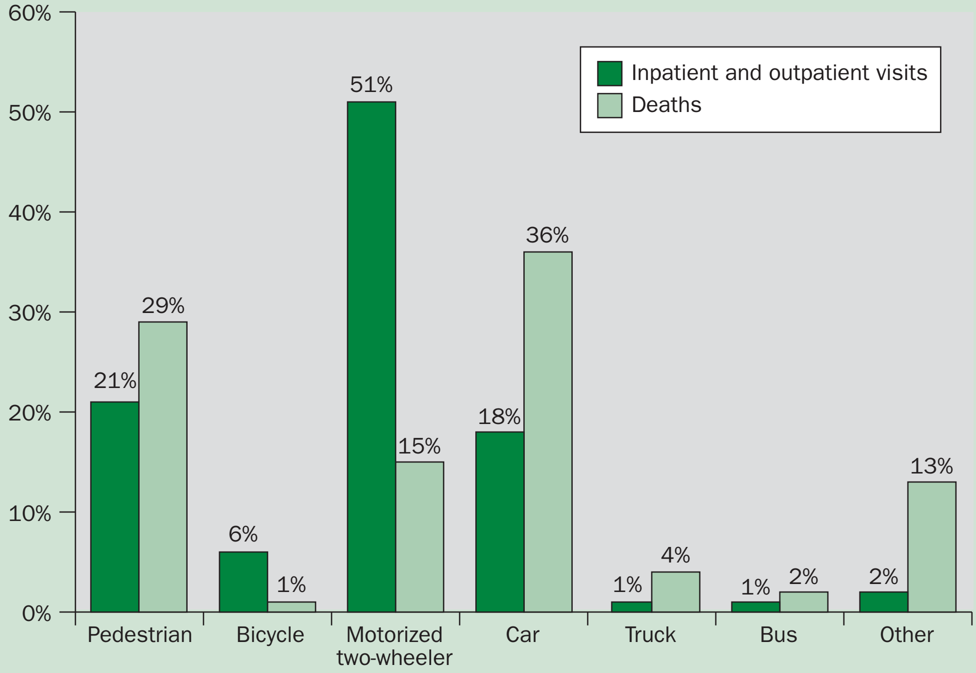
Nearly two-thirds of the road traffic deaths are car occupants or pedestrians. Half of all non-fatal hospital admissions and outpatient visits for non-fatal road traffic injuries are riders of motorized two-wheelers, as can be seen in the figure below. The marked difference in the patterns of fatal and non-fatal injury show that estimates of non-fatal injuries are needed alongside estimates of deaths, in order to appropriately measure the impact and identify priority issues for action.

Distribution of road traffic injuries by victim's mode of transport in Iran



Source: *(32)*

The researchers recommend that for all countries that do not have a reliable mechanism for estimating the full burden of road traffic injuries, existing data sources should be used to create a national snapshot, taking care to understand and correct for biases and limitations of the sources.

The estimates resulting from this methodology do not include specific location data that traffic engineers can use to identify and treat hazardous locations, but they do provide reliable information on patterns of injury severity, road user involvement and road type to suggest evidence-based strategies and interventions that can effectively reduce the national burden of road traffic injuries.

Building national estimates of the road traffic injury burden from multiple data sources is something that should be done alongside – not instead of – the development of road safety data systems.

Summary

This module has provided an overview of how to assess the current status of road safety data collection. Four major components of the situational assessment are:

Step 1: Identify people and agencies involved in collection, management and use of road safety data. Describe their roles, responsibilities and relationships. Begin a dialogue with key stakeholders.

Step 2: Identify existing data sources and systems. Describe their characteristics and assess data quality, with a focus on definitions, accuracy, completeness and under-reporting.

Step 3: Describe the needs and expectations of end-users of road safety data.

Step 4: Identify factors in the political environment that will facilitate or hinder proposals for improvements to road safety data systems.

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3

How to design, improve and implement data systems

Modules 1 and 2 described the importance of reliable data for road traffic injury prevention and monitoring, and how to assess the road safety data situation in a country or region. This module describes how to use this information to strengthen existing road crash data systems, or design and implement new ones.

The sections in this module are structured as follows:

- **3.1 Establishing a working group:** This section shows how to develop a multisectoral working group to define objectives and choose the best approach. This is an essential step to ensure overall coordination of the system, with input from all stakeholders.
- **3.2 Choosing a course of action:** The appropriate course of action depends on objectives, the content and quality of available data, the features and functioning of available systems, and available resources.
- **3.3 Recommended minimum data elements and definitions:** This section presents an overview of minimum data elements for a common road crash dataset that can be used for national analysis (a full list of definitions and data values appears at the end of the module).
- **3.4 Improving an existing system:** This section covers strategies for strengthening an existing road crash data system (based on police data) through improving data quality and system performance. Topics include in-depth evaluation of existing systems, data collection tools, reporting requirements, training, quality assurance, database system features, linkage and data management plans.
- **3.5 Designing and implementing a new system:** This section describes the steps to take if there is no system, or if existing data systems cannot be modified to fulfil the key objectives (assuming there is the political will, resources and capacity to implement a new system).
- **3.6 Considerations for non-fatal data:** This section summarizes actions that can be taken to improve the availability and reliability of data on non-fatal road traffic injuries.
- **Minimum data elements:** full list of definitions and data values.

3.1 Establishing a working group

Decisions about strengthening road safety data systems should be made in consultation with a multisectoral working group. This should comprise agencies and individuals who have been identified as collaborating partners in the situational assessment (see Module 2). If there is a lead agency for road safety, it should be represented in the group. Working group members will have technical and practical responsibility for implementing changes to road safety data collection systems. Their regular duties will need to accommodate their new responsibilities as part of the working group.

The working group should identify a coordinator who will have overall responsibility for the group's work. The coordinator, whether paid or not, should have clearly defined responsibilities. These include overseeing the activities of the working group, monitoring progress, and ensuring that all those directly involved (as well as other key stakeholders) are kept well informed. The coordinator should have the necessary authority, resources and support to carry out these tasks. For this reason, the role is best filled by someone whose work already includes some of these responsibilities, for example, the chief technical officer within the transport department, the person in charge of the traffic police database, or the person responsible for data in the national road safety lead agency. In many cases it makes sense for the individual/agency that will have responsibility for the road crash data system to act as the coordinator.

In its first meeting, the working group should agree its purpose and the roles and responsibilities of each member. Key stakeholders and other parties who are interested in road safety data developments (but who will not have technical responsibilities) can be consulted through an advisory group, which meets less frequently than the working group.

Setting goals

One of the first tasks of the working group is to define goals for road safety data systems. If the national lead agency and/or national strategy has specified general road safety goals, these should be reviewed and discussed in terms of the data requirements for achieving and monitoring each one. Group members should then be given the opportunity to present their perspective on the primary goals for road safety data systems. Eventually the group must agree on common goals and key system requirements. This will help with the selection of common data elements and help identify which goals can be met with existing data sources and systems, and which require something new.

Module 1 described how reliable road safety data are needed to accurately identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance. Data are also needed for effective advocacy. This requires data that describe the social costs of road traffic injuries, i.e. deaths, non-fatal injuries and crashes (*final outcomes*); exposure to risk, e.g. population size, number of vehicles, traffic volumes; safety performance indicators such as helmet use or speeding (*intermediate outcomes*); and interventions implemented (*outputs*).

Though current good practice suggests countries set goals and targets for each of these areas, few have done so. Most countries and jurisdictions focus on reductions of deaths and non-fatal injuries (*final outcomes*). In practice this means policy-makers usually need data on absolute numbers, rates, trends, severity, and costs of road traffic injuries by geographic area, age group, crash type and road user type/mode of transport. This module therefore focuses on strengthening data systems for final outcome data, with a particular emphasis on road crash data systems based on police data.

Regardless of decisions about the short-term focus of a new data system (e.g. one based on final outcome data), the working group should develop a long-term strategy for meeting the full range of data needs required for effective road traffic injury prevention and performance monitoring (see Module 1).

> **NOTE**
>
> When road crash data systems are improved, the reported number of injuries can rise, sometimes dramatically, because the system has become more effective at capturing events. Political concerns about the impact of this apparent increase can underlie resistance to changes in road safety data systems. Open dialogue with policy-makers allows people and agencies to express their concerns about how such results might affect their funding, performance review, press coverage, and to consider together how these concerns might be addressed. The press should be sufficiently briefed before any new figures are released, to help them correctly report the change in trend. A media/information strategy is essential for highlighting these issues and minimizing political and community concerns.

3.2 Choosing a course of action

When improving road safety data systems, there is no single course of action that will be right for every country or jurisdiction, at all times. The following sections therefore describe a range of strategies for strengthening road safety data systems and provide examples of good practice. The working group must consider these possible strategies in the context of their own situational assessment (for example, see Case study 3.1), and identify what is likely to be the most effective and feasible approach. The working group must then decide the most appropriate course of action.

> **NOTE**
>
> Political support for investment of human and financial resources in road safety data systems is a critical piece of the jigsaw. Without this support it will be difficult to implement the kinds of changes needed to build good road safety data systems. If the situational assessment reveals major problems with – or a lack of – road safety data systems but there is not yet support to address this, then use the data gathered in the assessment to advocate for investment in data systems. Use the data to estimate the magnitude of the road traffic injury problem, and use information about data quality and under-reporting to argue the need for greater attention to road safety data.

CASE STUDY 3.1: **Using situational assessment to choose a course of action, Bengalaru (Bangalore), India**

The city of Bengalaru (Bangalore), India, carried out a situational assessment of the growing problem of road traffic injuries in the city. Data available suggested that there were increasing numbers of crashes involving pedestrians, cyclists and users of motorized two-wheelers.

Coordinated by the WHO Collaborating Centre for Injury Prevention and Safety Promotion at the National Institute of Mental Health and Neurosciences, the process began with a stakeholder consultation with the city's police, transport department and representatives from 25 hospitals. The goals and objectives of the assessment included reviewing the availability, quality and usefulness of existing data, defining what new data were needed, deciding on mechanisms to be used to collect this information and planning how the data would be used and disseminated.

The situational assessment included a one-year data collection phase. This involved identifying and selecting centres that would collect the data; a preparatory phase to develop the tools to collect data, and training 300 police and hospital professionals to use them. Information gathered over the assessment period provided an estimate of the extent of the problem of fatalities, the extent and severity of non-fatal injuries, as well as information on the geographical distribution of injuries, socio-demographic characteristics of those most affected, and involvement of risk factors in road traffic crashes.

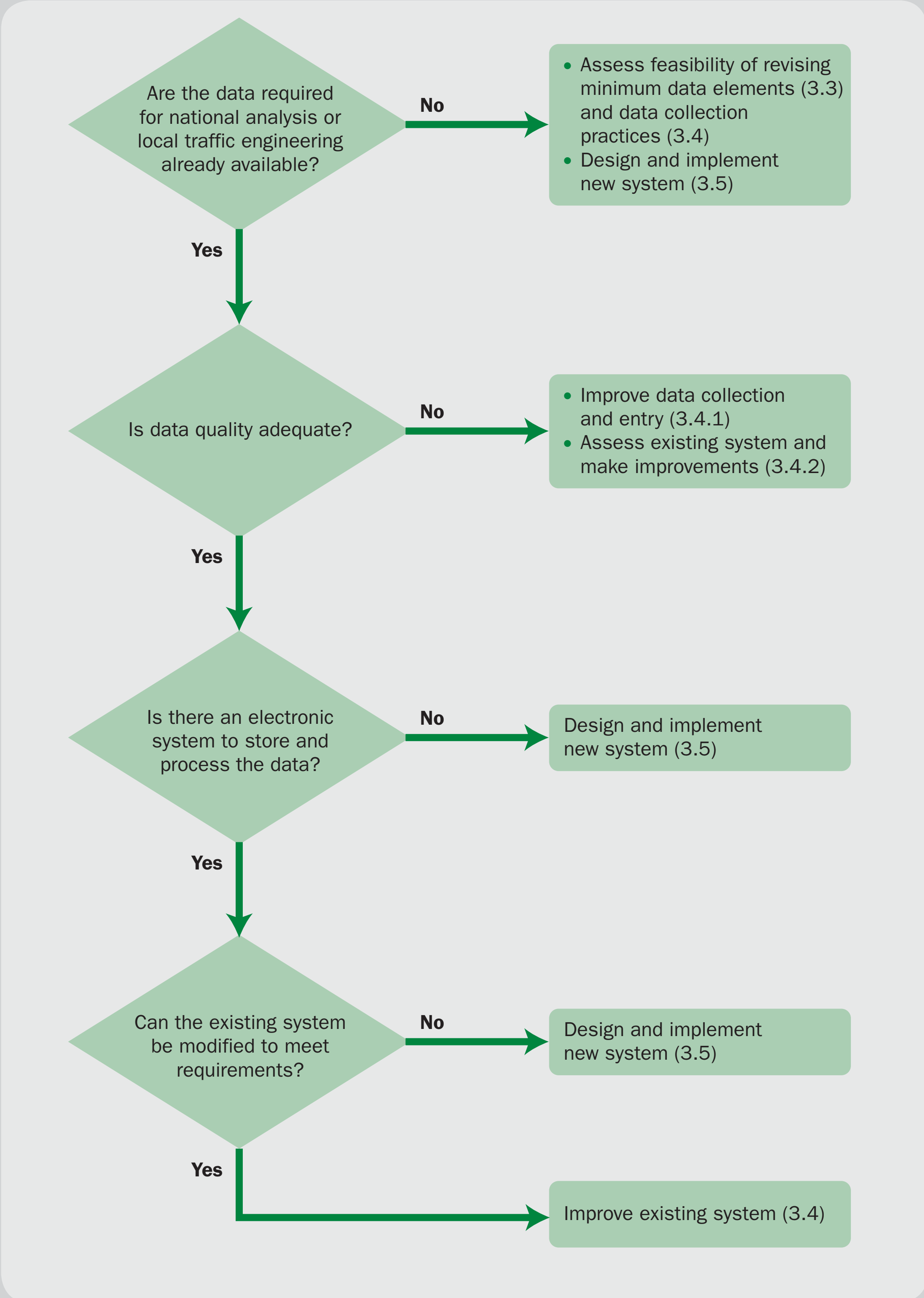
As well as collecting data, the assessment provided detailed information on the processes used to collect information. This suggested that while data on deaths could be collected from police (after some improvements were made to their data collection capacity), hospitals could also collect injury data using standard emergency trauma care forms. Stakeholders found that there were opportunities for integrating both police and hospital data, using particular technological tools. They also noted the critical need for administrative support, personnel training, monitoring and regular feedback to ensure the sustainability of a programme. Thus the assessment identified that road traffic injury surveillance was possible without building an entirely new system, but rather by strengthening existing systems to obtain relatively small amounts of good quality information.

Apart from collecting data, the process of conducting a situational assessment served to identify the need for capacity to be built for analysis and interpretation of data. Several limitations to the existing system were identified, and activities were initiated to address these, including cooperation by police and hospital staff, ongoing training, establishing mechanisms for data analysis, systematic feedback of data to stakeholders, resource allocation and assigning roles. The need to identify mechanisms to coordinate the programme, as well as to monitor and evaluate activities, was also considered. Following this assessment, attempts are being made to make continuous data available on a regular basis. The data have been used to strengthen a number of road safety and trauma care interventions. For more information see *1*.

The main strategies to strengthen final outcome data include:

- improving the data quality and system performance of road crash data systems that draw mainly on police data, or design and implement such a system if none exists (see Figure 3.1 and sections 3.3–3.5);
- improving health facility-based data on road traffic injuries. Consider implementing a surveillance system. This is especially important for improving non-fatal road traffic injury data (see section 3.6);

Figure 3.1 **Using a situational assessment to choose a course of action**



- improving the vital registration system, particularly death registration. Implementing required changes is usually beyond the mandate and capacity of road safety stakeholders, but you can advocate for change (for further guidance, see resources available from the Health Metrics Network, www.who.int/healthmetrics/en/);
- working with public health and road safety experts at an academic institution to combine existing data sources to generate more accurate estimates on the magnitude and impact of road traffic injuries (see Box 2.6 Module 2).

Sections 3.3, 3.4 and 3.5 provide guidance on strengthening road crash data systems that are based mainly on police data. Figure 3.1 illustrates how actions might be prioritized for strengthening or implementing road crash data systems. The flowchart assumes road safety is already recognized as a major health and development issue, and one requiring political backing and reliable data for effective planning and monitoring. Strategies for improving data on non-fatal road traffic injuries are discussed in section 3.6, since these involve measures that extend beyond a police-based road crash data system.

The case studies presented in this module provide examples of road crash data systems that are working well, mainly in low- and middle-income countries. These examples illustrate how a wide range of approaches can lead to successful data systems. There are many more valuable case studies in the World Bank Global Road Safety Facility guidelines for road safety management capacity review, which readers are strongly encouraged to view (*2*).

Police as key stakeholders

Police records are the primary source of road crash data in most jurisdictions, but police may not be responsible for the data systems that utilize this data, nor for initiating changes to such systems. It is easy to understand how resistance might arise in a situation where police have their own system for documenting crashes, and where their efforts in data collection are neither recognized nor appreciated. This can be compounded if transport or highway departments propose – perhaps without consultation – a new road crash data system that requires substantial changes in the way police officers work.

Effective road crash data systems cannot succeed without the acceptance of the police force. The best way to make sure the system benefits police, and to foster a sense of police ownership, is to **involve police in all stages of project planning** for changes to the system (or implementation of a new system). This means seeking police participation in the situational assessment, the identification of goals, and the selection, implementation and evaluation of strategies to improve the system. Police participation in decisions about data collection procedures is particularly important in the design of data collection forms.

Frequently, extensive demands are made on the initial data collection process from the crash site, yet no information is passed back to the data providers. Police justifiably complain about the extra work required to collect data for other agencies when there is no productive benefit to their own work. From a practical perspective, therefore, it is critical that there is a structured feedback mechanism providing timely and useable information to traffic department managers, supervisors and, most importantly, crash investigators and patrol officers.

The provision of an annual report on crash statistics is not an effective feedback mechanism to help efficient law enforcement strategies to be put into place. The feedback must be provided on a regular basis to meet police user requirements.

NOTE

Strategies for addressing reluctance or resistance among law enforcement stakeholders include (see also Case study 3.2):

- demonstrating to staff at various levels how the changes will ensure better information and analysis for positive road safety outcomes in terms of research, policing and engineering – and ultimately in saving lives. Procedures, paperwork and data entry would be streamlined to provide benefits to all;
- institutionalizing procedures through government order, or by defining Standard Operating Procedures (see Case study 3.6);
- fostering the commitment of senior police management to road safety in general, and crash data quality in particular. Top level political and management support can encourage wider acceptance;
- discussing the availability of personnel and vehicles for traffic policing with those highest in the police chain of command;
- considering the availability of essential equipment for police for accurate scene measurements and crash investigation (e.g. tape measures, maps);
- demonstrating how police data are being used by other stakeholders to improve road safety, e.g. distribute an annual report to police, including case studies of how police data were used to identify and improve hazardous locations;
- establishing mechanisms to provide relevant analyses to police in an accurate and timely manner, so they can use the data for intelligence-led enforcement (e.g. trend analysis of location, day of week and time for fatal and severe injury crashes).

CASE STUDY 3.2: **Data-led enforcement strategy in Victoria, Australia**

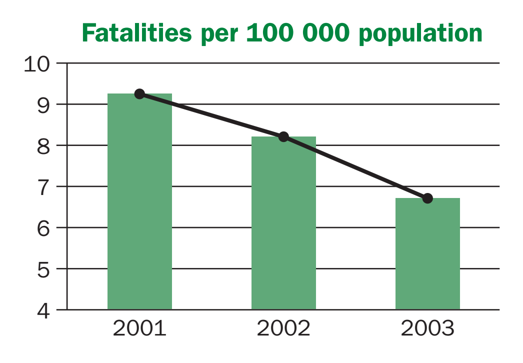
Over the past 30 years, Victoria Police and its road safety partners have consistently relied upon data to drive the road safety enforcement and education strategies.

In 2001, data analysis from fatal and serious crashes identified speed as a major factor in road trauma in approximately 30% of road crashes. Data from the VicRoads speed survey analysis indicated that in a 60 km/h speed zone, the majority of motorists drove at approximately the threshold speed, i.e. the speed at which enforcement action is taken. In many countries, this tolerance level (although never disclosed by police) has effectively become the speed limit.

The Transport Accident Commission, in collaboration with Victoria Police, undertook a massive and sustained education campaign called **Wipe off 5** – i.e. reduce your speed by 5 km/h. Research indicated that for every 1 km/h reduction in average vehicle speed, the crash frequency was reduced by 3%. Phase one began in August 2001, followed in November by a second phase with more intensive media coverage. The twin targets were careless and deliberate speeding, particularly in the low-level speeding range.

Phase three commenced in December 2001 with enhanced speed enforcement strategies, including additional mobile speed cameras and targeted police operations. The enforcement threshold was then reduced systematically from February 2002 by 1 km/h increments across the state each month for three months (i.e. overall the threshold speed was reduced by 3 km/h). The strong media message of *60 km/h means 60 km/h* was promoted in parallel. All data and actions were closely monitored, with an immediate effect in speed reduction.

The benefits of the threshold reduction strategy became clear from the substantial drop in numbers of Victorian road fatalities for the 2002 (16%) and 2003 (11%), and more importantly, a reduction in the five-year average. The enforcement threshold has been maintained to this date. Victoria Police continue to rely on data with intelligence-led, outcome-focused enforcement strategies.



3.3 Recommended minimum data elements and definitions

Whether you choose to modify an existing system or build something new, the common dataset composed of minimum data elements (variables) will be a key tool for ensuring the appropriate data are captured to enable analysis, and for maximizing consistency and compatibility of data collected across different jurisdictions.

The purpose of defining minimum data elements and specifying uniform definitions and criteria is to provide a dataset for describing road traffic crashes, and the resulting injuries, that will generate the information necessary for national analysis and road safety improvements (*3*). Uniformity of crash data is especially important when combining sub-national datasets, and for international comparisons.

The common dataset concept is well-known and used in public health (*4*). The concept is used in some countries that have road safety data collected at state or provincial level, to facilitate uniform data collection, for example Australia's *Minimum Common Dataset for Reporting of Crashes on Australian Roads* and the USA's *Model Minimum Uniform Crash Criteria*, or *MMUCC*. In the *Community database on Accidents on the Road in Europe*, or *CARE*, a set of common data elements and definitions is accompanied by transformation rules so that national data collected according to various criteria can be transformed to meet the common data elements (*Common Accident Dataset*, or *CADaS*).

Minimum data elements should be selected considering the following criteria:

- **Data elements and values must be useful for road crash analysis**. These elements should be routinely collected when a road traffic crash occurs. Data that will not be used should not be collected.
- **Data elements and values should be comprehensive and concise**. Each variable must include a description and definitions of the possible data values (see minimum data elements at the end of this module).
- **Data which are very difficult to collect should not be included**, regardless of their value for road crash analysis.

When planning for the introduction of minimum data elements, try to minimize changes to the definitions and values of existing data elements, as these can cause problems with consistency and comparability of data over time. If definitions or data element changes are made, clearly note in official records the date of change and allow for some misclassification during the transition.

Minimum data elements proposed in this manual

The common dataset recommended in this manual is based on the Common Accident Dataset (CADaS), developed to provide a common framework for road crash data collection in Europe. The minimum data elements selected for CADaS were based on extensive research on data sources and systems available in 25 European countries, and stakeholders' needs and priorities for crash data analysis at the national level (*5, 6*). The data elements of CADaS were finalized after more than four years of consultation with road safety data experts and are currently being applied in the European CARE database.

For this manual, minimum data elements of CADaS were reviewed and selected according to the criteria listed above, bearing in mind the unique challenges faced in low- and middle-income countries. The resulting common dataset was reviewed by experts and practitioners in several low- and middle-income countries, and revised for relevance and feasibility. Implementation of this common dataset will help countries strengthen their road safety data for planning and monitoring purposes, and will facilitate the consistency and comparability of road safety data internationally.

Like CADaS, the common dataset proposed in this manual can be adopted as a full set of criteria for a new data collection system, or adopted progressively in the course of improvements to an existing one. It is important to note that changes to an existing data collection system may not be required at all – depending on the practices and definitions in use, it may be possible to implement this common dataset by applying appropriate transformations to existing data so it can be analysed according to the format and definitions specified here.

Not all of these data will be collected at the crash scene. If other data sources are available and reliable, they should be drawn on for variables that are troublesome for police officers to record at the crash scene (e.g. road functional class, vehicle engine size).

The proposed dataset specifies **minimum** data elements, with an emphasis on those variables that will be useful for national analysis. Jurisdictions may need to collect additional variables to facilitate local analysis, law enforcement follow-up and in-depth crash studies. Extra variables can easily be added to this dataset, according to specific requirements and circumstances.

Before implementing the common dataset, the type of crashes that will be included in the database must be defined. The variables presented here are intended for use in documenting information about crashes which result in at least one injury – crashes resulting in property damage but no injury would be excluded from the database. If a country wishes to include damage-only crashes, the variables can be adapted to describe them.

Table 3.1 summarizes the minimum data elements, while Table 3.2 describes additional variables commonly collected. Box 3.1 explores one of these additional variables – purpose of journey – in greater detail. Detailed definitions and data values for each data element can be found at the end of this module.

Table 3.1 Minimum data elements: overview

Crash related	Road related	Vehicle related	Person related
• Crash identifier (unique reference number assigned to the crash, usually by police) • Crash data • Crash time • Crash municipality/ place • Crash location • Crash type • Impact type • Weather conditions • Light conditions • Crash severity°	• Type of roadway* • Road functional class* • Speed limit* • Road obstacles • Road surface conditions* • Junction • Traffic control at junction* • Road curve* • Road segment grade*	• Vehicle number • Vehicle type† • Vehicle make† • Vehicle model† • Vehicle model year† • Engine size† • Vehicle special function† • Vehicle manoeuvre (what the vehicle was doing at the time of the crash)	• Person ID • Occupant's vehicle number • Pedestrian's linked vehicle number • Date of birth • Sex • Type of road user • Seating position • Injury severity • Safety equipment • Pedestrian manoeuvre • Alcohol use suspected • Alcohol test • Drug use • Driving licence issue date • Age°

° Derived or calculated from other data elements.

* Depending on the quality and detail of road inventory and hardware data available, it may be possible to obtain this data element through linkage to other databases.

† Depending on the existence, quality and detail of a motor vehicle registration database, it may be possible to obtain this data element through linkage to motor vehicle registration files.

Table 3.2 Examples of additional variables that are commonly collected

Crash related	Road related	Vehicle related	Person related
• Location relative to roadway	• Urban area • Tunnel • Bridge • Number of lanes • Markings • Work-zone related	• Vehicle identification number (VIN, issued by manufacturer) • Registration place and year • Registration number • First point of impact • Insurance • Hazardous materials	• Distracted by device • Driver licence class and jurisdiction • Driver manoeuvre • Trip/journey purpose (see Box 3.1)

BOX 3.1: **'Purpose of journey' data element**

Information about crash victims' *purpose of journey* is an important building block for effective road safety intervention, particularly as it shows the contribution to the overall road toll of road traffic crashes related to different occupations, and suggests areas for intervention. Such data, however, are not collected in most jurisdictions around the world and this lack of surveillance has been identified as a major obstacle to improving occupational road safety. It has been proposed that road safety data systems include a *purpose of journey* data element.

Definitions for the *purpose of journey* field used in the UK and in Queensland, Australia include the following:

- Journey as part of work
- Commuting to/from work
- Taking child/student to/from school
- Pupil travelling to/from school
- Life and network necessities and social activities (e.g. grocery shopping, visiting friends)
- Life enhancement activities (sports, hobbies, driving for pleasure)
- Holidays and weekends away
- Other (to be specified)
- Unknown

For this data field to be effective, police officers must be sufficiently trained to understand the importance of the data, to identify the *purpose of journey* and record it appropriately.

Source: *7, 8.*

3.4 Improving an existing system

Results of a situational assessment should suggest areas for improvement in an existing road crash data system. If an in-depth evaluation of the system was not conducted as part of the situational assessment, it should be done now. The US Centers for Disease Control and Prevention guidelines for planning and conducting an evaluation of a surveillance system is a useful tool to guide this process, and is summarized below (*9*).

Evaluation should begin with a flowchart of the process, description of the system, including its purpose, operation and resource requirements, building on the information gathered in the situational assessment (see Module 2, section 2.2). Stakeholders who use data generated by the system should be involved in defining questions to be answered by the evaluation.

The system should be assessed for its usefulness, e.g. the ability to detect road traffic injuries in a timely way, to allow counts of the number of road traffic deaths and injuries and description of their characteristics, to facilitate intelligence-led enforcement, and to facilitate assessment of the impact of interventions. Key questions to answer are whether the system meets its objectives, and whether the data are being used to improve road safety.

The CDC guidelines recommend assessing system performance with respect to several attributes (*9*). The importance of each attribute depends on the system's objectives.

- **Simplicity** of structure and ease of operation.
- **Flexibility** – can easily adapt to changes in operating conditions or information needs.
- **Data quality** – completeness, accuracy and validity.
- **Acceptability** – willingness of relevant agencies to participate in the system.
- **Sensitivity/reporting levels** – proportion of cases detected, and ability of system to monitor changes in trends.
- **Representativeness** – accuracy in describing the occurrence of road traffic injuries over time, and their distribution in the population by place and person.
- **Timeliness** of dissemination of information for intervention and programme planning. This is especially important for enforcement and public awareness strategies.

It will also be useful to have information on the features available in the crash database system, such as built-in quality checks during data entry, mechanisms to make navigating the system easier (e.g. drop-down menus, map-based selection), mapping, location-based analysis (e.g. site ranking by crash rates, numbers, costs or contributing factors).

Combined with information from the situational assessment, the results of this evaluation can be used to develop recommendations for improving the quality, efficiency and usefulness of the system (see also *10*).

NOTE

Improvements to existing data systems often focus on software solutions and database management (see section 3.4.2). Strategies in this area are appealing because they may be faster and easier to implement, and people may be excited about the possibilities of new technology. However, when prioritizing a course of action it is imperative to keep in mind that **even the best system cannot produce high-quality data if data collection and entry practices are poor.** Improving data quality through changes in data collection/entry may be more difficult to implement, but in the long run, reliable road safety data cannot be obtained without them (see section 3.4.1).

3.4.1 Strategies to improve data quality

The situational assessment and in-depth evaluation may reveal that the major problem with an existing system is poor data quality, related to data collection and entry practices. Several strategies that may be used to make improvements in these areas are discussed below:

- Review definitions
- Strengthen reporting requirements

- Improve data collection tools
- Collect accurate location information
- Improve training
- Quality assurance measures

Box 3.2 contains a checklist of questions to assess how data quality can be improved.

BOX 3.2: **Checklist for data quality improvement**

- Should variables be added or removed from the minimum dataset?
- Do current definitions need to be modified?
- Should reporting requirements be changed?
- Do current data collection tools allow simple and quick data capture? Do they need to be revised?
- How can paperwork requirements and data collection and entry procedures be simplified?
- Are police officers sufficiently trained for road crash data collection? Is further training needed for data collectors and/or those responsible for data entry?
- How can we improve identification of crash location?
- What quality assurance measures should be considered?

Review definitions

Module 2 discussed how definitions and criteria used to specify variables for data collection can affect data quality (by influencing which events are included or excluded) and also the likelihood of error in measurement or recording. The definitions of the minimum data elements provided above are intended to maximize data quality and comparability.

NOTE

Every change to the variables in the common dataset for national analysis means a change to the data collection form and data collection procedures used by police officers at the crash scene, and possibly in follow-up to the crash. If the change requires additional training for all traffic police, do not underestimate the magnitude of this task.

In addition, most police officers are already responsible for a mass of paperwork for a multitude of competing priorities. There must be a balance between analysis-related data needs and the demands placed on the time and workload of police officers.

Special attention should be given to the definitions associated with data values for classifying injury severity, to ensure that they are clear and easy to apply without specialized medical training (see definitions provided in minimum data elements). The definitions and methods of measurement specified for crash location also require careful consideration, to make sure they are compatible with data collection procedures (e.g. if the police force is not even equipped with tape measures, let alone Global Positioning System (GPS) devices, do not define crash location by GPS/ Geographic Information System (GIS) coordinates).

Strengthen reporting requirements

Where there is a legal requirement to report to the police road traffic crashes that result in injury, and for the police to officially record/report such crashes, injury crashes are more likely to be documented and counted in a data collection system.

In contrast, legal requirements for drivers to call police to the scene of the crash even if no one is injured can involve the police in lengthy administrative processes for minor incidents. This may reduce the number of officers available to answer calls to crash scenes, and reduce the time officers have for proper data collection and follow-up.

Improve data collection tools

Most of the world's road crash data collection is done by hand, using paper forms. A standardized data collection form, along with training in its use, can therefore improve data quality. The structure and layout of the data collection form can have a significant impact on data quality. Data collection forms are often designed to match database structure and the logical grouping of data elements. While this may simplify transfer of data from the form to a database ('data entry'), it may not be the best structure for data collectors, causing them to record details incompletely or inaccurately.

If data forms need revising or creating from new (see Case study 3.3), the following recommendations will help (*4*):

- Seek and use the experience and expertise of people who will be responsible for recording information on the form – e.g. police offers who oversee crash sites in the case of primary data collection forms, or data clerks if the form will be completed by abstracting data from police reports.
- Seek advice from a statistician with experience in data collection instruments. This person can help with form design and structure to help ensure maximum speed and accuracy in data collection, and that recorded information is easy to collate and process.
- Make the form easy on the eye, easy to understand (e.g. when space allows, define abbreviations in the margin), as short as possible, and above all, easy to complete.
- Pre-code the forms (i.e. print the codes on the forms themselves next to the data to be entered) for as many fields as possible, using numbers rather than letters or symbols. Numeric codes are easier to process and less prone to data entry errors.

- A clear reference book containing detailed instructions for completing the form should be available to help answer questions and assist training.
- Test the form in real data collection scenarios, with people who will be completing it once it is adopted for general use. Document problems collectors have understanding fields or recording responses, and the length of time it takes to complete. Revise the form as necessary.

In addition to fields for recording information on the crash, road, vehicle and person variables, data collection forms should provide adequate space for a sketch of the collision, including measurements, and a summary narrative description of events (*11*).

Some software packages specially designed for the collection and processing of road traffic crash or injury data incorporate the option of computerized data collection forms to record data electronically at the crash scene. This saves manual data entry, but it can be expensive and requires high capacity for electronic processing. It also requires police officers who are comfortable and confident with the use of the handheld devices or portable computers. Data validation can be problematic when data are recorded electronically, as there is no paper record to verify the data. Electronic data collection should be field tested extensively before implementation, and evaluated for its effect on reporting rates.

Collect accurate location information

Identifying the exact crash location is not always easy for police, and often data on location are inaccurate or not specific enough to allow for detailed analysis by location. The specificity of location identification varies considerably between countries and also between different areas of the road network (e.g. inside and outside built-up areas).

Methods for recording crash location include the following (for more information see *11, 12*):

- **Road name/route number and latitude/longitude (X, Y) coordinates.** This method records the crash location using the X, Y coordinates of a given location in a geographic coordinate system. The most reliable way is to take measurements with a mobile Global Positioning System (GPS) device at the crash scene, immediately following the crash. This uses satellites to provide actual geographic coordinates for the current location that can be converted to a local or national coordinate system. GPS may not work well in built-up areas where the satellite signal is blocked. Coordinates can also be read from a map, but this requires up-to-date maps and leaves greater room for error.
- **Linear Referencing System (LRS).** This provides a mechanism to describe the location of a point with unknown map coordinates by referencing it to a known point along a road network (e.g. kilometre posts along motorways). Using this method, unique route numbers are assigned to continuous sections of road. The route numbers may or may not correspond with those shown on official road maps

CASE STUDY 3.3: **Redesigning the statistical road crash data collection form, Spain**

Spain's Traffic General Directorate (DGT) identified the need to substantially redesign its statistical accident data questionnaire, thereby improving its usefulness, increasing its capacity to meet the growing demand for information, and reduce the time, effort and other resources invested in data collection.

The redesign process included:

- exploring the current state of crash data collection, using existing data from police crash data archives;
- establishing a Technical Work Commission, made up of representatives of the police in charge of crash data collection, the DGT, and universities and ministries involved in the collection and use of road traffic crash and injury data;
- the collection and review of information from the different crash data collection forms at the national and international level;
- carrying out a survey of police traffic-crash data management, to diagnose the state of information collection procedures, systems and quality;
- proposing contents for revised form, based on results obtained from the previous steps and distinguishing between crashes occurring on urban and inter-urban roads;
- organising workshops to enable the Technical Work Commission to reach consensus on which variables to include, the structure of the data collection form, and categories, codes and definitions. Achieve consensus on varying levels of information required, according to the severity of the crash. For each field of information, rate the usefulness and the level of difficulty for collecting the data. The following recommendations are worth mentioning:
  - Homogenization of criteria and the definitions for data collection by all police when an injury crash happens, as well as harmonization with European standards.
  - Improvement of the information fields and adaptation to new technologies, e.g. a proposal for monitoring injured victims at 30 days, inclusion of geographical coordinates to identify specific crash location, and alcohol and drug-use information.
  - Definition of an alternative method for classification of 'crash type' that overcomes current limitations, and allows a study of the sequence of events of a crash from a statistical perspective (METRAS method of sequencing events, see *13*).
- evaluating the new form using consolidated data from a pilot field study;
- detailed specifications for database structure and hardware;
- using software applications and computer systems that are flexible and adaptable for the collection, management and analysis of crash data, and that include automated data quality checks. Development of interchange mechanisms with other databases currently in operation;
- developing an instruction handbook and implementing a training programme;
- implementing a new crash data collection system;
- evaluation.

This methodology has been applied successfully in the state of Catalonia to redesign the crash data collection form, and currently is being applied at the national level to introduce standard crash data collection throughout the country.

or road signs. A zero-km point is chosen on each road, and a particular location is measured by the distance from that point. Good km-post sign systems with appropriate frequency (200 metres on main roads and 500 metres on secondary roads) facilitate accurate identification of crash location. Missing, damaged or too few km-posts make the system less useful for police in locating a crash scene. The effectiveness of LRS in crash location also depends on the availability of sufficiently detailed and accurate maps for police officers recording location information.

- **Link-node system.** This method uses known points along the road network, usually intersections, identifying them as nodes with a unique number. The section of road connecting one node to another is called a link and is also assigned a unique reference number. Specific locations can be identified by specifying the distance from a node and the direction of travel. Like LRS, the effectiveness of a link-node system depends on easily recognizable reference marks along the road and the availability of sufficiently detailed and accurate maps for police officers recording location information.
- If none of the systems above is in use, which is often the case in low- and middle-income countries, the **road name and street number** can be used to identify crash location. This is the least accurate method, with particular problems in rural areas.

In cities or towns it is important that police officers attending a crash scene record the highway or street location and accurately measure the distance from the nearest cross intersection, junction or identifying landmark. The point of collision should be clearly identifiable from known or permanent features so that follow-up investigators can identify the crash location from the description provided. In country or rural areas, the same level of care is required to identify the exact location of the crash with reference to known landmarks, accurate distances from towns or villages, permanent road markings, mile or kilometre posts, road signs, property locations, curves or road intersection points.

In all situations, road and vehicle directions (compass point directions – particularly north) should be recorded accurately. The police vehicle odometer can be used check the distance of the crash from identifiable landmark locations. Even if GPS is available and used, physical measurements with a tape measure should still be undertaken to determine the point of impact. Photographs of the crash scene and surrounding environment, supported by accurate measurements, can also provide useful information.

NOTE

At a minimum, officers required to attend crash sites, record particulars and investigate the incident should have a 100 metre tape measure, a 10 metre tape measure and a local map.

To make the best use of crash location data, the method for specifying location in the crash file should be compatible (or the results convertible) to the location information system used in corresponding files in other databases, such as road inventory or traffic files. Algorithms can be developed to match GPS/Geographic Information System (GIS) data with LRS reference points.

Improve training

Training police officers complete the data collection forms properly, and in data entry techniques if relevant, can improve data quality. Police officers who are responsible for filling in data at the crash scene should receive training in the following areas:

- The purpose of data collection (i.e. why it is critical for road traffic injury prevention) and the importance of their role as data collectors. The WHO/TRIPP *Road traffic injury prevention training manual* is a helpful resource (*14*).
- Which forms and/or reports they are responsible for completing, and when.
- Which information is needed for each field on the data collection form.
- Definitions of terms and associated data values, abbreviations and codes (especially important for variables that require subjective judgement, such as injury severity or light conditions).
- Which fields are mandatory to complete at the crash scene.
- Interview techniques for eliciting information from people involved in the crash and for obtaining eyewitness testimony.
- How to take and record required measurements (e.g. crash location, skid marks and point of impact).
- How to sketch a crash diagram.
- Techniques to validate data during the collection process (e.g. taking multiple measurements, clarifying conflicting statements).
- Data collection and entry procedures, and their responsibilities in these processes.

Staff with data entry responsibilities should receive training in the following areas:

- What forms and/or reports they are responsible for completing, and when.
- What information is needed for each field on the data collection form.
- Definitions of terms and associated data values, abbreviations and codes.
- If staff will be entering data that are not pre-coded, special training is needed for proper extraction and coding of data.
- Validation checks and techniques that can be used in the data entry process.
- Data collection and entry procedures, and their responsibilities in these processes.

If the traffic police force is large, it may be more efficient to train a select group of officers who can then train others in their jurisdiction (the 'train-the-trainer' approach).

Appropriate training is an essential part of data quality assurance, but it does not guarantee quality improvements. There are many reasons why a police officer might not complete a data collection form properly, even when trained to do so. Competing priorities (e.g. pressure to clear the crash site and minimize congestion), time pressures and perceived stake in road safety data collection all influence ability and willingness to collect crash data. Data collection forms and procedures for data collection, entry and reporting should be designed to make the police officer's job as simple, quick and easy as possible. Remember that data collection is just one part of the overall police responsibility for crash investigation and any prosecution procedures.

Quality assurance measures

Quality assurance measures are planned, systematic checks built into data collection and entry procedures to ensure that data captured in the system are accurate and reliable. These checks should be performed on a regular basis, and might include:

- periodic observation of police officers recording data at the crash scene;
- tracking the number of crashes which have been reported to police but do not yet have a crash record in the system (report the number of pending records on a weekly or monthly basis);
- periodic checks of a random sample of electronic records against their matching original source (e.g. hard copy of data collection form, police report) for completeness and accuracy;
- periodic checks of a random sample of records for correct classification of injury severity and crash severity (using detailed police reports or hospital data as reference);
- running statistical tests to determine if certain fields are more prone to being incomplete (see Module 2), so that potential bias can be identified and addressed through changes to data collection instruments or training.

Quality assurance also includes planning for in-depth retrospective evaluations and for assessments of under-reporting (see module 2), which would be done less frequently than the monitoring activities described above.

3.4.2 Strategies to improve data system performance

The situational assessment and in-depth evaluation may indicate that data quality is adequate, but changes may be needed to improve the functioning of the system in which the data are stored and processed. Several strategies that may be used to make improvements in these areas are discussed below:

- Review workflow and user requirements
- Assess database system features
- Possibilities for linkage
- Review (or create) a data management plan
- Implement quality assurance measures (see section 3.4.1)

Box 3.3 contains a checklist of questions to help you identify aspects of the existing data system that can be improved.

BOX 3.3: **Checklist for data system improvement strategies**

- Which departments contribute data, enter data, or analyze data directly from the existing system, and what changes are proposed?
- From workflow mapping, which parts of the process lead to long time delays, duplication of work, or have a negative impact on data quality?
- Do the features of the database system meet users' key requirements? If not, what features are needed, and can the existing data software platform be altered to meet these requirements?
- Is there a need to change the data software platform used?
- Is linkage to other databases feasible and desirable? What are the possible mechanisms?
- Is there a data management plan? Does it specify procedures for data collection, entry, processing and use? Are roles and responsibilities specified and assigned appropriately? Does it contain adequate provisions for data back-up and security?
- What additional quality assurance measures can be introduced?
- Are there enough staff dedicated to the system and do they have sufficient capacity to operate it?

Review workflow and user requirements

Workflow mapping shows how crash data move through the system, from collection at crash scene to analysis and dissemination. This visual representation can help identify procedural problems that have a negative impact on the overall data system. A workflow map should have been created during the situational assessment or in-depth evaluation. If not, it should be done now. The purpose is to identify the processes by which data move through the system and who is responsible at each step. Figure 3.2 shows a workflow map for a hypothetical road crash data system where data are collected by the police, and data entry and analysis are centralized at the National Road Safety Council.

The workflow map should document how things actually happen, not what the process is supposed to be. For example, if the hard copies of crash data records should be sent monthly to the central processing agency for data entry, but in reality they are sent only twice a year, this should be captured in the workflow map. Further guidance on workflow mapping can be found in (*15*).

Once the workflow mapping is complete, validate it with the working group and use it to identify areas where improvements can be made, either by changing procedures or practices, or changing the data software platform. Mapping the ideal workflow may assist this.

Figure 3.2 Example of a workflow map

WORKFLOW MAP – Crash reporting and data analysis – current actions and activities

ROAD SIDE INVESTIGATION
Police attend at crash scene

- Take notes on paper
- Interview witnesses
- Sketch scene, take measurements (estimates only, no tape measurements)
- Complete some elements of crash report form
- Take photographs (sometimes)
- Record – time, date, location, fatalities, injuries, vehicles, directions, point of impact

→

ACTION AT POLICE POST/STATION

INFORMANT

- Crash report form completed by hand (three-page form)
- Crash, casualty type, cause, civil blame, criminal action
- Accident book at station completed (accountable document)

↓

SUPERVISOR

- Check form and report
- Signed off or returned to informant for further investigation

↓

FATALITY

- Within 24 hours telephoned to Regional HQ
- Other crash type: normal process

↓

Hard copy of crash report

- Posted to Regional HQ – maybe once or twice a week

→

REGIONAL HQ

- Recorded and collated onto master (form)
- Summary table faxed to National HQ database
- Hard copy of crash report form filed
- No analysis undertaken

↓

NATIONAL DATA COLLECTION

- Fax received from Regional HQ
- Data entry manually to computer
- Collated by Regional crash type, road user, location, classification, age
- Blackspots identified in table
- Some basic analysis undertaken
- Quarterly reports available

ANNUAL REPORT PUBLISHED

Source: R. Shuey

NOTE

Centralized data entry, where data collection forms or crash reports completed by police officers are forwarded to a single location for coding and entry to the crash database, can be an effective way to improve data quality and system efficiency if the central body is adequately staffed with well-trained people (see Case study 3.4).

CASE STUDY 3.4: **Road Crash and Victim Information System, Cambodia**

The volume of motorized road traffic in Cambodia has risen rapidly since 1995. At the same time, weak traffic regulations, insufficient enforcement, speed increases because of improved roads and a lack of road safety education have led to rapidly rising numbers of road crashes and casualties. Inadequate public health care provision for people with road traffic injuries, and poor access to health services generally have made the problem worse.

Until recently, road crash data were collected by three different ministries (Public Work and Transport, Interior, and Health). Although the databases developed by these ministries provided relevant indicators on Cambodia's road safety situation, under-reporting levels were high and the databases were limited in scope, incompatible and inaccurate.

Recognizing the key role of reliable data for effective road safety prevention, the three ministries began to develop a new system in 2004, based on standardized and more detailed data collection forms. The project was led by Handicap International Belgium (HIB), with support from the French Development Cooperation, Belgian Technical Cooperation and the World Health Organization. The system has been developed in accordance with the requirements of ASEAN and the United Nations, and aligned to Action 2 (Road Accident Data Systems) of the National Road Safety Action Plan of the Royal Government of Cambodia. The system has been extended to cover all provinces in Cambodia and to equip traffic police with global positioning system (GPS) devices.

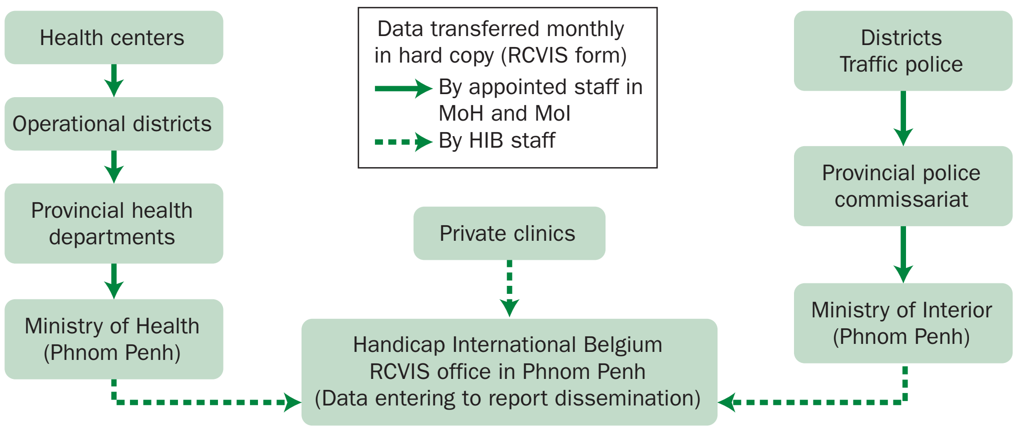
The objective of the Road Crash and Victim Information System (RCVIS) is to provide accurate, continuous and comprehensive information on road crashes and victims. This in turn will increase understanding of the current road safety situation, help plan appropriate responses and policy, and help evaluate the impact of current and future initiatives.

Data sources

To minimize under-reporting, the RCVIS draws on combined information collected from traffic police and hospitals. To ensure high quality data collection, Handicap International Belgium, in collaboration with the Ministry of Interior and Ministry of Health, ran training sessions on the use of the new standard data collection forms, inviting traffic police from each district, and technical staff from health centres and hospitals located on national roads in 24 provinces.

The following figure shows how data are transferred from district to ministry level. Both ministries are responsible for the collection of data from their provincial officers, while HIB is responsible for centralizing the data from both ministries and private clinics, and analysing the data and publishing it.

Data collection flow



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System life cycle

The information cycle of the RCVIS can be described as:

1. **Data collection:** There are two different RCVIS forms. The first, used by traffic police, concentrates on the type and causes of crashes, while the second, filled in by hospital and health centre staff, focuses on the type and severity of injury. In general, traffic police are not present at all crash scenes and do not report all crashes they witness. Hospital data are therefore needed to complement traffic police data. Once complete, the forms are sent to the relevant national levels (Ministry of Health and Ministry of Interior in Phnom Penh) at the end of each month.
2. **Data verification and follow up:** Each month HIB collects the forms from the national levels (ministry offices) and private clinics. Next, data verification ensures the forms are complete and contain accurate information. Additional contact may be made directly to the provincial staff who filled in the forms to get more detailed information.
3. **Data entry and storage:** After verification, the forms are entered into the database through two applications – one for police, and one for hospitals.

   The applications are designed to prevent confusion and mistakes during data entry (e.g. if the victim is a motorbike rider, seatbelt information is not needed).
4. **Data check and analysis:** Data checks are made to spot duplicated data entry by health facilities and traffic police. If a casualty is reported by a health facility as well as by the traffic police, it will be entered only once, as hospital data. To eliminate double entries, common core variables such as name of victim, accident date, time, type of road user, type of transport, location of crash, severity of injury, and hospital discharge are checked.

   The checking process is complicated and is therefore done manually. After the checking process, all data are centralized into the RCVIS database, which will be analysed and used to produce reports. Data are exported for further analysis using software such as SPSS Statistics and Microsoft Excel.
5. **Monthly/annual report production:** A report is produced to compare the evolution of trends from month to month, or year to year. Unusual trends can be spotted – for example drink–driving during the Khmer New Year, or the number of victims wearing a helmet after a period of helmet enforcement. These can be reviewed again in the database. If causes and remedies are identified, they will also be included in the report.
6. **Monthly/annual report dissemination:** The reports are disseminated regularly in soft and hard copy to more than 400 end users, including the National Road Safety Committee (NRSC), the ministries of Public Work and Transport, Interior, Health, and Information, the National Assembly, news media and local and international non-governmental organizations.
7. **End user and feedback:** At the end of the annual reports, a feedback form is attached that end users can fill in and return to HIB via e-mail or hard copy.

Impact of the system

- **Increase of political will:** Through data dissemination via media, government officials have contacted HIB for more detailed data to help develop policies, strategies and an action plan to reduce road crashes (e.g. the Cambodian prime minister referred to RCVIS data to call for more commitment and action on road safety).
- **Improvement of blackspots:** The Ministry of Public Work and Transport, in collaboration with the Japan International Cooperation Agency (JICA), is now using blackspot data to plan appropriate remedial actions at dangerous locations along the national road network. TICO, an emergency response organization, uses the data to locate ambulances close to spots with frequent crashes.
- **Reference to develop plans and proposals:** RCVIS data provide the reference for all road safety stakeholders (NRSC, Ministry of Health, WHO, GRSP) to develop strategies, proposals, and documents for the Cambodian road safety sector.
- **Evaluation:** RCVIS data have been used as an evaluation tool to measure the effectiveness and impact of project implementation, such as helmet promotion and community-based education projects.
- **Extension to another system:** Based on the experience of RCVIS, the Ministry of Health has decided to extend the system into a broader Injury Surveillance System (ISS), which will include data on other causes of injury, such as falls, domestic violence, and drowning.

HIB will continue supporting the implementation of the RCVIS while the system management is transferred to the ministries of Health and of Information, and the General Secretariat of the National Road Safety Committee.

Database system features

Compare stakeholder data needs, and the related user requirements, with the system features documented in the assessment/evaluation. Changes should be considered for areas where these do not match. For example, a key stakeholder group might place high priority on the ability to generate reports that differ from the system's pre-defined reports. Some of these discrepancies may be possible to address by changing the database architecture or access to the system, while others may require introduction of a different software platform.

NOTE

A database is a collection of related data organized for storage, search and retrieval. Databases of paper records are organized, searched and retrieved by hand. Electronic databases use computer software platforms to organize, store, search and retrieve the records, as directed by an administrator or user. Electronic databases can be structured according to various models (e.g. hierarchical, relational). The structure, or architecture, of the database directly affects users' ability to search and retrieve records quickly, and the types of analyses that can be performed.

Seek assistance from someone with extensive experience in database creation and management, including up-to-date knowledge of database models, software platforms and developments in technology. This expert should be able to help identify how the existing database system can be altered to better address user requirements, and whether the existing software platform is capable of supporting these changes. They should also be committed to ongoing support (see Box 3.4).

Research on 11 'good practice' crash database systems in Asia, Europe and North America identified several useful features (*16*):

- Built-in quality checks (algorithms and logic checks).
- GIS linkage to allow accurate identification of crash location.
- Ability to add new data fields without re-developing the database.
- Database navigation features such as drop-down menus, clickable maps.
- Pre-defined queries and reports.
- Option for customized, user-defined queries and reports.
- Mapping ability, for data entry, crash selection and presentation of aggregated crash information.
- Ability to export data to third-party applications (e.g. Microsoft Excel, Statistical Analysis Software (SAS)) for further statistical analysis.
- Inclusion of crash narrative, sketches of crash scene, photographs and videos linked to crash.
- Automatically generated collision diagrams.

BOX 3.4: **Working with consultants and commercial suppliers**

Road safety consulting and the development of commercial products related to road safety data constitute a growing business. Consultants and suppliers provide an important service and represent significant expertise. The knowledge, skills and time required to design, implement and modify road crash data systems should not be underestimated.

However, consultants and suppliers must be chosen with care to ensure appropriate service and sustainability. Choice of the wrong consultants or products can lead to frustration, wasted resources and failure of the project. This is equally true whether contracting consultants to assist with modifications to an existing road crash data system, or designing a completely new one.

To maximize success of the project:

- choose consultants and suppliers with specialist knowledge, experience working in countries with road safety situations and data systems similar yours, and the capacity to provide ongoing technical support;
- ask other clients about their experience and satisfaction;
- ask about the contractor's staffing and delivery capabilities;
- include follow-up activities in the contract and clarify availability of and mechanisms for support after completion of the project;
- pay contractors on a fixed-fee basis, where they are paid for meeting deliverables, rather than on a time basis, where contractors are paid per hour of work;
- choose commercial products (e.g. software platforms) that have been tested and proven, and that will be adequately supported, (for implementation and long term) by the supplier or other consultants;
- choose commercial products that your staff can be trained to use and support, so you do not have to depend solely on supplier support after implementation.

- Crash density maps.
- Site ranking based on crash rates, numbers, costs.
- Route assessments.
- Ability to monitor sites of interest, i.e. before and after treatments.
- Details of search criteria included on outputs.
- Web-based access for data entry and analysis.
- Public-access version of database.

Integration of hospital data on injury severity and outcomes was also identified as an important feature, though few road crash database systems have achieved this. It is worth noting that crash database systems may be able to perform at an adequate level without these features. However, addition of these features would improve the accuracy, efficiency and utility of data provision through the system (*16*).

Possibilities for linkage

Linking police data and other data sources is often proposed as a way to improve data quality, but it may not be the best starting place for database system improvement.

Establishing successful linkages among existing databases can be extremely complicated and difficult to do. Resources may be better invested in other strategies.

As a first step, a subset of the multisectoral data working group could meet regularly (weekly, monthly, or quarterly depending on the volume of severe and fatal crashes) to review and compare data from different sources, and discuss possibilities for formal linkage mechanisms. If it is not possible to establish linkages among databases, it may still be possible to include data from other sources by using centralized data entry (see Case studies 3.5 and 3.8).

Under-reporting levels and accuracy of injury severity classification can be assessed using periodic studies (see Module 2) where systematic linkage of databases is not feasible. Further information on data linkage is provided in section 3.5.

CASE STUDY 3.5: **Fatality Analysis Reporting System, USA**

The USA's Fatality Analysis Reporting System (FARS) was conceived, designed, and developed in 1975 by the National Center for Statistics and Analysis (NCSA) – part of the National Highway Traffic Safety Administration (NHTSA). It provides the traffic safety community with the means to identify traffic safety problems, develop appropriate solutions and provide an objective basis for evaluating the effectiveness of motor vehicle safety standards and highway safety programmes.

FARS contains data derived from a census of fatal traffic crashes within the 50 states, the District of Columbia and Puerto Rico. Crashes included in the database involved at least one motor vehicle travelling on a traffic way open to the public, and resulted in the death of a person (vehicle occupant or non-motorist) within 720 hours (30 days) of the crash.

All FARS data on fatal motor vehicle traffic crashes are gathered from each state's own source documents, and are coded on standard FARS forms. Analysts obtain the documents needed to complete the FARS forms, which generally include some or all of the following: police accident reports, state vehicle registration files, state driver licensing files, state highway department data, vital statistics, death certificates, coroner/medical examiner reports, hospital medical reports, and emergency medical service reports. Each case has more than 125 coded data elements that describe the crash, vehicles, and people involved.

FARS data released to the public do not include any personal identifying information such as names, addresses, or social security numbers, and vehicle identification numbers are abbreviated in public access files on the Internet. Thus any data kept in FARS files and available to the public fully conform with Privacy Act laws.

FARS data are used extensively within NHTSA, the national lead agency for road safety. National and state-level analyses are performed. NHTSA publishes FARS data in various formats including fact sheets, an annual statistical compendium, and reports on special themes. FARS data can be queried by the public and can also be made available on CD-Rom and computer tape. NHSTA regularly receives requests for FARS data from state and local governments, research organizations, private citizens, the automobile and insurance industries, Congress, and the media.

For more information about FARS, or to access FARS data, see
www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.0efe59a360fbaad24ec86e10dba046a0/

Review (or create) a data management plan

The data management plan should document the intended workflow (or Standard Operating Procedures) of data collection, entry, processing and analysis, specifying roles and responsibilities of the people and agencies involved. Putting this plan in writing provides a 'road map' of how the system should function, and acts as a monitoring tool.

The plan should specify:

- the agency and title of staff member in charge of the overall road crash data system – this is the agency that 'owns' the database and is usually responsible for data processing and analysis;
- summary of key user requirements for database system;
- software platform;
- facilities and equipment requirements;
- description of data to be collected (e.g. index of data elements);
- agency and staff responsible for data collection (may differ by data element);
- data collection instruments and procedures (may differ by data element);
- agency and staff responsible for data entry (may differ by data element);
- data entry procedures;
- data cleaning and processing procedures;
- quality assurance measures (both built-in and manual);
- agency, title and duties of database administrator(s), usually responsible for back-up, security, system performance and availability, development and testing support for hardware and software;
- back-up equipment, software and procedures;
- IT-specific security mechanisms, software and procedures;
- provisions for protecting confidentiality;
- linkage mechanisms (if applicable);
- system access for analysis and reporting;
- dissemination – output formats, frequency, target audience, agency and the person responsible for producing this information.

NOTE

Protect your data! Review back-up procedures and security mechanisms with an IT expert to make sure data are as safe as possible from accidental or malicious loss (e.g. through computer hackers). Avoid carrying data on a laptop computer or storage device that may be lost or stolen.

In addition to a data management plan, it is important to ensure that sufficiently trained staff are available to allow the data management system to function properly. A system environment evaluation can reveal if this is the case (see *4*). If not, additional staff and training may be required.

3.5 Designing and implementing a new system

This section describes the steps to take if there is no road crash data system in place, or if existing systems cannot be modified to meet your requirements (in the latter case, we assume there are the resources and political will to support the design and implementation of a new one; see Case study 3.6).

Though the steps are described in sequence, they are not mutually exclusive and it is not always necessary to follow them in order. For example, data collection tools can be developed (step 5) at the same time that system requirements are being identified (step 4).

Step 1: Address data quality issues

The world's best data system is only as reliable as the data inputs it receives. With the working group, review data quality problems identified in the situational assessment, and the methods for addressing them described in section 3.4.1. Implement the most suitable methods. This can be a parallel process to the development and implementation of the system as a whole.

CASE STUDY 3.6: **Road Accident Data Management System (RADMS), Tamil Nadu, India**

The state government of Tamil Nadu, southern India, set itself the goal of reversing the state's growing number of road traffic crashes, deaths and injuries. Recognizing the importance of reliable data in achieving this goal, implementation of a road crash data system was planned under the Tamil Nadu Road Sector Project, aided by the World Bank. The Highways Department funded the project and the Police Department was given the responsibility of finding a solution. The state government contracted a group of international IT specialists and road safety consultants in 2008 to assist with the implementation of the Road Accident Data Management System (RADMS).

Before the new system was implemented, police officers completed accident reports and other paperwork required for administrative and legal purposes. Data were extracted from police reports and used to calculate basic summary statistics (with a one-year delay) to produce annual statistics. No further analyses were performed, no data validation procedures were in place, and there were no incentives for collecting data.

The new system was designed in consultation with the Police Department, Highways Department and the Transport Department. The Government of Tamil Nadu chose to implement a proven 'off-the-shelf' system (Road Safety Management System, or RSMS, from IBS Software Service), rather than develop something entirely new. The new system, RADMS, is a comprehensive, web-based, GIS-enabled online system that facilitates end-to-end crash data management, from crash scene data collection, to final analytical outputs. It also facilitates safety management, including planning and implementation of interventions based on data. It provides a single system for the three departments, including data capture, analysis, reporting and management.

Crash data are collected by the police officer present at the crash scene, on a standard paper accident report form. The data are then entered in the RADMS by police officers from more than 1300 police stations covering 38 police districts. This data are then validated and the quality centrally checked by a police team. Supplementary data on roads is added by the Highways Department, and driver and vehicle details added or validated by the Transport Department (see the figure below).

Continues . . .

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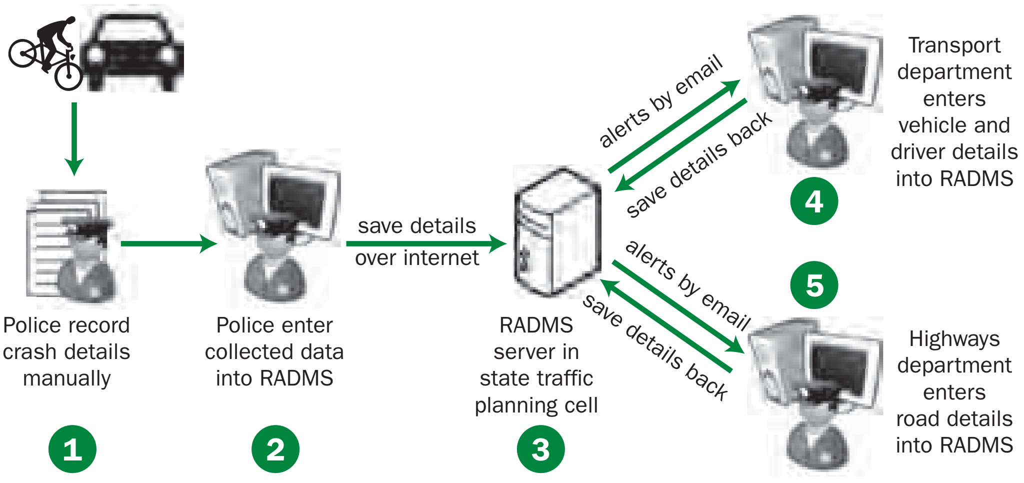
RADMS data capture process



Using RADMS, all transactions, including sophisticated map-based analysis, can be done over the Internet. When there is no connectivity or Internet access, the system functions in a standalone way for data entry, and data can be transferred later when connections are available – by email, file transfer protocol (FTP) or plain CD data transfer.

Since there are multiple departments and stakeholders, including research institutions accessing live crash data, security and confidentiality are prioritized. Access to the system is managed using 'role-based access control', where each department can see only data relevant for their use and analysis. Further, there is geography-based access control, for example a police officer from district A will be able to access only his data, and not a neighbouring district's detailed data.

As part of the implementation of RADMS, a new, simpler accident report form was introduced and police officers were trained to complete it by specialist international police trainers. Over a period of nine months the software was installed in 1350 police stations and with more than 600 other stakeholders (e.g. engineers). Detailed, hands-on training on the software and on data entry was given to over 4000 police officers over a period of two months, and a select group received further training to become crash investigation and data collection trainers ('train the trainers' approach).

In addition to automatic quality checks written into the software, several quality assurance procedures are built into the system. These include liaison with the district crime branch to check that all reported crashes have a completed accident report form (ARF); monthly reports of pending ARFs are sent to the police superintendent or commissioner; quarterly training for police personnel with data entry duties (assisted by consultants for first year of implementation); data quality review of sample ARFs from each district.

The Police, Transport and Highways departments developed a written Standard Operation Procedure (SOP) to specify the procedures for data collection, transmission and management under RADMS. This SOP was ratified by the Assembly and issued as a government order to all stakeholder departments, ensuring long-term sustainability and resources for the programme.

Continues . . .

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The SOP specifies which standard reports should be generated by which agency, and the frequency, format, and to whom these should be sent. These include a variety of monthly and quarterly reports and an annual review. Each of the main stakeholders produces a quarterly report to the state government showing what actions were taken based on data, and the results of these actions.

The software was piloted first in two districts for a month, and then rolled out through the entire state (1380 police stations). Application rollout was relatively easy since the RSMS solution was web-based software, requiring only an Internet connection and a browser, and not requiring any software installation.

Several factors have contributed to the success of this project:

- Clear project objectives and well-defined system requirements before the start of the project.
- Implementation of a proven commercial 'off-the-shelf' solution with a short implementation period.
- One single system for multiple stakeholders.
- Institutionalizing the system through the Standard Operating Procedures document, which defined roles, responsibilities and governance mechanisms.
- Choice of specialist IT suppliers with quality standards, delivery capabilities, and long-term commitment to the software.
- Support and maintenance available every day, at any time.
- Comprehensive training component – short, medium and long term.
- Complete acceptance by police, as it simplified their work and reduced duplication of work, and provided feedback on the value of their data collection.
- Contractors were paid for meeting the objectives and requirements (fixed fee project) and not for the time they spent on the project (time-based project).
- Internally funded, continuous training programmes, periodic training needs assessment, five-year maintenance and upgrade for the software.

Step 2: Select and define minimum data elements

This requires a balance of data that are absolutely necessary, data that are desirable, and data that are feasible to collect. The common dataset presented in section 3.3 should be a guide. The definitions can be adapted to local realities (e.g. in hot climates there is no need to specify values for snow or icy weather conditions), but wherever possible, the definitions provided should be preserved to maximize data consistency and comparability. Review the data elements for relevance to the jurisdiction, but do not 'reinvent the wheel'.

At this stage the working group must also reach consensus on the definition of road traffic crash for the purpose of the data collection system, as this might differ from the standard definition (e.g. to include crashes that occur off roadways). The group must also decide whether the system will include crashes of all severity levels.

NOTE

If it is not feasible to implement the 30-day definition for road traffic fatality in the data collection phase, the working group will need to select the appropriate conversion factor to apply to aggregated data for presentation in summary statistics.

Step 3: Define data capture procedures

Data capture describes the process used to collect information about the crash, and to transfer that information to the crash database system. It is part of the overall system workflow. There is no single best practice scenario for data capture, and what works well in one jurisdiction does not necessarily work well in another. Primary data collection for the minimum data elements may be carried out by police officers at the crash scene, or data collection might involve extracting information from police crash reports. Data entry may be performed by individual police officers or at the police station level, or it may be centralized, with one agency at regional or national level entering the data collected by police. In some cases it may be possible to import relevant data to the crash database system directly from another information system.

The following questions can help you define the best data capture procedures for your system:

- Is it feasible for police officers to use a standard form to record crash data, or should data be extracted from crash reports? (Note that data extraction from crash reports may be subject to misinterpretation, so it is preferable to implement a standard police data collection form or amend the crash report to include relevant information).
- If police officers complete standard data collection forms, will they also be responsible for transferring this data to the database system (data entry)?
- If data are to be extracted from police reports, which agency and staff will be responsible for data extraction? Will they use a standard form to record extracted data? Will they also be responsible for transferring data to the database system (data entry)?
- Are there data elements that require non-police data sources to complete (e.g. road segment grade)? How will data from these sources be captured, and who will enter it into the system?
- If data entry is centralized, will that agency actively collect the recorded crash data (see Case study 3.7), or will police districts and other entities be responsible for forwarding data forms to the responsible agency? How often?
- What kind of initial and ongoing training will be provided for data collectors, data extractors and staff with data entry responsibilities?

M. Khayesi, WHO

CASE STUDY 3.7: **Active, centralized data extraction and entry, Ghana**

The Building and Roads Research Institute (BRRI) in Kumasi, Ghana has operated the Ghana National Road Accident Database under funding from the National Road Safety Commission (NRSC) since the mid-1990s. BRRI has used MAAP5 and MAAP for Windows to enter the data and perform analysis.

BRRI annually visits all police stations in the country to extract crash details and other information from plain-language descriptions of the crash (held in files by police at each main traffic police station) and to enter them into a standard form. Several attempts have been made to introduce a standard proforma for data collection by the police, but this has not proved sustainable to date.

BRRI provides a stable hub with staff who understand how to collect and enter data. The data are analysed by BRRI and the results published in a number of papers. Some annual analysis is published on the National Road Safety Commission website (www.nrsc.gov.gh/).

Ghana is a good example of a low-income country where data have been used to investigate and evaluate safety issues further. This is a major achievement, despite difficulties with the data collection process and quality.

CASE STUDY 3.8: **Road traffic injury surveillance system using multiple data sources, Peru**

In Peru, a national road traffic injury surveillance system (RTISS) using multiple data sources was established in 2007, funded and led by Peru's Ministry of Health.

Development of the system began in 2005 when the National Office of Epidemiology (NOE), and the Disaster Prevention Division of the Ministry of Health decided to implement a road traffic injury surveillance system that could gather reliable information about the impact of traffic crashes on the health of communities. A technical traffic crash prevention team was formed at the NOE.

In 2005, an injury surveillance training course was conducted by the US Centers for Disease Control and Prevention for participants from different regions of Peru, helping determine an appropriate methodology for the system. A pilot system was tested and refined, and in 2007 the public health surveillance system was established in hospitals (public and private) in 21 of the country's 24 states.

Road traffic injuries attended for the first time at the Emergency Department of these 'sentinel' hospitals are included in the system. The insurance reimbursement office in each health facility is responsible for combining data from three sources for each case, using a standard surveillance form. The form records:

- information about the injured person, extracted from hospital records;
- characteristics of the event, extracted from police records;
- data related to the driver of the vehicle or vehicles involved, extracted from police records and insurance policies.

The data capture method did not require procedural changes or new data collection forms for police officers or health workers, since data are extracted from hospital, police and insurance records. Data from these different sources are available at the hospital because administrative procedures require that patients, or relatives of patients, seeking treatment for road traffic injuries bring copies of the police report and insurance policy to the hospital.

Continues . . .

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Data from the surveillance forms are entered into the system by entry staff in each hospital's epidemiology office. The dataset is reviewed for quality and sent to the DIRESA (State Health Office) every fifth day of the month. Records are aggregated at state level and sent to the Epidemiology Office at the Ministry of Health. This office is responsible for compiling cases at the national level, analysing data, preparing quarterly reports, and conducting training courses for those using the system. The report is disseminated to the road safety group within the Ministry of Health, to the state health offices, and to the multisectoral Road Security Council. To date the combined dataset is being used by the Ministry of Health, and not by police or insurance companies, though they may request data for further investigation.

Data analysis has indicated differences among road traffic injuries by region. For example, in the capital city Lima, the most frequent road users involved are pedestrians, while at national level it is vehicle occupants. In the Amazon region the most frequent injuries are related to motorcyclists and occupants of motor cars, which are the most common means of transport in that area. The challenge is to maintain the system in the 21 regions, to expand it to the rest of the country, and to define interventions at local and national level, based on the surveillance data. Priority areas have been identified:

- Improvement of pre-hospital care services. Most patients (98%) are transported to the hospital by people without training in emergency medical services (relatives, taxi drivers, firefighters).
- Young drivers are involved in most injury cases.
- There are higher than usual numbers of cases in some states, especially those in the Andean mountains.

The methodology of this system relies on the existence of an insurance office and an epidemiology office at the hospital, which not all hospitals have. In addition, the administrative requirement of the patient bringing police and insurance records to the hospital might not be easy to replicate, or desirable in other countries.

Step 4: Identify system requirements and resources

Before you begin to design the database system, it is important to understand what you require from the system, the human and financial resources available for its development and implementation, and whether further resources are required.

When estimating resource availability, consider what resources will be needed over the long term to support the maintenance and development of the system and ongoing training needs, in addition to initial costs such as software platforms, training, and consultancies.

Human resources should be considered in the planning stage. The database system should have at least one full-time member of staff dedicated to overseeing it. Additional staff may be required for data entry, depending on data capture procedures. If existing staff take on new data entry or management responsibilities, they should have time dedicated to these tasks (e.g. specify 20% time for data entry in the terms of reference). Steps should be taken to ensure continuity of staff in charge of the system. This might involve training replacements for those who leave or retire, or hiring permanent civilian staff to run systems administered by law enforcement agencies who frequently rotate staff.

At this stage the working group should have agreed goals and priorities for the crash data system. Consider the technical features required for the system to meet these needs, and review the list of desirable features described in section 3.4.2.

Along with the situational assessment, the following questions can help further identify your requirements:

- What is the geographic scope of the system (national, provincial, or district level)?
- How many stakeholders (i.e. agencies/departments) will enter data in the system? At how many different locations?
- How many stakeholders will have direct access to the system for data analysis purposes?
- What are the priority system features for your key stakeholders, in terms of data entry, management and analysis?
- What type of software solution do you envisage?
  - ▹ A single desktop software platform, where data are entered and analysed on one computer?
  - ▹ Multiple licences for a desktop software platform – i.e. where data can be entered from multiple locations in a Local Area Network (LAN) (typically fewer than 10 entry points?)
  - ▹ A comprehensive, integrated, web-based software platform where different stakeholders use the same system, accessed via the Internet, for data entry, analysis, reporting, querying, planning, and other functions?
  - ▹ Are your visions for a software platform and related IT requirements compatible with current IT infrastructure in your country?
- What linkage mechanisms do you foresee, if any (see Box 3.5)?
- Will you use in-house expertise or involve external contractors to develop the system (contractors are recommended, bearing in mind the issues discussed in Box 3.4)?

Once the key system requirements have been identified, you can determine whether an existing 'off-the-shelf' software platform might meet those requirements – for example the Microcomputer Accident Analysis Package (MAAP), available from the Transport Research Laboratory; the Road Safety Management System (RSMS), available from IBS Software Services, or Bulletin d'Analyse des Accidents Corporels (BAAC), available from ISTED (see Box 3.6). Products such as these allow relatively quick implementation and varying degrees of customization.

BOX 3.5: **Linkages with other databases**

For linkage to add value to data quality, the linked data must be accurate, up to date and collected in a stable system and accessible format. Considerations for database linkage include confidentiality concerns, compatibility of definitions, data fields that can be used to match records, and compatibility of data format and software platforms.

In countries where a road crash data system is being introduced for the first time and related databases such as road inventory, vehicle registration or driver licensing are also under development, there are opportunities for easier linkage. Databases can be developed in a compatible manner.

Technology can be used to simplify complex relationships and procedures – for example, it is possible for staff in a hospital to enter data in an electronic health record, and have that data simultaneously captured in the road crash database.

NOTE

Use the questions above and the lists in section 3.4.2 (*Database system features*) to summarize the minimum specifications of the system. This will help you decide whether your agency has the necessary expertise to develop a system, or whether an external consultant is required. If you decide to develop the software and system internally, make sure you accurately estimate the costs, time and expertise required. If you decide to hire a consultant or buy a commercial software product, get bids from several candidates and review the recommendations in Box 3.4, working with consultants and suppliers.

BOX 3.6: **The Bulletin d'Analyse des Accidents Corporels (BAAC) system**

The BAAC system (or the 'road traffic crash injury analysis form' system) was developed by the non-profit organization ISTED in the mid-1990s for implementation in nine French-speaking countries in Africa.

The system is designed to capture essential context data on road traffic crashes which result in injuries or death. It includes data collection, capture and analysis.

BAAC is based on a standard form completed by control agencies (usually police in urban areas, and gendarmerie outside urban areas). Data are captured in a database on PCs, enabling different levels of analysis according to various criteria, using reports in tabular or graph formats, or even geographic information systems (GIS) in the latest versions.

The forms comprise more than 70 data fields, grouped under two main sections:
- Crash, comprising 40 data elements (such as date, time, location, weather conditions, road characteristics, etc.).
- Vehicle, comprising 35 data elements (such as type, condition, and details for the persons involved in the accident).

In addition, a number of tables enable customization of the database to the characteristics of the country of implementation (e.g. roads, administrative divisions) while mantaining the standardizesd crash survey framework.

The BAAC system has been developed in several stages, from 1993 to 2003, using the Microsoft Access database to enable implementation even in the most limited computer environments. Data capture is assisted through built-in data validation, pop-up menus and pre-set customized lists, and is designed to conform exactly to the paper version of the BAAC form. The latest versions include GIS features. As most of the data fields are coded (not free text), it is possible to create custom queries on almost any type of information captured in the database, for more detailed analysis.

BAAC has been implemented in Senegal, Guinea, Mali, Burkina Faso, Benin, Togo, Niger, Gabon, and Madagascar. ISTED facilitates a BAAC user group for information exchange and support. For more information, see www.isted.com.

Step 5: Choose data collection tools

Road safety data collection tools range from simple, paper-based questionnaires to sophisticated, electronic mobile devices that can transfer data in real time. Whatever the format, the data collection tool must include all data items that need to be collected according to the minimum data elements.

Frequently police collect less structured information (narrative descriptions, statements) that make up a case file or report. The data required for a coded form can be extracted from such information (see Case study 3.7), but the use of a standard proforma can increase the quality and consistency of data. It is important to introduce standard data collection tools where possible.

There may be differences in the standard data collection form used by police at the crash scene, and the statistical data collection form used to record key variables for analysis. Some off-the-shelf road safety database products include or can generate data collection forms.

Data collection tools should be designed with input from the people who will use them on a daily basis, and be tested before widespread implementation. Standard forms should be kept brief and preferably pre-coded (see Figure 3.3, Tamil Nadu data collection form, for example). Review the recommendations in section 3.4.1.

Once the form has been tested, revised if necessary, and approved, data collectors can be trained to use it and begin data collection.

NOTE

If data collection is to be done using paper forms, with manual data entry using the paper forms, it is not necessary to wait for the database system to be fully functional before data collection begins. As long as the paper records are stored safety and organized well, the data can be entered in the system later. This approach gives the benefit of increasing the time period of data coverage, and providing opportunity for data collection quality checks to begin.

Step 6: Make a project timeline

At this stage in the process, the purpose and objectives of the road crash data system should be clear, along with the corresponding system requirements and features, data collection tools and procedures. The next step is to develop a time-bound action plan for development, testing and implementation of the system, including expected results, deadlines, milestones and who is responsible for each action item. Keep the implementation period as short as possible, to ensure the momentum and enthusiasm of stakeholders.

Figure 3.3 Pre-coded police data collection form, Tamil Nadu, India

TAMILNADU POLICE
ACCIDENT REPORT FORM

FIR No. | Acc ID | Section of Law

District | Police Station

Number of vehicles involved
Number of driver casualties
Number of passenger casualties
Number of pedestrian casualties
Hit and Run ☐ Yes ☐ No

Accident Severity
1. Fatal
2. Grievous injury
3. Simple Injury (Hospitalised)
4. Simple Injury (Not Hospitalised)
5. Vehicle damage only (Non – injury)

Date Month Year
Accident Date
Accident Day
Accident Time (24 hour clock)

Road Condition
1. Good
2. Poor
3. Muddy
4. Slippery surface
5. Oily
6. Speed breaker
7. Rutted/ Pot holed
8. Dry
9. Wet
10. Others

Road Classification
1. NH 3. ODR
2. SH 4. MDR

Shoulder Type
1. Paved 2. Unpaved

Traffic Movement
1. Two-way 2. One-way

Junction Type
1. 6. Junction with More than 4 arms
2. 7. Bridge (Flyover)
3. 8. Rail crossing Manned
4. 9. Rail crossing Unmanned
5. 10. None of these.

Junction Control
1. Not at junction
2. Police officer
3. Traffic signals
4. Flashing signal
5. STOP sign
6. GIVE WAY sign
7. Uncontrolled

No. of lanes

Central divider ☐ Yes ☐ No

Collision Type
1. Head on
2. Hit pedestrian
3. Hit from rear
4. Hit animal
5. Hit from side
6. Hit tree
7. Side swipe
8. Skidding
9. Ran off road Collision
10. Overturning
11. Overturning – no collision
12. Hit object in road
13. Hit object off road
14. Hit parked vehicle
15. Others

Surface Type
1. Tarred (Bitumen)
2. Concrete
3. Metalled (WBM)
4. Kuttcha

Speed Limit

Road Works ☐ Yes ☐ No

Traffic Restrictions
1. One-way street
2. Entry of heavy vehicles prohibited
3. Speed restrictions
4. Parking prohibited
5. Any other (specify)

Road Category
1. One Way Bridge
2. Two Way Bridge
3. Other

Road Geometry

Horizontal Features
1. Straight Road
2. Slight Curve
3. Sharp Curve

Vertical Features
1. Flat Road
2. Gentle incline
3. Steep incline
4. Hump
5. Dip

Carriageway width (mtr)
Shoulder Width (mtr) 1. 2.
Road Width (mtr)

Contributory Factor
1. Fault of driver / rider
2. Bad weather
3. Defect in road condition
4. Fault of Cyclist
5. Fault of driver of another vehicle
6. Fault of pedestrian
7. Poor light condition
8. Falling of boulders
9. Neglect of civic bodies
10. Fault of passenger
11. Defect in mechanical condition of vehicle
12. Cause not known

Accident Location and Site Condition Sketch
Show site in relation to well-known places such as schools, temples, mosques, churches, bridges and road junctions. Mark distances to these places. Always give street names. Show road location features like drainages, culverts, potholes, street light. Mark the accident clearly with a cross or arrow.
North

Road Name
Road No. Kilometre
Latitude
Longitude

Weather
1. Fine
2. Mist / Fog
3. Cloudy
4. Light rain
5. Heavy rain
6. Flooding of causeways / rivulets
7. Hail / Sleet
8. Snow
9. Smoke / Dust
10. Strong wind
11. Very cold
12. Very hot

Light Conditions
1 Daylight
2. Twilight
3. Darkness–no street lights
4. Darkness - with street lights on
5. Darkness - with Poor street light

Landmark
1. Near school / college
2. Near / inside a village
3. Near factory / industrial area
4. Near religious place
5. Near recreation place / cinema
6. In bazaar
7. Near office complex
8. Near hospital
9. Open area
10. Near bus stop
11. Near petrol pump
12. At pedestrian crossing
13. Affected by encroach
14. Narrow bridge or culvert
15. Residential area

Police Description Of The Accident (*e.g. V1 heading towards Pudukottai was overtaking a stopped bus when it hit V2 coming in opposite direction*)

Map Number
Node 1 Node 2

VEHICLE DETAILS (Write numbers corresponding to options from help)	VEHICLE 1(V1)	VEHICLE 2(V2)	VEHICLE 3(V3)
Vehicle registration number			
Vehicle Make			
Vehicle Model			
Engine Number			
Chassis Number			

Continues . . .

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Certificate Fitness	In force/ Not in force	In force/ Not in force	In force/ Not in force
Insurance No. / Company / Expiry date			
Tax Details			
Vehicle Type (Refer Vehicle Type Help for filling details)			
Vehicle Defect (Refer Vehicle Defect Help for filling details)			
Tyre Burst	Y/ N	Y/ N	Y/ N
Vehicle Lights	Faulty/ Misuse	Faulty/ Misuse	Faulty/ Misuse
Vehicle Manoeuvre (Refer Vehicle Manoeuvre Help for filling details)			
Skid Length (mtr)			
Vehicle Damage (Write number – refer last page graphic)			
Number of Non-injured Persons			
DRIVER DETAILS (Write numbers corresponding to options from help)	**DRIVER 1**	**DRIVER 2**	**DRIVER 3**
Name			
Gender of Driver	Male/ Female	Male/ Female	Male/ Female
Age			
Licence Type (Full / Learner's/ No license / Expired)			
Licence Number			
Driver Injury Severity (Refer Injury Severity Help for filling details)			
Details of the Deceased (Died on the spot / on the way)			
Type of Driver Injury (Write Number – refer graphic on last page)			
Driver's Education (Refer Driver's education help)			
Alcohol / Drugs (Alcohol / Drugs / Not Suspected)			
Seat Belt/ Helmet Worn	Y / N	Y / N	Y / N
Used Mobile Phone	Y / N	Y / N	Y / N
Driver Error (Refer Driver Error Help for filling details)			

INJURED PASSENGERS Complete the tables using codes from bottom help panel (Estimate age if not known)

Name	Casualty Class	In Vehicle No.i.e V1, V2 or V3	Sex (M / F)	Age	Injury Severity	Injury Type	Position	Action	Belts / Helmets(Y/ N)
1.	2								
2.	2								

INJURED PEDESTRIANS Complete the tables using codes from bottom help panel (Estimate age if not known)

Name	Casualty Class	Due to Vehicle No.(i.e V1, V2 or V3)	Sex (M / F)	Age	Injury Severity	Injury Type	Location	Students from / to School (Y/ N)	Action	Alcohol Suspected (Y/ N)
1.	3									
2.	3									

Analysis of Cause of Accident and Finding of the Team	**Remedial Measure to prevent these type of Accidents**

Help Panel

Vehicle Type
1. Motor Cycle
2. Scooter
3. Moped
4. Autorikshaw
5. Car
6. Jeep
7. Taxi
8. Bus
9. Mini Bus
10. Truck
11. Tempo
12. Articulated vehicle
13. Tractor
14. Light Goods Van
15. Heavy Goods Van
16. SUV / MUV
17. Animal drawn
18. Bicycle
19. Cycle rickshaw
20. Hand drawn
21. Other Vehicles

Vehicle Defect
1. Brakes
2. Steering
3. Tyre Puncture
4. Multiple defects
5. None of these
6. Bad Lights
7. Bald Tyre

Vehicle Manoeuvre
1. Turning right
2. Overtaking from left
3. Turning left
4. Parked
5. Making 'U' turn
6. Sudden start
7. Merging
8. Stationary
9. Diverging
10. Other / Not known
11. Starting from off- side
12. Starting from near side
13. Sudden stop
14. Using private entrance
15. Parking the vehicles
16. Reversing
17. Crossing traffic stream
18. Temporarily held up
19. Other/ Known
20. Going ahead overtaking
21. Going ahead, not overtaking

Driver's Education
1. Upto standard 8
2. Standard 8-10
3. Std 11 & 12
4. Graduate
5. Post Graduate

Pedestrian Location
1. On Pedestrian Crossing
2. Within 50m of Ped Xing
3. On traffic island
4. In centre of road (not 1-3)
5. On footpath
6. On shoulder
7. Other

Pedestrian Action
1. Standing
2. Crossing road
3. Walking along middle
4. Walking along edge
5. Playing on road
6. Other

Passenger Action
1. Sitting
2. Standing
3. Boarding
4. Alighting
5. Falling
6. Other

Injury Severity
1. Fatal
2. Grievous
3. Simple (H)
4. Simple (NH)
5. Non-injury

Passenger Position
1. Front seat
2. Rear seat
3. Pillion Rider
4. Bus passenger
5. Back of truck or pickup
6. Other

Driver Error
1. None
2. Starting off carelessly
3. Exceeded lawful speed
4. Did not give right of way to pedestrian
5. Followed too closely
6. Other improper overtaking
7. Overtook on curve
8. Cut in sharply after overtaking
9. On wrong side of the road
10. Failed to give signal
11. Wrong signal
12. Improper turn
13. Consumption of alcohol/drugged
14. Disregarded traffic light Signal
15. Disregarded 'STOP' sign
16. Lack of attention
17. Wrong parking location
18 Failed to give way to vehicle
19. Disregarded Police officer
20. Bad use of headlights
21. Overtook on hill
22. Asleep or fatigued/ sick
23. Other

Vehicle Damage
1. No Damage
7. Multiple Damage
8. No Damage details

Injury Type

Members of the Committee	Name	Signature
Police Officer	________________	________________
M/V Inspector	________________	________________
A.E/ J.E(Highways)	________________	________________

Step 7: Develop a data management plan

The data management plan documents how the system should function, including roles and responsibilities of various staff and agencies, mechanisms for protecting the data, and quality assurance measures. Prepare a data management plan according to section 3.4.2.

Step 8: Implementation

The initial implementation phase should include testing of data collection instruments, procedures and software, and 'roll out' to all intended users. While much attention is given to this initial implementation, it is only the beginning. Quality assurance checks, in-depth evaluations, database developments and ongoing training of new and existing staff are required to keep a system functioning well.

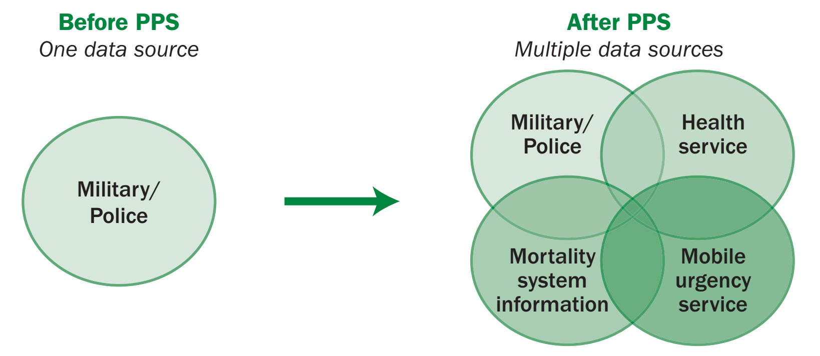
Regular quality assurance checks (e.g. random checks for data completeness and accuracy) should be built into the system. In-depth evaluations should be conducted regularly to assess whether the system meets its objectives, whether data are timely, accurate and useful, and whether the system outputs are used to improve road safety (see section 3.4).The first evaluation should occur about six months after the implementation of the system. This should allow time for start-up problems to be addressed. The next evaluation should occur one year after implementation to ensure smooth operation, and then again at five years. Under-reporting should be assessed approximately every five years, if not done as part of the in-depth evaluation. The objectives of the road crash data system may change over time and should be reviewed regularly.

CASE STUDY 3.9: **Implementing a multisectoral data system, Guaíba, Brazil**

The city of Guaíba, Brazil, began implementing its Proactive Partnership Strategy (PPS) in 2006, with support from the Global Road Safety Partnership. The PPS team includes representatives from municipal government departments including Transport, Traffic, Health and Education.

Before implementation of PPS, information about road traffic crashes and injuries was obtained exclusively from police records, and all data were kept in hard copy format. One of the first activities of the PPS data management team was to implement a new road crash data system, which has improved the reliability and accuracy of road crash data (see the figure below).

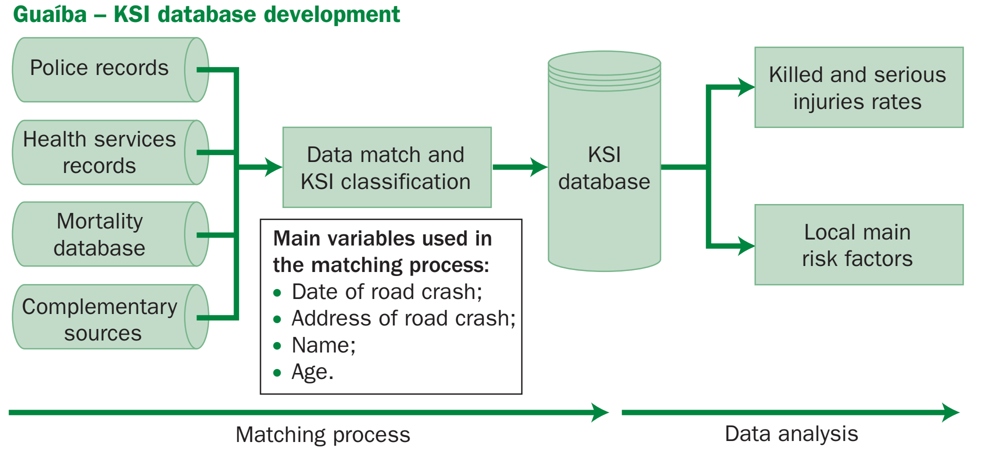
Data sources before and after implementation of PPS



Under the new system, road crash data are collected by the PPS data management team at military police headquarters, in municipal traffic departments and at health care facilities (pre-hospital care, hospitals and the legal medical institute). Data are entered in an electronic database developed specifically for the project.

The data are exported quarterly to a health service representative who performs a matching process among the records. The matching process improves reporting levels and enables a more accurate classification of injury and crash severity. Records of crashes resulting in deaths or serious injury – referred to *killed and serious injuries (KSI)* are kept in the database.

Guaíba – KSI database development



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Results are distributed as standard reports, and it is possible to generate customized queries and reports to satisfy specific needs.

The reports are provided quarterly to each PPS department coordinator and include the overall city performance and an analysis of fatalities and serious injuries as the main performance indicator. A summary of the data is publicly accessible on the Department of Traffic website.

Currently the KSI database is the main and most reliable source of information about road crashes in Guaíba. With appropriate data analysis methodology, the PPS team has been able to enter into deeper levels of crash data analysis.

The data collection system is functioning well, and data are being used to influence road safety management (see case study in Module 4).

3.6 Considerations for non-fatal data

Some experts argue that police data on non-fatal injuries will never achieve high reporting levels because, even if police are properly trained to classify injury severity, injuries may not be apparent at the scene of the crash where this evaluation occurs (*17*). Furthermore, if the difference between severe and slight is the most police can be expected to judge well, this does not provide enough information to measure the impact of non-fatal injuries on public health.

To compound this, there is a clear lack of consistency around the use of the terms 'severe' or 'slight'. In some countries 'severe' is defined as 'requiring hospital attention', in others it is 'inpatient hospital care for at least 24 hours', while yet others have longer admission times. There is usually little liaison between police and health care facilities on how long a patient is admitted for, and so consequently the 'serious' category can range from a few scrapes and bruises to severe head injuries. In addition, in most high-income countries, almost all occupants in a vehicle are sent to hospital to be 'checked over' because of the possibility of covert injuries such as whiplash, and for insurance purposes. By contrast, in low- and middle-income countries, being seen by a doctor after a crash depends on access to care, a good pre-hospital care system, finances and other variables.

Further to this, different types of non-fatal injury are neither equal in their health impact on individuals, nor in their costs to society. Traumatic brain injury, for example, is one of the most costly forms of injury, requiring lengthy hospital stays and rehabilitation services, and often resulting in functional disability. In the same crash, a person with traumatic brain injury and a person with compound fractures in the leg might both be classified as 'severe injuries' under the definition of hospitalization for 24+ hours, when clearly there is a big difference in the long-term impact of these injuries.

Priorities for road traffic injury prevention and resource allocation cannot be properly identified without reliable and detailed information on the type of non-fatal injuries, going beyond slight/severe/fatal. In the vast majority of situations, police will be unable to provide this information.

In order for there to be reliable non-fatal data, one or more of the following strategies would need to be followed:

- Establish linkages between police and hospital databases, or develop mechanisms to incorporate hospital data into the road crash data system (see Case study 3.9).
- Mechanisms for regular follow up between police and hospitals, for example the hospital notifies the police when the patient is discharged, or grants access to police officers to enquire about the length of hospital stay/discharge date.
- Periodic comparison of databases.
  - ▹ Periodically conduct linkage studies with hospital records to assess the accuracy of police classification of injury severity against ICD codes (see Module 2) or Abbreviated Injury Scale scores.
  - ▹ Develop a standard methodology to assess under-reporting in police data by injury severity level (e.g. by matching police and hospital records and summarizing cases present in one or both databases). Use the results to estimate conversion factors that can be applied to police non-fatal injury data to provide a more accurate estimate of the real number of non-fatal injuries (see *18* for more details). Apply the methodology at regular intervals to re-assess the conversion factor(s).
  - ▹ Develop or use separate health information for non-fatal injuries.
    - – Introduce a hospital-based injury surveillance system. Step-by-step guidance for developing an injury surveillance system is available in the WHO-CDC *Injury Surveillance Guidelines*, and the CDC *Injury Surveillance Training Manual* (*4, 10*).
    - – If feasible, organize a mechanism for follow-up between police and hospitals, or link police and hospital databases so that health-derived information on injury severity is used to check police classification and to provide additional information on the nature of injury.
    - – Promote the use of ICD coding of hospital data and introduce measures to improve the use of external cause codes (E-codes) for injuries (see Case study 3.10).
    - – Conduct population-based surveys to estimate the magnitude of non-fatal road traffic injuries.

CASE STUDY 3.10: **Using health databases to assess road traffic injuries, Spain**

In Spain, road traffic injury statistics have been based mainly on police reports, with the use of health databases for this purpose being uncommon. In 2002 a working group was established to assess the health impact of road traffic injuries. The members of the working group include the Directorate General for Road Traffic (Spanish lead agency for road safety policy), the Ministry of Health, regional and local health departments and several research centres.

The group has published two reports about the availability, characteristics and use of health databases in Spain (*19, 20*), mostly based on the Hospital Discharges Minimum Data Set (*Conjunto Mínimo Básico de Datos de Altas Hospitalarias,* CMBDAH). The CMBDAH is a database administered by the Ministry of Health, which includes information about each discharge from a public hospital in Spain.

The working group has formulated several recommendations for improving the CMBDAH database (*19*):

- Improving the completeness of the ‘E-code’ (external causes of injuries). In about 25% of all road traffic injury-related hospital discharges, information on the relevant ‘E-code’ is currently missing. This may cause a serious underestimation of the real number of hospitalizations resulting from road traffic crashes.
- Introducing a new variable that identifies duplicated cases, i.e. people admitted more than once for the same injury.
- Improving the coverage of the database by including private hospitals.
- Including a identifier for each individual into the database, in order to link with police records.
- Creating a database using emergency services records, similar in format to the CMBDAH database itself.

Summary

- Establish a working group of key stakeholders with technical responsibility for implementation. The working group should develop a long-term road safety data strategy as well as a short-term action plan. The group should define primary goals and technical requirements for the system, and use the situational assessment to determine the best course of action.
- Police are key stakeholders. Efforts to improve final outcome data will not succeed without them. Involve the police in all stages of project planning, and ensure police participation in decisions that will affect their workload and methods of working.
- The specification of minimum data elements allows a common dataset for describing road traffic crashes, their characteristics and resulting injuries. The common dataset provides the information necessary for national analysis and road safety planning. This module proposes a set of minimum data elements and specifies uniform definitions and data values.

- Implement a 30-day definition for road traffic fatality. If it is not possible to apply this definition for data collection purposes, identify the appropriate correction factors and apply it to fatality data during data processing.
- Data quality can be improved by implementing minimum data elements, refining definitions, legal requirements to report injury crashes, improving data collection tools and procedures, improving methods used to identify and record crash location, training, and implementing quality assurance measures.
- Road crash data system performance can be strengthened by improving the flow of data through the system (from crash scene to final output), inclusion of useful features in the database system, and implementing a data management plan.
- Linkage to other databases can improve data quality if the other source is accurate, up-to-date, stable and in an accessible format. However, this is often not feasible because of issues such as incompatibilities in databases or privacy concerns. The methods to assess under-reporting described in Module 2 can be applied periodically as an alternative. In situations where other key databases (e.g. road inventory, vehicle registration, injury surveillance) are also in development, it may be easier to link databases or integrate data from other sources into the main crash database.
- Selection of consultants and suppliers requires research and careful consideration.
- 'Off-the-shelf' software platforms can be an effective solution for new systems and can often be rapidly implemented. Products should be widely pre-tested and proven, and come with appropriate levels of support for database installation and support beyond the initial implementation period.
- The quality of non-fatal road traffic injury data can be improved by using appropriate definitions of severity for police reporting, organizing a follow-up mechanism between police and hospitals, periodic assessments of the accuracy of police-reported severity, periodic assessments of police under-reporting of non-fatal injuries (allowing estimation of conversion factors), implementing a hospital-based injury surveillance system, linking databases (where feasible), and conducting population-based surveys.

Minimum data elements: full description

Crash data elements

The crash data elements describe the overall characteristics of the crash.

C1. Crash identifier

Definition: The unique identifier (e.g. a 10-digit number) within a given year that identifies a particular crash.

Obligation: Mandatory

Data type: Numeric or character string

Comments: This value is usually assigned by the police as they are responsible at the crash scene. Other systems may reference the incident using this number.

C2. Crash date

Definition: The date (day, month and year), on which the crash occurred.

Obligation: Mandatory

Data type: Numeric (DDMMYYYY)

Comments: If a part of the crash date is unknown, the respective places are filled in with 99 (for day and month). Absence of year should result in an edit check. Important for seasonal comparisons, time series analyses, management/administration, evaluation and linkage.

C3. Crash time

Definition: The time at which the crash occurred, using the 24 hour-clock format (00.00-23:59).

Obligation: Mandatory

Data type: Numeric (HH:MM)

Comments: Midnight is defined as 00:00 and represents the beginning of a new day. Variable allows for analyses of different time periods.

C4. Crash municipality and region

Definition: The municipality (C4.1) and county or equivalent entity (C4.2) in which the crash occurred.

Obligation: Mandatory

Data type: Character string

Comments: Important for analyses of local and regional programmes and critical for linkage of the crash file to other local/regional data files (hospital, roadway, etc). Also important for inter-regional comparisons.

C5. Crash location

Definition: The exact location at which the crash occurred. Optimum definition is route name and GPS/GIS coordinates if there is a linear referencing system (LRS), or other mechanism that can relate geographic coordinates to specific locations in road inventory and other files. The minimum requirement for documentation of crash location is the street name, the reference point, distance from reference point and direction from reference point.

Obligation: Mandatory

Data type: Character string, to support latitude/longitude coordinates, linear referencing method, or link node system.

Comments: Critical for problem identification, prevention programmes, engineering evaluations, mapping and linkage purposes.

C6. Crash type

Definition: The crash type is characterized by the first injury or damage-producing event of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Crash with pedestrian:** Crash between a vehicle and at least one pedestrian.

2 **Crash with parked vehicle:** Crash between a moving vehicle and a parked vehicle. A vehicle with a driver that is just stopped is not considered as parked.

3 **Crash with fixed obstacle:** Crash with a stationary object (i.e. tree, post, barrier, fence, etc).

4 **Non-fixed obstacle:** Crash with a non-fixed object or lost load.

5 **Animal:** Crash between a moving vehicle and an animal.

6 **Single vehicle crash/non-collision:** Crash in which only one vehicle is involved and no object was hit. Includes vehicle leaving the road, vehicle rollover, cyclists falling etc.

7 **Crash with two or more vehicles:** Crashes where two or more moving vehicles are involved.

8 **Other crashes:** Other crash types not described above.

Comments: If the road crash includes more than one event, the first should be recorded, through this variable. If more than one value is applicable, select only the one that corresponds best to the first event. Important for understanding crash causation, identifying crash avoidance countermeasures.

C7. Impact type

Definition: Indicates the manner in which the road motor vehicles involved initially collided with each other. The variable refers to the first impact of the crash, if that impact was between two road motor vehicles.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **No impact between motor vehicles:** There was no impact between road motor vehicles. Refers to single vehicle crashes, collisions with pedestrians, animals or objects.

2 **Rear end impact:** The front side of the first vehicle collided with the rear side of the second vehicle.

3 **Head on impact:** The front sides of both vehicles collided with each other.

4 **Angle impact – same direction:** Angle impact where the front of the first vehicle collides with the side of the second vehicle.

5 **Angle impact – opposite direction:** Angle impact where the front of the first vehicle collides with the side of the second vehicle.

6 **Angle impact – right angle:** Angle impact where the front of the first vehicle collides with the side of the second vehicle.

7 **Angle impact – direction not specified:** Angle impact where the front of the first vehicle collides with the side of the second vehicle.

8 **Side by side impact – same direction:** The vehicles collided side by side while travelling in the same direction.

9 **Side by side impact – opposite direction:** The vehicles collided side by side while travelling in opposite directions.

10 **Rear to side impact:** The rear end of the first vehicle collided with the side of the second vehicle.

11 **Rear to rear impact:** The rear ends of both vehicles collided with each other.

Comments: Useful for identifying structural defects in vehicles.

C8. Weather conditions

Definition: Prevailing atmospheric conditions at the crash location, at the time of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Clear** (No hindrance from weather, neither condensation nor intense movement of air. Clear and cloudy sky included)
2 **Rain** (heavy or light)
3 **Snow**
4 **Fog, mist or smoke**
5 **Sleet, hail**
6 **Severe winds** (Presence of winds deemed to have an adverse affect on driving conditions)
8 **Other weather condition**
9 **Unknown weather condition**

Comments: Allows for the identification of the impact of weather conditions on road safety. Important for engineering evaluations and prevention programmes.

C9. Light conditions

Definition: The level of natural and artificial light at the crash location, at the time of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Daylight:** Natural lighting during daytime.
2 **Twilight:** Natural lighting during dusk or dawn. Residual category covering cases where daylight conditions were very poor.
3 **Darkness:** No natural lighting, no artificial lighting
4 **Dark with street lights unlit:** Street lights exist at the crash location but are unlit.
5 **Dark with street lights lit:** Street lights exist at the crash location and are lit.
9 **Unknown:** Light conditions at time of crash unknown

Comments: Information about the presence of lighting is an important element in analysis of spot location or in network analysis. Additionally, important for determining the effects of road illumination on night-time crashes to guide relevant future measures.

Crash data elements derived from collected data

CD1. Crash severity

Definition: Describes the severity of the road crash, based on the most severe injury of any person involved.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Fatal:** At least one person was killed immediately or died within 30 days as a result of the road crash.

2 **Serious/severe injury:** At least one person was hospitalized for at least 24 hours because of injuries sustained in the crash, while no one was killed.

3 **Slight/minor injury:** At least one of the participants of the crash was hospitalized less than 24 hours or not hospitalized, while no participant was seriously injured or killed.

Comments: Provides a quick reference to the crash severity, summarizing the data given by the individual personal injury records of the crash. Facilitates analysis by crash severity level.

NOTE

Several crash-related variables can be derived from collected data, including number of vehicles involved (total), number of motorized vehicles involved, number of non-motorized vehicles involved, number of fatalities, number of non-fatal injuries, day of week, and more. These variables provide counts or other information without the user having to go back to individual records. Depending on the type of reports generated, deriving these data elements can save time and effort.

Road data elements

The road related data elements describe the characteristics of the road and associated infrastructure at the place and time of the crash.

R1. Type of roadway

Definition: Describes the type of road, whether the road has two directions of travel, and whether the carriageway is physically divided. For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the road where the vehicle with priority was moving is indicated.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Motorway/freeway:** Road with separate carriageways for traffic in two directions, physically separated by a dividing strip not intended for traffic. Road has no crossings at the same level with any other road, railway or tramway track, or footpath. Specially sign-posted as a motorway and reserved for specified categories of motor vehicles.

2 **Express road:** Road with traffic in two directions, carriageways not normally separated. Accessible only from interchanges or controlled junctions. Specially sign-posted as an express road and reserved for specified categories of motor vehicles. Stopping and parking on the running carriageway are prohibited.

3 **Urban road, two-way:** Road within the boundaries of a built-up area (an area with sign-posted entries and exits). Single, undivided street with traffic in two directions, relatively lower speeds (often up to 50 km/h), unrestricted traffic, with one or more lanes which may or may not be marked.

4 **Urban road, one-way:** Road within the boundaries of a built-up area, with entries and exits sign-posted as such. A single, undivided street with traffic in one direction, relatively lower speeds (often up to 50 km/h).

5 **Road outside a built-up area:** Road outside the boundaries of a built-up area (an area with sign-posted entries and exits).

6 **Restricted road:** A roadway with restricted access to public traffic. Includes cul-de-sacs, driveways, lanes, private roads.

8 **Other:** Roadway of a type other than those listed above.

9 **Unknown:** Not known where the incident occurred.

Comments: Important for comparing crash rates of roads with similar design characteristics, and for conducting comparative analyses between motorway and non-motorway roads.

R2. Road functional class

Definition: Describes the character of service or function of the road where the first harmful event took place. For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the road where the vehicle with priority was moving is indicated.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Principal arterial:** Roads serving long distance and mainly interurban movements. Includes motorways (urban or rural) and express roads. Principal

arterials may cross through urban areas, serving suburban movements. The traffic is characterized by high speeds and full or partial access control (interchanges or junctions controlled by traffic lights). Other roads leading to a principal arterial are connected to it through side collector roads.

2 **Secondary arterial:** Arterial roads connected to principal arterials through interchanges or traffic light controlled junctions supporting and completing the urban arterial network. Serving middle distance movements but not crossing through neighborhoods. Full or partial access control is not mandatory.

3 **Collector:** Unlike arterials, collectors cross urban areas (neighbourhoods) and collect or distribute the traffic to/from local roads. Collectors also distribute traffic leading to secondary or principal arterials.

4 **Local:** Roads used for direct access to the various land uses (private property, commercial areas etc). Low service speeds not designed to serve interstate or suburban movements.

R3. Speed limit

Definition: The legal speed limit at the location of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

nnn: The legal speed limit as provided by road signs or by the country's traffic laws for each road category, in kilometres per hour (km/h).

999 unknown: The speed limit at the crash location is unknown.

Comments: For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the speed limit for the road where the vehicle with priority was moving is indicated.

R4. Road obstacles

Definition: The presence of any person or object which obstructed the movement of the vehicles on the road. Includes any animal standing or moving (either hit or not), and any object not meant to be on the road. Does not include vehicles (parked or moving vehicles, pedestrians) or obstacles on the side of the carriageway (e.g. poles, trees).

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Yes:** Road obstacle(s) present at the crash site.

2 **No:** No road obstacle(s) present at the crash site.

9 **Unknown:** Unknown presence of any road obstacle(s) at the crash site.

NOTE

Countries where a large proportion of the road network is unpaved may wish to include the variable 'road surface type' to allow for analysis of crash rates by road surface type.

R5. Road surface conditions

Definition: The condition of the road surface at the time and place of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Dry:** Dry and clean road surface.

2 **Snow, frost, ice:** Snow, frost or ice on the road.

3 **Slippery:** Slippery road surface due to existence of sand, gravel, mud, leaves, oil on the road. Does not include snow, frost, ice or wet road surface.

4 **Wet, damp:** Wet road surface. Does not include flooding.

5 **Flood:** Still or moving water on the road.

6 **Other:** Other road surface conditions not mentioned above.

9 **Unknown:** The road surface conditions were unknown.

Comments: Important for identification of high wet-surface crash locations, for engineering evaluation and prevention measures.

R6. Junction

Definition: Indicates whether the crash occurred at a junction (two or more roads intersecting) and defines the type of the junction. In at-grade junctions all roads intersect at the same level. In not-at-grade junctions roads do not intersect at the same level.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **At-grade, crossroad:** Road intersection with four arms.

2 **At-grade, roundabout:** Circular road.

3 **At-grade, T or staggered junction:** Road intersection with three arms. Includes T intersections and intersections with an acute angle.
4 **At-grade, multiple junction:** A junction with more than four arms (excluding roundabouts).
5 **At-grade, other:** Other at-grade junction type not described above.
6 **Not at grade:** The junction includes roads that do not intersect at the same level.
7 **Not at junction:** The crash has occurred at a distance greater than 20 metres from a junction.
9 **Unknown:** The crash location relative to a junction is unknown.

Comments: Crashes occurring within 20 metres of a junction are considered as crashes at a junction. Important for site-specific studies and identification of appropriate engineering countermeasures.

R7. Traffic control at junction

Definition: Type of traffic control at the junction where crash occurred. Applies only to crashes that occur at a junction.

Obligation: Mandatory if crash occurred at a junction (R6)

Data type: Numeric

Data values:

1 **Authorized person:** Police officer or traffic warden at intersection controls the traffic. Applicable even if traffic signals or other junction control systems are present.
2 **Stop sign:** Priority is determined by stop sign(s).
3 **Give-way sign or markings:** Priority is determined by give-way sign(s) or markings.
4 **Other traffic signs:** Priority is determined by traffic sign(s) other than 'stop', 'give way' or markings.
5 **Automatic traffic signal (working):** Priority is determined by a traffic signal that was working at the time of the crash.
6 **Automatic traffic signal (out of order):** A traffic signal is present but out of order at time of crash.
7 **Uncontrolled:** The junction is not controlled by an authorized person, traffic signs, markings, automatic traffic signals or other means.
8 **Other:** The junction is controlled by means other than an authorized person, signs, markings or automatic traffic signals.

Comments: If more than one value is applicable (e.g. traffic signs and automatic traffic signals) record all that apply.

R8. Road curve

Definition: Indicates whether the crash occurred inside a curve, and what type of curve.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Tight curve:** The crash occurred inside a road curve that was tight (based on the judgment of the police officer).

2 **Open curve:** The crash occurred inside a road curve that was open (based on the judgment of the police officer).

3 **No curve:** The crash did not occur inside a road curve.

9 **Unknown:** It is not defined whether the crash occurred inside a road curve.

Comments: Useful for identification and diagnosis of high-crash locations, and for guiding changes to road design, speed limits, etc.

R9. Road segment grade

Definition: Indicates whether the crash occurred on a road segment with a steep gradient.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Yes:** The crash occurred at a road segment with a high grade.

2 **No:** The crash did not occur at a road segment with a high grade.

9 **Unknown:** It is not defined whether the crash occurred at a road segment with a high grade.

Comments: Useful for identification and diagnosis of high-crash locations, and for guiding changes to road design, speed limits, etc.

Vehicle data elements

The vehicle data elements describe the characteristics and events of the vehicle(s) involved in the crash.

V1. Vehicle number

Definition: Unique vehicle number assigned to identify each vehicle involved in the crash.

Obligation: Mandatory

Data type: Numeric, sequential two-digit number

Comments: Allows the vehicle record to be cross-referenced to the crash record and person records.

V2. Vehicle type

Definition: The type of vehicle involved in the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Bicycle:** Road vehicle with two or more wheels, generally propelled solely by the energy of the person on the vehicle, in particular by means of a pedal system, lever or handle.

2 **Other non-motor vehicle:** Other vehicle without engine not included in the list above.

3 **Two/three wheel motor vehicle:** Two or three-wheeled road motor vehicle (includes mopeds, motorcycles, tricycles and all-terrain vehicles).

4 **Passenger car:** Road motor vehicle other than a two or three-wheeled vehicle, intended for the carriage of passengers and designed to seat no more than nine (driver included).

5 **Bus/coach/trolley:** Passenger-carrying vehicle, most commonly used for public transport, inter-urban movements and tourist trips, seating more than nine persons. Includes vehicles connected to electric conductors and which are not rail-borne.

6 **Light goods vehicle (<3.5 t):** Smaller (by weight) motor vehicle designed exclusively or primarily for the transport of goods.

7 **Heavy goods vehicle (≥3.5 t):** Larger (by weight) motor vehicle designed exclusively or primarily for the transport of goods.

8 **Other motor vehicle:** Other vehicle not powered by an engine and not included in the two previous lists of values.

9 **Unknown:** The type of the vehicle is unknown or it was not stated.

Comments: Allows for analysis of crash risk by vehicle type and road user type (in combination with Type of road user, P20). Important for evaluation of countermeasures designed for specific vehicles or to protect specific road users.

V3. Vehicle make

Definition: Indicate the make (distinctive name) assigned by motor vehicle manufacturer.

Obligation: Mandatory if the vehicle is a motorized vehicle. Not applicable to bicycles, tricycles, rickshaws and animal-powered vehicles.

Data type: Character string. Alternatively, a list of motor vehicle makes can be composed, with a code corresponding to each. Such a list allows for more consistent and reliable recording, as well as for easier interpretation of the data.

Comments: Allows for crash analyses related to the various motor vehicle makes.

V4. Vehicle model

Definition: The code assigned by the manufacturer to denote a family of motor vehicles (within a make) that have a degree of similarity in construction.

Obligation: Mandatory if the vehicle is a motorized vehicle. Not applicable to bicycles, tricycles, rickshaws and animal-powered vehicles

Data type: Character string. Alternatively, a list of motor vehicle models can be composed, with a code corresponding to each. Such a list allows for more consistent and reliable recording, as well as for easier interpretation of the data.

Comments: Record the name of the model as referred to in the country in which the crash occurred. Allows for crash analyses related to the various motor vehicle models.

V5. Vehicle model year

Definition: The year assigned to a motor vehicle by the manufacturer.

Obligation: Mandatory if the vehicle is a motorized vehicle. Not applicable to bicycles, tricycles, rickshaws and animal-powered vehicles

Data type: Numeric (YYYY)

Comments: Can be obtained from vehicle registration. Important for use in identifying motor vehicle model year for evaluation, research, and crash comparison purposes.

V6. Engine size

Definition: The size of the vehicle's engine is recorded in cubic centimeters.

Obligation: Mandatory, if vehicle is motorized. Not applicable to bicycles, tricycles, rickshaws and animal-powered vehicles.

Data type: Numeric

Data values:

- **nnnn:** Size of engine
- **9999:** Unknown engine size

Comments: Important for identifying the impact of motor vehicle power on crash risk.

V7. Vehicle special function

Definition: The type of special function being served by this vehicle regardless of whether the function is marked on the vehicle.

Obligation: Mandatory, if vehicle is motorized. Not applicable to bicycles, tricycles, rickshaws and animal-powered vehicles.

Data type: Numeric

Data values:

1 **No special function:** No special function of the vehicle.
2 **Taxi:** Licensed passenger car for hire with driver, without predetermined routes.
3 **Vehicle used as bus:** Passenger road motor vehicle used for the transport of people.
4 **Police / military:** Motor vehicle used for police / military purposes.
5 **Emergency vehicle:** Motor vehicle used for emergency purposes (includes ambulances, fire service vehicles etc).
8 **Other:** Other special functions, not mentioned above.
9 **Unknown:** It was not possible to record a special function.

Comments: Important to evaluate the crash involvement of vehicles used for special uses.

V8. Vehicle manoeuvre

Definition: The controlled manoeuvre for this motor vehicle prior to the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Reversing:** The vehicle was reversing.
2 **Parked:** Vehicle was parked and stationary.
3 **Entering or leaving a parking position:** The vehicle was entering or leaving a parking position
4 **Slowing or stopping:** The vehicle was slowing or stopping
5 **Moving off:** The vehicle was still and started moving. Does not include vehicle leaving or entering a parking position.
6 **Waiting to turn:** The vehicle was stationary, waiting to turn.
7 **Turning:** The vehicle was turning (includes U-turns).

10 **Changing lane:** The vehicle was changing lane.

11 **Avoidance manoeuvre:** The vehicle changed its course in order to avoid an object on the carriageway (including another vehicle or pedestrian).

12 **Overtaking vehicle:** The vehicle was overtaking another vehicle.

13 **Straight forward / normal driving:** The vehicle was moving ahead away from any bend.

8 **Other**

9 **Unknown**

Person data elements

The person data elements describe the characteristics, actions, and consequences relating to the people involved in the crash. These elements are to be completed for every person injured in the crash, and also for the drivers of all vehicles (motorized and non-motorized) involved in the crash.

P1. Person number

Definition: Number assigned to uniquely identify each person involved in the crash.

Obligation: Mandatory

Data type: Numeric (two-digit number, nn)

Comments: The persons related to the first (presumed liable) vehicle will be recorded first. Within a specific vehicle, the driver will be recorded first, followed by the passengers. Allows the person record to be cross-referenced to crash, road and vehicle records to establish a unique linkage with the Crash ID (C1) and the Vehicle number (V1).

P2. Occupant's vehicle number

Definition: The unique number assigned for this crash to the motor vehicle in which the person was an occupant (V1).

Obligation: Mandatory

Data type: Numeric (two-digit number, nn)

Comments: Allows the person record to be cross-referenced to the vehicle records, linking the person to the motor vehicle in which they were travelling.

P3. Pedestrian's linked vehicle number

Definition: The unique number assigned for this crash to the motor vehicle which collided with this person (V1). The vehicle number assigned under (V1) to the motor vehicle which collided with this person.

Obligation: Mandatory

Data type: Numeric (two-digit number, nn, from V1)

Comments: Allows the person record to be cross-referenced to the vehicle records, linking the person to the motor vehicle that struck them.

P4. Date of birth

Definition: Indicates the date of birth of the person involved in the crash.

Obligation: Mandatory

Data type: Numeric (date format – dd/mm/yyyy, 99/99/9999 if birth date unknown)

Comments: Allows calculation of person's age. Important for analysis of crash risk by age group, and assessing effectiveness of occupant protection systems by age group. Key variable for linkage with records in other databases.

P5. Sex

Definition: Indicates the sex of the person involved in the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Male:** On the basis of identification documents / personal ID number or determined by the police.

2 **Female:** On the basis of identification documents / personal ID number or determined by the police.

9 **Unknown:** Sex could not be determined (police unable to trace person, not specified).

Comments: Important for analysis of crash risk by sex. Important for evaluation of the effect of sex of the person involved on occupant protection systems and motor vehicle design characteristics.

P6. Type of road user

Definition: This variable indicates the role of each person at the time of the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Driver:** Driver or operator of motorized or non-motorized vehicle. Includes cyclists, persons pulling a rickshaw or riding an animal.

2 **Passenger:** Person riding on or in a vehicle, who is not the driver. Includes person in the act of boarding, alighting from a vehicle or sitting/stranding.

3 **Pedestrian:** Person on foot, pushing or holding a bicycle, pram or a pushchair, leading or herding an animal, riding a toy cycle, on roller skates, skateboard or skis. Excludes persons in the act of boarding or alighting from a vehicle.

8 **Other:** Person involved in the crash who is not of any type listed above.

9 **Unknown:** It is not known what role the person played in the crash.

Comments: Allows for analysis of crash risk by road user type (in combination with Vehicle type, V2). Important for evaluation of countermeasures designed to protect specific road users.

P7. Seating position

Definition: The location of the person in the vehicle at the time of the crash.

Obligation: Mandatory for all vehicle occupants

Data type: Numeric

Subfield: Row

Data values:

1 **Front**

2 **Rear**

3 **Not applicable** (e.g. riding on motor vehicle exterior)

8 **Other**

9 **Unknown**

Subfield: Seat

Data values:

1 **Left**

2 **Middle**

3 **Right**

4 **Not applicable** (e.g. riding on motor vehicle exterior)

8 **Other**

9 **Unknown**

Comments: Important for full evaluation of occupant protection programmes.

P8. Injury severity

Definition: The injury severity level for a person involved in the crash.

Obligation: Mandatory

Data type: Numeric

Data values:

1 **Fatal injury:** Person was killed immediately or died within 30 days, as a result of the crash.

2 **Serious/severe injury:** Person was hospitalized for at least 24 hours because of injuries sustained in the crash.

3 **Slight/minor injury:** Person was injured and hospitalized for less than 24 hours or not hospitalized.

4 **No injury:** Person was not injuried.

9 **Unknown:** Injury severity was not recorded or is unknown.

Comment: Important for injury outcome analysis and evaluation and appropriate classification of crash severity (PD1). Important element for linkage with records in other databases.

P9. Safety equipment

Definition: Describes the use of occupant restraints, or helmet use by a motorcyclist or bicyclist.

Obligation: Mandatory

Data type: Numeric

Subfield: Occupant restraints

Data values:

1 **Seat-belt available, used**

2 **Seat-belt available, not used**

3 **Seat-belt not available**

4 **Child restraint system available, used**

5 **Child restraint system available, not used**

6 **Child restraint system not available**

7 **Not applicable:** No occupant restraints could be used on the specific vehicle (e.g. agricultural tractors).

8 **Other restraints used**

9 **Unknown:** Not known if occupant restraints were in use at the time of the crash.

10 **No restraints used**

Subfield: Helmet use

Data values:

1 **Helmet worn**

2 **Helmet not worn**

3 **Not applicable** (e.g. person was pedestrian or car occupant)
9 **Unknown**

Comments: Information on the availability and use of occupant restraint systems and helmets is important for evaluating the effect of such safety equipment on injury outcomes.

P10. Pedestrian manoeuvre

Definition: The action of the pedestrian immediately prior to the crash.

Obligation: Mandatory

Data type: Numeric

Data values

1 **Crossing:** The pedestrian was crossing the road.
2 **Walking on the carriageway:** The pedestrian was walking across the carriageway facing or not facing traffic.
3 **Standing on the carriageway:** The pedestrian was on the carriageway and was stationary (standing, sitting, lying etc).
4 **Not on the carriageway:** The pedestrian was standing or moving on the sidewalk or at any point beside the carriageway.
8 **Other:** The vehicle or the pedestrian was performing a manoeuvre not included in the list of the previous values.
9 **Unknown:** The manoeuvre performed by the vehicle or the pedestrian was not recorded or it was unknown.

Comments: Provides useful information for the development of effective road design and operation, education and enforcement measures to accommodate pedestrians.

P11. Alcohol use suspected

Definition: Law enforcement officer suspects that person involved in the crash has used alcohol.

Obligation: Mandatory for all drivers of motorized vehicles, recommended for all non-motorists (pedestrians and cyclists).

Data type: Numeric

Data values:

1 **No**
2 **Yes**
3 **Not applicable** (e.g. if person is not driver of motorized vehicle)
9 **Unknown**

P12. Alcohol test

Definition: Describes alcohol test status, type and result.

Obligation: Conditional (mandatory if alcohol use suspected, P25)

Data type: Numeric

Subfield: Test status

Data values:

1 **Test not given**
2 **Test refused**
3 **Test given**
9 **Unknown if tested**

Subfield: Test type

Data values:

1 **Blood**
2 **Breath**
3 **Urine**
8 **Other**
9 **Test type unknown**

Subfield: Test result

Data values

Value

Pending

Result unknown

Comments: Alcohol-related crashes are a major road safety problem. Information on alcohol involvement in crashes facilitates evaluation of programmes to reduce drink-driving.

P13. Drug use

Definition: Indication of suspicion or evidence that person involved in the crash has used illicit drugs.

Obligation: Mandatory for all drivers of motorized vehicles, recommended for all non-motorists (pedestrians and cyclists).

Data type: Numeric

Data values:

1 **No suspicion or evidence of drug use**
2 **Suspicion of drug use**

3 **Evidence of drug use** (further subfields can specify test type and values)
4 **Not applicable** (e.g. if person is not driver of motorized vehicle)
9 **Unknown**

P14. Driving licence issue date

Definition: Indicates the date (month and year) of issue of the person's first driving licence, provisional or full, pertaining to the vehicle they were driving.

Obligation: Mandatory for all drivers of motorized vehicles

Data type: Numeric (MMYYYY)

Data values:

Value (MMYYYY)
Never issued a driving licence
Date of issue of first licence unknown

Comments: Allows calculation of number of years' driving experience at the time of crash.

Person data elements derived from collected data

PD1. Age

Definition: The age in years of the person involved in the crash.

Data type: Numeric

Comments: Derived from Date of birth (P4) and Crash date (C2). Important for analysis of crash risk by age group, and assessing effectiveness of countermeasures by age group.

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4

Using data to improve road safety

DATA THAT are collected and analyzed but not acted upon represent a poor use of resources. The ultimate aim of developing good road safety data systems is to use the information generated to improve the road safety situation. This module provides users with an introduction to how the outputs of road safety data systems may be used for evidence-based road traffic injury prevention, and monitoring and evaluation of road safety performance.

The sections in this module are structured as follows:

- **4.1 Dissemination:** People can only use road safety data if they have access to it. The module begins with a discussion of dissemination mechanisms.
- **4.2 Using road safety data:** This section looks at the role of data in the decision-making cycle presented in Module 1, and summarizes how crash data are used by traffic engineers to identify problems and make improvements to the road network.
- **4.3 Monitoring road safety performance:** This section describes indicators that may be used to monitor the road safety situation, and their strengths and limitations. The selection of qualitative and quantitative policy objectives, or targets, is briefly discussed.
- **4.4 International cooperation on road safety data:** This section describes the activities of several international agencies to strengthen road safety data capacity worldwide.
- **4.5 Assessing interventions:** This section describes how outputs of a road safety data system may be used to evaluate the impact of interventions.

4.1 Dissemination

As described in Module 1, reliable data provide the foundations for effective road safety management. After relevant analysis and collation, outputs of the road crash data system should be used locally and nationally to:

- identify risk factors and risk areas (i.e. diagnose road safety problems);
- determine appropriate interventions;
- monitor progress in achieving road safety objectives;
- evaluate the effectiveness of interventions.

To facilitate this, data must be available and accessible. Traffic engineers, police officers and public health specialists at the local level, regional authorities responsible for road safety, and national-level policy-makers should all have access to the data in order to identify problems and appropriate cost-effective solutions. Mechanisms such as statistical reports, newsletters, websites and workshops must be established to disseminate the results of analysis regularly to road safety stakeholders. The different data needs of various stakeholders should be considered. It is unlikely that the same analyses and reports will be equally useful for all data users. Special consideration should be given to developing appropriate mechanisms for disseminating relevant data to:

- the police, to demonstrate the importance of their role in data collection and to help them better target enforcement efforts;
- traffic engineers, to help them identify high-risk locations and develop appropriate solutions;
- planners in the health sector, to help them plan for adequate health services and appropriate interventions to prevent road traffic injuries;
- road safety policy-makers, to help them diagnose priority problems and implement appropriate strategies and interventions;
- policy-makers in finance, transport, law enforcement and health, to help them understand the impact of their policies on road safety;
- the general public, to make them aware of the magnitude (and changes in the magnitude) of the problem, and how their behaviour contributes.

NOTE

It is essential to publish data on road traffic injuries, even if the figures are worse than expected. Improvements to road crash data collection systems may lead to an increase in the reported number of road traffic injuries, simply because the data are more accurate. Even if the increase in deaths and injuries reflects an actual change, rather than a change in measurement, this is important information for planning. Failure to share and publish road safety data hinders appropriate priority identification, fair resource allocation and evaluation of the impact of road safety management.

Road traffic injury data should be published as national statistics, comprising an annual statistical yearbook as well as monthly and/or quarterly reports (see Box 4.1). These statistical reports should contain basic figures for the main road safety variables at national level. Moreover, customized reports may be published to answer specific demands from specialist users. Statistical analyses should also be conducted for regional and local levels, and the results disseminated regularly. Basic fact sheets devoted to particular road safety topics can also be a useful means of communicating data both to policy-makers and the public.

However, general figures published by national or international administrations may not fully cover the specific areas of concern of road safety researchers. Moreover, in most cases, combined data are required per road user, per vehicle and for road characteristics. Such detailed data should be made available to specialist users where they request it. Alternatively, and if resources permit, access can be given through an online searchable database (for example, see Box 4.2).

BOX 4.1: **Mechanisms for disseminating data**

There are many excellent examples of dissemination of road safety data through publications and websites. Only a few could be presented here.

In **New Zealand,** the Ministry of Transport provides a variety of reports and statistical summaries. These are based on analysis of detailed information on crash circumstances and causes, extracted from police reports and stored in the Ministry's Crash Analysis System:

- *Motor Vehicle Crashes in New Zealand* is an annual statistical statement of national data from the Crash Analysis System. The report also includes national hospital statistics on breath and blood alcohol levels, road user behaviour and comparative international statistics.
- *Crash Facts* is a series of national fact sheets produced annually and covering topics such as alcohol, speed, young drivers and pedestrians.
- A monthly report of updated crash statistics.
- A series of briefing notes and regional reports based on analysis of data at the regional level.

These products can be downloaded free of charge from the Ministry of Transport website (www.transport.govt.nz/research/RoadCrashStatistics/).

In **Cambodia**, information on road traffic injuries and crashes from traffic police and health facility records is stored in the Road Crash and Victim Information System (RCVIS). These data are analysed with the support of Handicap International Belgium (Phnom Penh office) and presented in monthly and annual reports. The reports are disseminated regularly in electronic and printed form to more than 400 end users in the National Road Safety Committee (NRSC), Ministry of Interior, Ministry of Health, Ministry of Public Works and Transport, Ministry of Information, National Assembly, news media, and local and international non-governmental organizations. The reports can be found on the National Road Safety Committee website (www.roadsafetycambodia.info/action2).

In the **USA**, the National Center for Statistics and Analysis (NCSA) of the National Highway Traffic Safety Administration (NHTSA) publishes annual fact sheets on key road safety topics. These are available online through the Customer Automated Tracking System, which gives customers access to electronic publications, documentations, manuals, and presentations (www-nrd.nhtsa.dot.gov/Cats/index.aspx). In addition, customized data requests and questions can be submitted directly to NCSA at this site. Another NHTSA website used to disseminate data is the Fatality Analysis Reporting System (FARS) Encyclopedia Website, which provides a compilation of FARS data from 1994 to the present, as well as other information resources (http://www-fars.nhtsa.dot.gov). Users can create reports, query and download the data, and access NCSA's publications, state laws, documentation, and terms and definitions.

Several **international organizations** provide statistics and reports for comparative road safety. These are useful sources of information as well as examples of what can be done to make data accessible.

- The *SafetyNet* project to develop a European Road Safety Observatory produced a series of fact sheets (*Traffic Safety Basic Facts 2008,* www.erso.eu/data/content/basic_facts.htm#_Basic_Facts) summarizing data for 14 EU countries for the period 1997–2006.
- The United Nations Economic Commission for Europe (UNECE) collects transport statistics, including information on road crashes, from 56 Member States. Statistics are accessible online via the UNECE website, which allows customized queries by country or by topic (http://w3.unece.org/pxweb/DATABASE/STAT/Transport.stat.asp). Similar information is available for the Member States of the UN Economic and Social Commission for Asia and the Pacific (UNESCAP) in the Asia-Pacific Road Accident Database (www.unescap.org/ttdw/data/aprad.aspx).
- The International Road Federation produces an annual compilation of road and vehicle statistics, including some road crash data. The report draws on official data sources from national statistics offices and national road administrations, and covers more than 185 countries (see www.irfnet.org/statistics.php).
- The Community Database on Accidents on the Roads in Europe, better known as CARE, contains detailed data on fatal and injury crashes provided by European countries. Annual statistical reports, summary tables and fact sheets are published regularly on the website, and certain agencies are allowed access to the database to create their own reports (http://ec.europa.eu/transport/road_safety/observatory/statistics/reports_graphics_en.htm).

BOX 4.2: **Searchable databases**

In the USA, the Centers for Disease Control and Prevention (CDC) hosts the web-based Injury Statistics Query and Reporting System (WISQARS™). It is an interactive database that provides customized reports of injury-related data – fatal and non-fatal outcomes as well as years of potential life lost.

For example, the system can generate information (see screen shot below) on how many motorcyclists were injured severely enough to warrant hospitalization in the USA during 2008.

Unintentional Motorcyclist - Traffic Nonfatal Injuries and Rates per 100,000

2008, United States, All Races, Both Sexes, All Ages
Disposition: Hospitalized

Number of injuries	Population	Crude Rate	Age-Adjusted Rate**
36,154*	304,059,724	11.88	11.55

*Injury estimate is unstable because it is based on small sample size. Use with caution.
** Standard Population is 2000, all races, both sexes.

The system is also able to generate charts and complex tables, and provides support to users through a tutorial and online help system.

Searchable, online databases such as this greatly increase the accessibility of road safety data for policy-makers, the general public and researchers. For further information about the CDC system, see www.cdc.gov/injury/wisqars/index.html


Le Quotidien

Trop de victimes sur les routes

Saint-Nicolas reprend la route

Another effective mode of disseminating information is via the media. The media provide channels of communication and education, and can also be effective agents of change, influencing public opinion and political will in the way they present information.

In addition to publishing information in a variety of formats, the 'owners' of databases related to road safety should be encouraged to make their data available to other road safety stakeholders, and for research to assess under-reporting and improve estimates by comparing or linking databases (see Module 2). Those responsible for data related to road crashes and injuries are often reluctant to share case-level records because of privacy concerns. A number of methods may be used to protect the privacy of individuals while sharing information in the record relevant to road safety.

Why data may not be used

The outputs of road safety data systems do not always get used for decision-making, even if data are perceived to be reliable (*1, 2*):

- *Timing* – data may not be available at the right time in the planning cycle.
- *Perceived relevance* – decision-makers may not see the usefulness of the data for planning purposes, or conclusions are not concrete and applicable.
- *Conflict* – decision-makers may be reluctant to use data if the findings contradict political priorities, public opinion, or even their own personal experience or beliefs.
- *Information culture* – the output of a data system may have little impact if institutional or general culture does not place importance on the role of accurate data in decision-making. Also, for politicians, data are just one of many inputs into the decision-making process.
- *Communication* – if the results of analysis, and their implications, are not presented clearly and succinctly and with concrete recommendations, they are less likely to be acted upon.

It is not possible to test for all these factors, especially those related to political and ideological barriers. Those in charge of road crash data systems – especially those with responsibility for analysis and dissemination of results – should build relationships with road safety policy-makers. Through ongoing communication and relationships, you can clarify expectations and identify measures for improving the use of road safety data in planning and policy-making (*2*). Practical steps to bridge the gap between data and policy include (*1*):

- conducting data needs assessments with end-users (see Module 2);
- involving policy-makers in the planning stages of a road crash data system, particularly regarding what data are collected, data quality control checks, and the data analysis and dissemination plan;
- timely dissemination of results;
- dissemination of results in a variety of formats, ranging from fact sheets to policy briefs to longer, more technical reports;
- using accessible language (i.e. minimizing technical jargon);
- organizing workshops, briefings and seminars with policy-makers to discuss findings.

4.2 Using road safety data

4.2.1 Advocacy

Data can be used for advocacy – this means raising awareness about road safety and using the 'story' told by the data to influence the policies, programmes and resources allocated to road safety (*3*). A wide range of activities can be classified as *advocacy*, including workshops, media reports, formation of alliances and coalitions, and campaigns.

Public advocacy campaigns, which often use mass media, should inform people about the main road safety problems and risk factors and how these can be prevented. An aware and informed public can demand appropriate responses from government. Advocacy campaigns can also influence widespread beliefs and attitudes that affect people's behaviour on the road. They should address public misconceptions, for example the belief that it is less important to use seat-belts when travelling in rear seats in cars. Campaigns that accompany the introduction of new laws and policies can enhance their effectiveness. Public health practitioners often have experience of implementing and evaluating effective health promotion campaigns, and thus are an important resource in an road safety related campaign.

Advocacy is also a critical tool for convincing policy-makers and donors that road safety is a priority issue deserving investment. Advocacy messages for government ministries and donors should be carefully crafted with consideration for the target audience and their specific context, including what arguments are most likely to 'speak' to them. Tips for developing advocacy messages and materials for policy-makers include the following:

- Describe the magnitude of the problem using indicators they will understand (e.g. health policy-makers are familiar with thinking of problems in terms of fatalities per 100 000 population, while transport policy-makers may be more comfortable thinking of fatalities per 10 000 vehicles).
- Help people understand the scale of the problem by comparing it to something of familiar size (e.g. other major health problems, size of certain towns or population groups).
- Avoid using language that is too technical.
- Provide information on the effectiveness of proven road traffic injury prevention strategies, and reductions in the costs to that can be made.

4.2.2 Technical uses of road safety data

The decision-making cycle presented in Module 1 (Figure 1.1) demonstrates that reliable data are needed to identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance. For the identification of problems, risk factors and priority areas, policy-makers require data to estimate the magnitude (absolute numbers and rates), severity, trends, and costs of road traffic injuries – both absolute, and in relation to other health conditions or social problems. This information, presented by geographic area, age group, crash type and road user group helps identify priority areas for road traffic injury prevention. When combined with knowledge of risk factors and effectiveness of interventions, the information can be used to identify priorities, choose effective responses, and target resources more efficiently. In most situations a police-derived crash database will not be adequate to meet these needs, but drawing on additional data sources such as injury surveillance systems, hospital discharge data or national surveys can help fill the gaps (see Case study 4.1).

CASE STUDY 4.1: **Motorcyclist deaths and interventions in Cali, Colombia, 1993–2002**

In the city of Cali, Colombia, a fatal injury surveillance system was established by the Mayor's office as part of the DESEPAZ programme (a Spanish acronym meaning Development, Security and Peace). This surveillance system has been collecting data on fatal injuries in the city since 1993, and continues today (see www.cali.gov.co/observatorios).

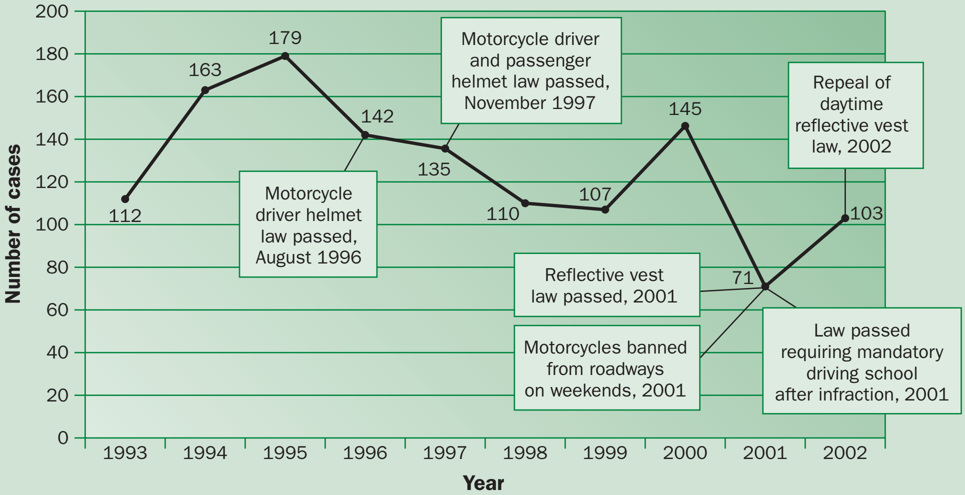
Data analysis has been performed periodically, and disseminated to decision-makers and the various sectors involved (e.g. police department, transport office, forensic medicine department) through statistical bulletins (see http://vigilesiones.univalle.edu.co/informes/boletines.html). One of the more successful strategies based on the findings of the surveillance system has been the introduction of mandatory helmet use for motorcyclists.

Data from the vital statistics office showed that road traffic injuries were one of the leading causes of death. In addition, the injury surveillance system showed that motorcyclists were one of the most affected groups, accounting for 30% of road traffic deaths. In 1996 the local administration introduced a law requiring motorcycle drivers to wear helmets. Surveys showed an increase in helmet use among motorcycle drivers, but no change in helmet use among passengers. During the same period the surveillance system showed a reduction in deaths of motorcycle drivers, but an increase in deaths of motorcycle passengers.

This information convinced decision-makers to modify the law, and a new law requiring helmet use for both motorcycle drivers and passengers was implemented in 1997. After introduction of this law, surveys found that helmet use increased among motorcycle drivers and passengers. Through the surveillance system it was possible to see that deaths of motorcycle drivers and passengers decreased after the new law, and a statistical evaluation showed that the reduction, observed over a five-year period, was significant (*4*).

In 2000 an unexpected increase in fatal injuries to motorcyclists was observed, and this was attributed to a reduction in law enforcement personnel. In 2001, three additional strategies were implemented to augment the helmet law: mandatory driving school after traffic infractions, mandatory use of reflective vests, and banning motorcycles from public roads on weekends. That year the lowest number of motorcyclist deaths was recorded.

Motorcyclist deaths and interventions in Cali, Colombia, 1993–2002



Source: (*5*)

NOTE

Public health professionals have an important contribution to make to the way road safety data are used to diagnose problems and determine appropriate solutions. Most have received specialized training in measuring the magnitude of diseases and injuries, identifying underlying causes, risk factors and risk groups, and in evaluating the impact of prevention programmes (6), which can be applied to road traffic injury prevention.

Use of road crash data for traffic engineering

Road crash databases derived from police reports, as described in Module 3, can be used in many ways. The summary statistics can be used in combination with other data sources to inform overall road safety strategies and interventions in many sectors. Findings from the database can also be used by police to target enforcement efforts more effectively, though this requires development of a mechanism to ensure that data are fed back to the police for their own use, especially from systems that are the responsibility of another agency or sector (see Case study 4.2).

CASE STUDY 4.2: **Application of road crash data, Malaysia**

All road crashes in Malaysia are investigated by the traffic division of the Royal Malaysian Police. Since 1991, a nationwide, standardized accident data collection form has been used to collect road crash information. Ninety-one data variables are collected, including general crash information, driver, vehicle, passenger and pedestrian information, whether an animal was involved, and location information. Crash data are stored electronically by police stations in each district.

In order to fully benefit from crash data collected by police, the Malaysian Institute of Road Safety Research (MIROS) has developed the MIROS Road Accident Analysis and Database System (M-ROADS). Electronic copies of crash data are collected regularly and uploaded into the M-ROADS database. Among the useful features developed in M-ROADS are cross-tabulation and accident location ranking. The system can analyse these data and provide intelligence on road safety problems.

Having a comprehensive crash dataset and analysis system has greatly helped the government plan and implement evidence-based road safety interventions in Malaysia. M-ROADS helps determine what the problem is, who should be targeted, why the problem occurs, how to solve the it, and when and where to carry out enforcement.

Two of the main problems identified by M-ROADS were speeding and traffic light violations. To reduce them, the government introduced the Automated Enforcement System (AES). Locations with high numbers of crashes and fatalities resulting from speeding and red light violations were identified using M-ROADS, and electronic cameras will be installed at these locations. Warning signs will alert drivers to the enforcement camera ahead, motivating them to slow down to the speed limit or obey the traffic light. It is estimated that AES may reduce overall fatalities by 9% by 2010.

Motorcyclists were also found to have a high fatality rate in Malaysia – the result of their vulnerability and involvement in 'out of control' and 'side impact' collisions. Further investigation identified that most injuries were to the head, suggesting that helmet wearing should be enforced. The question of when and where enforcement should be done can be identified uniquely for each state or district using M-ROADS, meaning enforcement is evidence-based and not done intuitively.

For more information, see www.miros.gov.my/.

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The most common use of police crash databases for road safety work is by traffic engineers in the transport sector, who use them to identify high-risk sites on the road network. Further investigation and in-depth crash analysis can then help identify probable site-specific risk factors, and appropriate road engineering or traffic management measures to reduce them. This type of investigation benefits from a fully computerized crash database that accurately records the location of each crash – if possible, through Geographic Information System (GIS) coordinates (see Module 3). The types of information required by traffic engineers for analysis are usually not captured in health facility data on road traffic injuries, so the police-derived database is key.

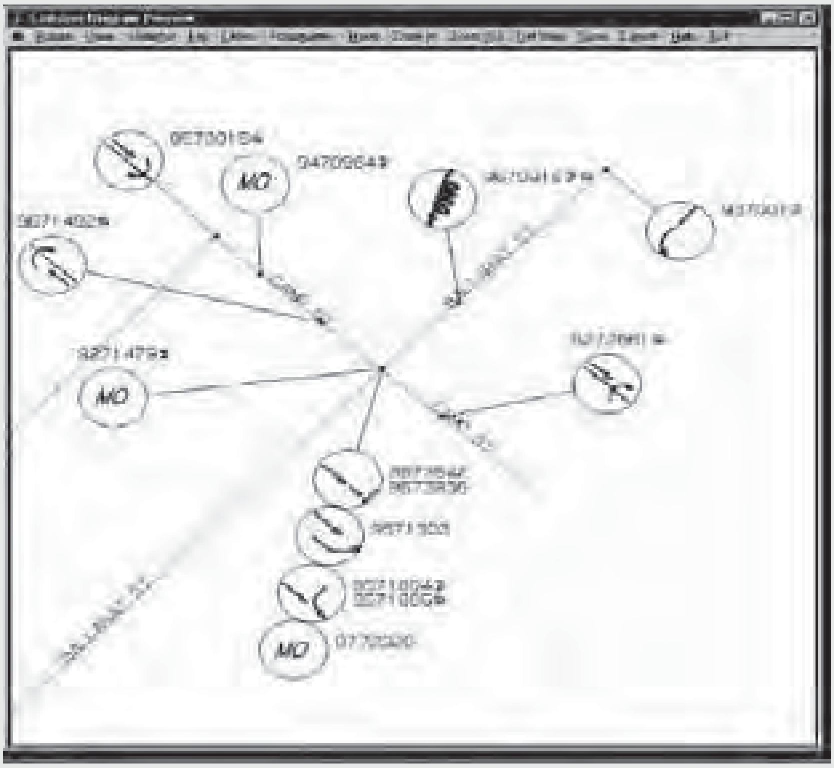
After specifying a time period for analysis (e.g. a three or five year period), sites with high crash numbers and/or rates (e.g. crashes per length or area of road) can be identified. It can be useful to apply statistical analyses to the data so that results at a particular site or section of road can be compared with the overall statistics, to determine whether a site has a real problem or whether the differences are because of random fluctuations. This is particularly important if there are few crashes per year at the site.

The next step is to prioritize high-crash locations for further investigation. Typically locations with the highest crash rates (e.g. crashes per year or per length of road) are assessed first. Many jurisdictions have a threshold for inclusion as a high-crash site or 'black spot'. For example, this might be five injury crashes in a three year period. Another system that is sometimes used is to select sites by including some measure of crash severity. For example, a simple calculation can be made of the total crash cost at a site. This is achieved by multiplying the number of crashes of different severities by the relevant 'cost' of that crash severity. Sites are then ranked on this cost basis for further investigation. Whatever criteria are selected, it should produce a manageable list of sites for further investigation.

Guidance is available on the process for investigating sites for treatment, and it is important that policies are in place to assist and manage this process (*7, 8, 9, 10*). Typically the investigation will include a detailed analysis of all crashes at a specific site (or road length or area). 'Stick' or collision diagrams can be prepared showing details of each crash at the site (for example, see Figure 4.1). A factor matrix may also be used to assess common features of crashes at the site.

These tools are useful in identifying common contributory factors at a site, and the information they provide is important in identifying possible remedial treatments. For instance, if crashes at a location involve a number of pedestrians, then treatments

Figure 4.1 **Collision diagram from the New Zealand Crash Analysis System**



Source: (*11*)

that improve safety for pedestrians should be considered. A visit to the site (preferably at similar times to when crashes commonly occur) is also a necessary part of the investigation. This may help identify additional road based factors or road user behaviours that may contribute to crash occurrence.

Crash sites can be assessed for one of four types of treatment:

- *single site* – application of treatments to a discrete location such as a junction or short length of road;
- *mass action* – application of treatments to several locations exhibiting the same problems;
- *route action* – application of treatments to a whole route;
- *area-wide action* – application of treatments over a whole area with a higher than expected crash rate.

Published guidance exists on appropriate treatments that can be used to address specific road safety problems (*7, 8, 10*). In addition, the gTKP (Global Transport Knowledge Partnership) in association with iRAP (International Road Assessment Program) and Australian Road Research Board have developed a free internet tool to help identify appropriate road safety solutions. This tool is aimed specifically at providing advice to road safety professionals working in low- and middle-income countries and can be accessed at www.irap.net/toolkit.

Guidance is also available on designing a safe remedial treatment, conducting an economic appraisal (including ranking sites for inclusion in a works programme), writing reports and monitoring the effectiveness of treatments (*7, 8, 9, 10*).

4.3 Monitoring road safety performance

It is not enough to use road safety data to develop interventions and countermeasures – the results must be assessed to determine their impact. One of the core functions of road safety management is monitoring and evaluation of the various outcomes described in Module 1 to assess whether goals and targets are being met (*12*). Indicators are variables that can be used to measure change, and therefore are important tools for monitoring and evaluation.

Road safety indicators are important for measuring the magnitude of the problem, assessing risk, and measuring the impact of road safety management (*13*). Describing the road traffic injury problem and assessing road safety performance requires indicators from many levels (see *12* and *14* for examples):

- *social costs* (e.g. medical, damage to property);
- *outcome indicators* (number of crashes, injuries, deaths);

- *intermediate outcomes*, e.g. prevalence of drink–driving, number of people wearing seat-belts/helmets (sometimes called safety performance indicators, or SPIs);
- *output* or *process indicators* (e.g. random breath tests, speed cameras – see Figure 1.3 in Module 1).

Some indicators are more accurate than others, but may be more difficult to measure. Indicators that will be used for assessment at regular intervals should be selected and defined based on available data (i.e. if there is no vehicle registration system, or the system is not reliable, fatalities per 10 000 motor vehicles is not a suitable indicator).

The selection and interpretation of road safety indicators requires some specialist knowledge, and work to define and test various road safety indicators is ongoing. The purpose of this discussion is not to define specific indicators that must be used, but rather to discuss the types of indicators available, their uses and limitations, and what is needed to assess the outcomes of road safety management.

NOTE

Ideal good practice for monitoring and evaluation involves the lead agency for road safety establishing (*12*):

- databases to identify and monitor final and intermediate outcomes and outputs;
- the socio-economic cost of road traffic injuries, and publishing this information;
- central computerized transport and driver licensing registries to manage data on the number of vehicles and drivers on the road, and making these easily accessible for enforcement agencies;
- travel patterns and exposure in the system for different types of road use through periodic national travel surveys;
- linkages periodically between police reports and hospital admissions data to assess levels of under-reporting;
- safety rating programmes on new cars and road networks that provide intermediate outcomes data (or supporting existing ones);
- studies to evaluate the effectiveness of specific road safety measures;
- tools for local highway and police authorities to undertake data collection, analysis and monitoring techniques, and database management.

In summary, good practice for monitoring and evaluation requires compiling data from multiple sources and understanding issues of under-reporting in various data sources. If a lead agency is not made responsible for coordinating and compiling these different data, it is difficult to piece together a comprehensive road safety picture. Note that very few countries – even countries with excellent data systems and good road safety performance – have achieved this.

4.3.1 Social costs

Social cost indicators facilitate comparison of the impact of road traffic injuries with outcomes of other policy areas – an important comparison for policy-related decision-making, with particular implications for resource allocation (*15*). Common indicators include the cost of one road traffic fatality, the cost of one road traffic injury and the average cost of different severities of road crashes. Based on the numbers of reported deaths, injuries and crashes, this is often amalgamated to give an estimate of total economic losses to the economy –usually expressed as a percentage of GNP. Depending on the methodology used, these indicators may include direct social costs such as crash-related medical care, property damage, and costs of police and legal intervention required for crash management; and indirect social costs such as lost productivity (earnings and time), and loss of an injured person's functional capacity (see Case study 4.3 for an example including both direct and indirect costs). Guidance for setting and measuring social cost indicators can be found in (*16, 17, 18*).

CASE STUDY 4.3: **Cost of road traffic crashes, South Africa**

South Africa uses a 'human capital' approach or 'gross output' method to calculate the public health impact of road traffic crashes. This method takes into account the following aspects:

- Direct costs
  - hospital, medical and funeral
  - vehicle damage
  - damage to goods carried
  - damage to fixed property
  - legal
  - insurance administration
  - towing
  - policing and promotion
- Loss of output
- Qualitative costs
  - pain, suffering, and loss of amenities of life

In South Africa in 2002, a fatality cost around US$114 000, a serious injury US$97 000, and a slight injury US$10 500. Lost output contributed to about 76% of the human casualty cost of a fatality, 54% of a serious injury and 3% of a slight injury (*19*). To calculate the total traffic injury cost from a public health perspective, the formula below was used, resulting in a total cost of over US$3 billion for that year.

Number of road traffic injuries (actual data)			Cost per injury			Cost by injury category			Total costs
Fatal	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*	*All injuries*
(a)	(b)	(c)	(d)	(e)	(f)	(g)=(a)×(d)	(h)=(b)×(e)	(i)=(c)×(f)	(j)=(g)+(h)+(i)

In 2006, the cost of a fatal crash had increased to nearly US$139 000 while in 2008 this was up to US$146 000 (*20*). Despite this increase in the unit cost per crash, the total cost of fatal crashes decreased from US$1.75 billion in 2006–2007 to US$1.69 billion in 2007–2008, attributed largely to a reduction in both the number and cost of pedestrian collisions.

4.3.2 Outcome indicators

If counts and frequencies alone are used as indicators, and all other factors are held constant, then larger populations will see more injuries, areas with larger vehicle populations will have more crashes, models of vehicles that are more common on the road would be involved in more crashes, and people who travel more often would be more likely to be involved in crashes than those who do not. In other words, greater exposure will result in increased likelihood of occurrence (i.e. risk) of the event, resulting in larger absolute numbers of road traffic deaths and injuries (*21*).

To facilitate accurate and fair comparison between municipalities, regions or countries, indicators must include a measure of exposure. Risk indicators are estimated by a ratio of the number of events (crashes, injuries or deaths) to the population exposed. The most appropriate exposure measures include vehicle- and passenger-kilometers travelled and time spent in travel; these data, however, can only be collected at the requisite level of detail through a systematic application of special transport surveys, and there is great variation in availability and quality of the data among countries (*22*).

Table 4.1 lists frequently used road safety outcome indicators, both relative and absolute, along with their strengths and limitations. Effective road safety management requires the availability of these measures by crash type, road type, vehicle class, road user, and various time periods (e.g. months of year, days of week, periods of the day). Appropriate interpretation of outcome indicators requires background information such as motorization levels and population density (*6, 15*). Case study 4.4 describes the use of a composite indicator of fatalities and serious injuries to monitor road traffic injury prevention in several municipalities in Brazil.

4.3.3 Safety performance indicators

Outcome indicators – road traffic crashes, deaths and injuries – capture the final events that are most often used to describe the road safety situation. These events, however, occur as the 'worst case scenario' resulting from unsafe operational conditions of the road traffic system. Monitoring the *intermediate outcomes* (e.g speed, alcohol, helmets etc) that affect those operational conditions is key to developing effective prevention strategies and to assessing the impact of interventions (*23*).

Safety performance indicators (SPIs) are any variables used in addition to crashes and injuries to measure changes in road safety performance, and to understand the processes that lead to these events. The indicators should have a causal relationship to crashes or injuries, and should be reliably measurable and easy to understand. Most often SPIs focus on *intermediate outcomes* related to road-user behaviour, vehicle safety and road networks (*23*). If reliable *final outcome* data are not available, SPIs may be monitored in the interim as a starting point for assessing road safety performance (*12*).

Several projects in Europe have been undertaken to define and test a series of SPIs, taking into account variations in availability and quality of data across the European

Table 4.1 Examples of road safety final outcome indicators

Indicator	Description	Use and limitations
Number of injuries	Absolute figure indicating the number of people injured in road traffic crashes Injuries sustained may be serious or slight	Useful for planning at the local level Not very useful for making comparisons A large proportion of slight injuries are not reported
Number of deaths	Absolute figure indicating the number of people who die as a result of a road traffic crash	Gives a partial estimate of the magnitude of the road traffic problem in terms of deaths Useful for planning at the local level Not very useful for making comparisons
Number of injury (or fatal) crashes	Absolute figure indicating the number of crashes that result in injury (or fatalities)	Useful for planning at the local level Not very useful for making comparisons One crash can result in multiple fatalities/injuries
Fatalities per 10 000 motor vehicles	Relative figure showing ratio of fatalities to motor vehicles	Shows the relationship between fatalities and size of motor vehicle fleet Omits non-motorized transport and other indicators of exposure Accuracy depends on reliability of vehicle registration Reductions may be due to growth in number of vehicles, rather than real road safety gains
Fatalities per 100 000 population	Relative figure showing ratio of fatalities to population	Shows the impact of road traffic crashes on human population Useful for estimating severity of crashes Useful for showing magnitude of problem in relation to other causes of death Useful for international comparisons
Fatalities per vehicle-kilometre travelled	Number of road deaths per billion kilometres travelled	Does not take into account non-motorized travel Vehicle-kilometres travelled can be hard to measure and is information not widely available

Source: Based on (*24*)

Union (*22, 23, 25*). The proposed SPIs are summarized below. These may not be feasible or appropriate for other regions or countries, but they serve as a guide to the kind of indicator that should be considered for monitoring *intermediate outcomes* in road safety.

- Incidence of **drink–driving** and/or proportion of road traffic fatalities resulting from blood alcohol concentration above a predetermined level.
- **Speeding** – measured at various locations in the road network (mean speed, standard deviation, proportion of drivers exceeding the speed limit).
- **Seat-belt use** in front seats and rear seats for all relevant motorized vehicles.
- Use of **child restraint systems** in front and rear seats for all relevant motorized vehicles.

CASE STUDY 4.4: **Use of indicators to improve road safety management, Guaíba, Brazil**

The establishment of a multisectoral data system as part of the Proactive Partnership Strategy (PPS) in Guaíba, Brazil (see Case study 3.9, Module 3), has led to significant changes in road safety management in the city. The availability of reliable data to describe actual conditions on the city's roads has enabled the local government to act strategically to prevent road traffic injuries.

The combination of police, hospital and legal medical institute data in the system has enabled the correct classification of injury and crash severity. Use of *killed and seriously injured* (KSI) data – i.e. fatalities within 30 days of the crash, and serious injuries (defined as admission to hospital for at least 24 hours, or requiring specialist medical attention such as fractures, concussion, severe shock and severe lacerations) – has allowed identification of the main local risk factors. This, in turn, has led to the implementation of appropriate programmes to reduce fatal and serious road traffic injuries by addressing these risk factors.

For example, excessive speed was identified as a key risk factor, which the PPS team sought to address through more widespread electronic speed enforcement, strategic redistribution of traffic police, strengthened overall enforcement and infrastructure improvement. KSI rates are one indicator used to monitor the impact of programmes.

The data-led approach to road safety management in Guaíba has led to real reductions in fatal and serious road traffic injuries. Hospitalization rates for road traffic injuries have been reduced by almost half since the Proactive Partnership Strategy was introduced in 2006.

- **Helmet-wearing rates** among motorcyclists, moped riders and cyclists.
- Proportion of vehicles using **daytime running lights**, by road type and vehicle type.
- Passive **vehicle safety** (crashworthiness, age and composition of vehicle fleet).
- **Road network and road design** – network layout, appropriate road classification, percentage of roads that meet the design standard, safety level of road segments.
- **Trauma management** – transport times, availability of equipment, quality of post-crash care.

Although measurement of safety performance indicators is increasingly recognized as good practice in road safety management and essential for achieving safe travel (*15, 26*), results of the *Global status report on road safety* showed that few countries have data that would allow them to monitor intermediate road safety outcomes (*27*). If SPIs are to become an integral part of road safety management, the data underlying the indicators must be adequately representative, reliable, valid and precise (*25*). Since police and hospital data on SPIs are not representative of behaviours among the general population, this will not be achieved without implementing specific mechanisms for generating and monitoring SPIs at the national level.

Some of the SPIs listed above can be measured using low-cost methods such as observational studies; indeed seat-belt and helmet wearing rates, and use of child restraint systems and daytime running lights are most accurately measured through observational studies rather than self-reported surveys or police records (*25*).

Although observational studies are fairly straightforward to implement, appropriate sampling strategies are critical to ensure data are representative and useful for policy-making. Indicators for vehicle safety, road network and design and trauma management may be more complex to measure, but it is important to identify steps to move towards data systems that can capture this information.

4.3.4 Process/implementation indicators

Process or implementation indicators capture the existence of policies and programmes, the content and quality of policies (e.g. the legal blood alcohol concentration limit), or the outputs of policies and programmes (i.e. types and number of measures that have been implemented) (*22*). Outputs are the deliverables of an intervention that are intended to lead to a change in the operational conditions of the road traffic system (*25*). These indicators provide insight into how road safety management is functioning, but they do not allow for measuring the impact of interventions and cannot be used to describe the road safety situation accurately in the absence of safety performance and outcome indicators. Table 4.2 shows an example of process indicators and targets used by the police in Victoria, Australia. Process indicators used to monitor injury surveillance systems in the health sector might include the number of road traffic injuries presenting to the emergency department, the number of patients requiring surgery for road traffic injuries, or the number of road traffic injury patients requiring hospital admission for more than 24 hours.

4.3.5 Setting targets

Policy objectives describe the outcomes that policy implementation is expected to achieve. These may be qualitative – 'to reduce the incidence and severity of motor vehicle collisions and transport-related injury'; or quantitative – 'to reduce the number of people killed or seriously injured in road accidents by 40%' (*28*). Quantitative objectives, or targets, demonstrate political commitment and can motivate action by those stakeholders accountable for achieving results (*26*). One study found that OECD countries that set quantitative targets were found to perform better over the period 1981–1999, with a 17% reduction in road traffic fatalities compared to countries without quantitative targets (*29*). However, improved road safety performance does not result only from the act of setting quantitative targets, but also from the resource allocation, planning, and programme implementation undertaken in efforts to meet a target.

Targets should correspond to the various levels of outcomes shown in the road safety management pyramid (see Module 1). *Final outcome* targets would represent the ultimate result desired from road safety policies, usually expressed as a percentage change in absolute numbers or rates, or total annual number of road traffic fatalities and injuries. This is the most common type of road safety target used by countries. *Intermediate outcome* targets set objectives for changes in the operational conditions

Table 4.2 **Performance measures of (police) institutional outputs, Victoria, Australia**

	Target 2003/2004	Result 2003/2004
Number of incidents/collisions investigated	38 000	38 138
Number of heavy vehicle operations investigated	13	14
Number of drug-impaired driving assessments conducted	230	164
Number of alcohol screening tests conducted	1 300 000	1 203 251
Number of vehicles detected speeding	932 000	1 001 282
Number of targeted police operations conducted	18	18
Percentage of fatal collisions investigated involving inappropriate speed	30	45.5
Percentage of fatal collisions investigated involving fatigue	8	7.5
Percentage of fatal collisions investigated involving alcohol/drug use	20	27.5
Percentage of heavy vehicle prosecutions which are successful	90	92.5
Percentage of drivers tested who fail preliminary/random breath tests	0.5	0.4
Total cost of output	$119.2m	$125.6m

Source: (*12*)

of the road traffic system, and are based on the SPIs discussed above. Although these *intermediate outcome* targets are important for monitoring the road safety situation in general, and progress in achieving the *final outcome* target in particular, most countries do not yet use them. Finally, output targets represent the deliverables necessary to achieve desired *intermediate* and *final outcomes*. Examples of road safety targets set at multiple levels can be found in reference *12*.

Targets should be ambitious but achievable, and grounded in expected results from planned interventions. Long-term targets should be accompanied by interim targets that facilitate assessment along the way (*26*). Only 42% of the countries and areas surveyed in WHO's *Global status report on road safety* reported having a formally endorsed national road safety strategy that includes measurable targets. More than one-third of these are in Europe, where much work has been done to set and harmonize targets in the region (*27*).

The five United Nations Regional Commissions have implemented a project called *Improving Global Road Safety: setting regional and national road traffic casualty* *reduction targets.* This aims to assist low- and middle-income countries in developing regional and national road traffic casualty reduction targets, and provide examples of good road safety practice that can help achieve the selected targets by 2015 (*30*). Project findings will be finalized and disseminated in 2010.

In the 'Moscow Declaration' adopted at the First Global Ministerial Conference on Road Safety, the ministers, heads of delegations and representatives of various organizations committed to "set ambitious yet feasible national road traffic casualty reduction targets that are clearly linked to planned investments and policy initiatives, and mobilize the necessary resources to enable effective and sustainable implementation to achieve targets in the framework of a Safe Systems approach" (*31*).

NOTE

Ambitious road safety targets set by regional bodies include:

- Reduce fatalities by 50% by 2010 (European Union)
- Reduce deaths by 600,000 by 2015 (UNESCAP Transport Ministers, Phnom Penh Declaration)
- Reduce fatalities by 50% by 2015 (endorsed by African Union)

While quantitative – i.e. measurable – and time-limited targets are preferable, in situations where there are no baseline data or data systems are not adequate enough to monitor targets, selection of qualitative policy objectives may be more appropriate. Furthermore, implementation of a new road safety data system or improvements that significantly improve the accuracy of existing data systems are likely to show an increase in the number of crashes, injuries and deaths.

4.4 Assessing interventions

Assessing the impact of any programme or intervention is vital to determine whether it works, to help refine programme delivery, and to provide evidence for continuing support of the intervention. Evaluation will not only provide feedback on effectiveness but will also help to determine whether the programme is appropriate for the target population, whether there are any problems with its implementation and support, and whether there are ongoing concerns that need to be resolved as the programme is implemented.

The outputs of a road safety data system should feed into efforts to assess the effectiveness of various road safety measures such as policies, legislation,

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campaigns, programmes and improvements to infrastructure. The same array of evaluation methods and tools used in other scientific disciplines are relevant and useful for assessing road safety interventions. This section presents a brief introduction to several evaluation methods, each with its own strengths and limitations.

It is important that the evaluation is built into the intervention from the outset, not simply 'bolted on' at the end. The evaluation framework should be built around the hierarchy of objectives identified for the policy or programme, and it is vital to be clear about the aims and objectives of the evaluation. Therefore it is essential that the evaluation framework is developed and implemented alongside the proposed intervention. Baseline data need to be collected before the intervention is put in place so that changes can be measured.

The type of evaluation to be conducted will depend on a number of factors. These include the aims of the evaluation itself, as well as the objectives of the intervention being evaluated. Choice of evaluation type and methodology should also be guided by local context and resource availability.

Process evaluation examines whether the intervention was carried out as planned. It is designed to identify strengths and weaknesses that can guide programme improvement, and to aid understanding of why certain outcomes were, or were not, achieved (*32*). Process evaluations usually use qualitative research methods and in most situations the outputs of a road safety data system will not provide adequate data for this kind of evaluation (the exception being those systems that include output indicators as described above).

Impact assessment determines whether the intervention has brought about a change that would not have occurred without the intervention (*32*). This type of assessment measures changes in variables such as road-user knowledge, perceptions and behaviour (e.g. compliance with speed limits), or impacts of engineering treatments.

Impact assessment would benefit from the availability of regularly measured Safety Performance Indicators (SPIs).

Outcome evaluation investigates whether the intervention was successful, i.e. led to the desired result. This type of evaluation measures changes in outcome indicators, sometimes in conjunction with SPIs as well.

4.4.1 Study types for impact and outcome evaluation

Impact and outcome evaluations may be carried out using a variety of quantitative methods. Using an experimental or quasi-experimental design to demonstrate a change (or not) is the most powerful programme evaluation for detecting changes in outcome. The methods used will depend on the aim and the budget for the evaluation.

There is an extensive and well-defined hierarchy of experimental designs for examining the effectiveness of interventions. These range from fully randomized control trials (which can provide high-level evidence for the effectiveness of an intervention) to, for example, uncontrolled 'before–after' studies which can only ever provide weak indicative evidence of effectiveness.

Randomized control trial (RCT)

The gold standard of evaluation, the randomized control trial will provide the highest quality evidence of whether an intervention or programme is successful. In an RCT trial, individuals or groups of individuals (e.g. a school or village, known as a cluster randomized trial) are randomly allocated to either receive, or not receive, the intervention. As participants (or groups of participants) are randomly assigned to one group or another, other factors that may influence the outcome – measured and unmeasured – are more likely to be balanced between the intervention and non-intervention group. However, although RCT designs should always be considered when evaluating effectiveness of an intervention, they do require significant resources and may be difficult to conduct with a limited budget.

There may also be ethical considerations in randomizing an intervention with known benefits (i.e. in denying an effective intervention to those participants who will be in the non-intervention group). It is important to note that there is no need to conduct a randomized controlled trial on the effectiveness of helmets, seat-belts, child restraints or reducing drinking and driving, as there is already sufficient evidence demonstrating the effectiveness of these measures.

Controlled before–after study

This is often the most practical design for programme evaluation. Randomization is not always feasible, for example where some areas have already adopted an intervention. The controlled before–after study design involves observing the outcome of interest (e.g. helmet wearing rates) before and after the intervention in both the people who receive the intervention, and those in a control group. The control group should be as similar as possible to the intervention group and any important differences between the groups need to be taken into account. Having a control group means that trends occurring in the population (separately from what is happening because of the intervention) are taken into account.

Interrupted time series design

It is possible to assess the effect of an intervention by using multiple measures of the outcome of interest before and after the intervention. There are a number of different variations on this design, some involving control groups. Studies that use these designs generally use routinely collected measures such as death rates, because multiple measures are required for appropriate analysis. The validity of this study design is, however, subject to distortions by other factors occurring simultaneously to the intervention which may also lead to the observed effect. However, statistical analysis of such data can take these factors into account, meaning it is possible to establish whether the intervention or programme was responsible for the change in outcome.

Before–after study (no control groups)

The before–after study without a control group is often used to evaluate the impact of a programme, but provides the weakest evidence. It involves measuring the outcome of interest before and after the intervention. This study design is simple, and may be conducted relatively cheaply, as all that is needed is a sampling frame and research assistants to conduct observations at various sites. However, without a control group, the scientific merit of this study type is relatively limited as it is often difficult to attribute with any certainty the change in outcome to the introduction of the intervention.

Sample size and statistical analysis

For all quantitative study types it is important to have sufficiently large numbers in the study to be sure that, if an effect exists, it is detectable. The rarer the event, the greater the sample size needs to be in order to detect a difference. Factors that must be taken into consideration in determining the sample size are the expected size of the effect to be detected, variability in the measures, and the prevalence of the variable of interest.

Sample size calculators are freely available on the internet (see note), but it is wise to consult a statistician regarding such estimates, particularly where cluster randomized trials or random and/or stratified samples are necessary.

For quantitative study designs, data will require statistical analysis. For further guidance see references *33* and *34*, or see the relevant lectures in the basic methods and injury sections at www.pitt.edu/~super1.

NOTE

Sample size calculators

Online sample size calculators may be found at http://calculators.stat.ucla.edu/sampsize/php or alternatively the statistical package Epi Info™ may be downloaded at www.cdc.gov/epiinfo/

A sample size calculator for cluster randomized trials may be found at www.abdn.ac.uk/hsru/epp/cluster.shtml.

4.4.2 Conducting an economic evaluation

In recent years it has become increasingly important to conduct economic evaluations of safety initiatives to demonstrate 'value for money', and to help determine the best way to spend limited budgets (*35*).

Economic evaluation addresses the question of whether an intervention represents a worthwhile use of resources. The usual way to address this is by a comparison of two or more intervention options – usually one of these is either a 'do nothing' or 'status quo' alternative.

Economic evaluation is based on the comparison of alternatives in terms of their costs and consequences (*35*). The term 'consequences' is used here to represent an outcome of value. There are various forms of economic evaluation that can be conducted – each differing in terms of scope, i.e. the range of variables included in the analysis. Importantly, each form of economic evaluation typically entails a set of starting assumptions; recognition of these is necessary for the policy-maker to make appropriate use of the evidence from such studies.

A common element across all forms of economic evaluation is that they involve measuring costs. Costs usually comprise, at least in part, the direct programme costs for the resources that are used to run the programme (e.g. equipment, staff, consumables). However, in principle, other costs may also be relevant such as those incurred by patients, carers and the wider community. Furthermore, there are 'downstream' costs and savings that may be considered. e.g. a programme may result in reduced hospitalizations and these savings in resources may be deemed relevant. The type of costs selected generally depends on the perspective taken in the evaluation and the nature of the resource allocation problem being addressed (*35, 36*).

In most low- and many middle-income countries no valuations are yet available on the costs of different severities of casualties and crashes. That research has to be carried out before cost benefit evaluations can be undertaken. Examples of such research undertaken in 10 South East Asian countries can be found on the Asian

Development Bank website (www.adb.org/Documents/Reports/Arrive-Alive/Costing-Reports/default.asp). Further guidance on the valuation of lives saved and serious injuries avoided can be found in iRAP's *The true cost of road crashes: valuing life and the cost of a serious injury*.

Methods used in economic evaluation

The most common form of economic evaluation is **cost-effectiveness analysis** (CEA). This entails the total cost of programmes measured alongside a defined outcome to produce a 'cost-effectiveness ratio' (e.g. cost per life saved, cost per life-year saved or cost per case prevented). Whether this represents 'value for money' and thus should be funded is ultimately a judgment for the decision-maker, and might depend on factors such as the cost effectiveness of other alternatives and budgetary constraints.

The assumption in CEA is that the objectives of interventions being compared are adequately captured in the measure of outcome used. However, a single dimensional measure such as lives saved may not be sensitive to quality-of-life changes. One modification to conventional cost-effectiveness analysis is **cost-utility analysis** which is based on an outcome measure, Quality Adjusted Life Year (QALY). QALY incorporates change in survival and quality of life, and thereby enables a wider set of interventions to be legitimately compared than would be possible with CEA.

Another form of economic evaluation, often used to evaluate transport sector investment, is **cost-benefit analysis** (CBA), which seeks to evaluate interventions in terms of total costs and total benefits – both dimensions being valued in monetary terms (e.g. dollars). Therefore if benefits are greater than costs, the decision would usually be to fund the programme if the benefit to cost ratio is above a pre-determined threshold. A cost-benefit analysis does not require a direct comparison with a programme alternative because the criterion on which investment decision is made is based solely on the comparison of costs and benefits from a single programme measured in monetary units. Another means of valuing benefits in monetary terms is in terms of productivity gains, e.g. reduced disability will result in greater productivity, which in turn could be measured by wage rates.

Choosing the appropriate type of economic analysis for the needs of the particular programme will depend on resources available (both economic and human), and the aims of the evaluation.

4.5 International cooperation on road safety data

International cooperation has proven critical for developing road safety data collection capacity and facilitating harmonization of definitions and standards to make road safety data more internationally comparable. Many international organizations are working with governments and other partners to help countries strengthen their road safety data collection systems. Others are working to improve the quality and comparability of road safety data – a critical activity because international comparisons can help identify national road safety problems and evaluate the effectiveness of safety measures. Though this work has been done mainly in Europe or in other high-income countries, much of it is relevant for all countries and important for achieving globally comparable road safety data.

The IRTAD Group of the OECD/ITF

The International Traffic Safety Data and Analysis Group (IRTAD) is a permanent working group of the Joint Transport Research Centre (JTRC) of the OECD and the International Transport Forum (ITF). It is composed of road safety experts and statisticians from renowned safety research institutes, national road and transport administrations, international organisations, universities, automobile associations and the car industry from OECD and non-OECD countries. Its main objectives are to contribute to international cooperation on road accident data and its analysis. The objectives of the IRTAD Group are to:

- be a forum for exchange on road safety data collection and reporting systems, and trends in road safety policies;
- collect accident data and conduct data analysis to contribute to the work of the ITF/OECD, as well as to provide advice on specific road safety issues;
- contribute to international cooperation on road accident data and its analysis.

The most visible product of the IRTAD Group is the International Road Traffic and Accident Database. The IRTAD database includes aggregated data (covering every year since 1970) on injury accidents, road fatalities, injured and hospitalized road users, as well as relevant exposure data such as population, network length, vehicle kilometers travelled and seat-belt wearing rates from 30 countries. Moreover, key road safety indicators are compiled on a monthly basis. The IRTAD Group is currently developing a set of new variables to be progressively included in IRTAD.

The IRTAD Group publishes an annual report every year summarizing the main safety trends and recent policy measures undertaken in member countries. It also conducts ad hoc data analysis. Recent work has focused on:

- under-reporting of traffic causalities;
- methodologies for linking hospital, police and other data, and estimating real number of casualties.

The ambition of IRTAD is to include new countries and to build and maintain a high-quality database on road safety information. IRTAD offers a mechanism for the integration of prospective member countries while assisting – where appropriate – the improvement of their road safety data collection systems. The intention is to offer a learning environment for new IRTAD members. A Memorandum of Understanding between the JTRC and the World Bank Global Road Safety Facility was signed in 2008 to provide twinning arrangements with existing IRTAD members and selected countries so that they can learn from the experience of IRTAD members, and progressively improve their data reporting systems.

More information can be found at www.irtad.net

European initiatives

Development of the Community database on Accidents on the Road in Europe (CARE database) has required close examination of compatibility of data variables and values. The CARE database has proposed as set of 38 variables and provided a glossary to define the variables and their possible values, along with transformation rules to ensure that countries provide compatible data (http://ec.europa.eu/transport/road_safety/observatory/statistics/care_en.htm). The database includes data from 19 European countries, with other countries in the harmonization and testing phase. The glossary and regular statistical reports are freely available on the CARE website, there is not unrestricted access to the searchable database.

The United Nations Economic Commission for Europe (UNECE) Working Party on Transport Statistics (WP.6) is an intergovernmental body dedicated to the development of appropriate methodologies and terminology to facilitate harmonization of data collection and statistics in the 56 Member Countries of UNECE. *The Illustrated Glossary for Transport Statistics*, developed by a working group of WP.6 comprising UNECE, Eurostat and the International Transport Forum, is a key tool for achieving this aim.

Global burden of disease estimates

The Global Burden of Disease (GBD) project provides a framework for integrating, validating, analysing and disseminating mortality and health information that is fragmented and inconsistent in many countries (see www.globalburden.org). The first GBD study used data from 1990 to quantify the health effects of more than 100 diseases and conditions, including road traffic injuries. Subsequent GBD updates produced by the World Health Organization have allowed consistent assessment of the comparative importance of diseases, injuries and risk factors as causes of death, loss of health and disability (together known as the 'burden of disease') for decision-making and planning purposes. GBD updates provide global, regional and national estimates. Revisions and updates to GBD are ongoing and currently are advised by an injury expert group which gathers injury data from countries and uses this real world data to improve the theoretical input behind the statistical models used to generate GBD estimates. The group has produced several discussion papers that are particularly useful when considering vital registration and health data on road traffic injuries (http://sites.google.com/site/gbdinjuryexpertgroup/Home).

Vital registration and health data

Vital statistics (summary measures of events such as births, deaths and marriages, drawn from vital registrations systems) and health statistics (from health facilities or surveillance systems) are a critical element for health planning in general, and an important source of road traffic injury data. Various initiatives are ongoing to help countries improve their vital registration systems and health statistics. The Health Metrics Network, for example, is a partnership of UN agencies, aid agencies, civil society and private foundations devoted to strengthening national health information systems. The Network has developed a toolkit for assessing the national health information system, and standards for strengthening health information systems (http://www.who.int/healthmetrics/en/). Supporting countries' efforts to strengthen health information systems is a core activity of the World Health Organization.

The *International Classification of Diseases* (ICD) provides standard diagnostic classification and codes for diseases and health conditions, including injuries, that are recorded on various vital records (e.g. death certificates) and health records. Use of the ICD enables storage and retrieval of diagnostic information for statistical analysis and other uses. It also facilitates international comparability in the collection, processing and presentation of vital and health statistics. The ICD has been revised several times since its inception more than a century ago, with ICD-10 being the latest version (*ICD-10*). Successful implementation of ICD versions 9 or 10 for coding death certificates and hospital data is a key strategy for improving and harmonizing health-related road traffic injury information. For countries that lack a vital registration system with adequate coverage and reliability, verbal autopsy standards have been developed to standardize the conduct of verbal autopsy studies and code causes of death according to ICD-10 (*37*).

Global collaboration

The United Nations Road Safety Collaboration (UNRSC) is a group comprised of United Nations agencies and other organizations committed to improving road safety globally (http://www.who.int/roadsafety/en/). The UNRSC has existed since 2004, when the United Nations resolution on "Improving global road safety" (A/RES58/289) called for improved collaboration and invited WHO, working in close cooperation with the United Nations Regional Commissions, to act as coordinator on road safety issues across the United Nations system. A series of good practice manuals–of which this manual is one–has grown out of the UNRSC, as members have worked to identify ways to help governments and civil society implement the recommendations of the *World report on road traffic injury prevention* (*7*). The Collaboration has biannual general meetings, and smaller project groups provide a mechanism for members with similar interests to exchange information and work together on specific projects. The data project group was instrumental in calling for, conceptualizing and advising this manual.

CASE STUDY 4.5: International collaboration for building data system capacity, Arizona, USA

As part of the development of this manual, the US National Highway Traffic Safety Administration hosted a workshop in July 2009 on road traffic injury data, in conjunction with the annual Traffic Records Forum. The objectives of the workshop were to provide training on developing road safety related data collection systems and to obtain feedback on a draft of this manual.

The workshop was planned and organized in collaboration with the World Health Organization, the US Centers for Disease Control and Prevention, and the Global Road Safety Partnership, with additional support provided by Make Roads Safe. Training materials were based on the draft data systems manual. Delegations from Argentina, Bangalore (India), Indonesia, Jordan, Kenya and Viet Nam participated in the workshop and included representatives from the transport, law enforcement and health sectors.

Delegates remained actively engaged throughout the workshop, identifying ways to improve road safety data in their countries, and outlining next steps. Participants gave helpful feedback on the draft manual during the revision process, and on the workshop format and content. Because collecting and analysing crash data cuts across jurisdictions, training efforts that use a team approach can strengthen communications between and within participating sectors.

Summary

- Data that are collected but not used represent a misuse of scarce resources.
- Data should be disseminated through diverse mechanisms such as statistical reports, newsletters, websites, online databases and workshops, to a variety of stakeholders, including the police, traffic engineers, public health specialists and health planners, and road safety policy-makers.
- Road safety data should be used by policy-makers responsible for road traffic injury prevention, as well as traffic engineers, to identify priority issues and geographic areas, and to select and evaluate appropriate, cost-effective interventions.
- Monitoring and evaluation is a core function of road safety management. Effective monitoring and evaluation of overall road safety performance requires selection of targets and indicators covering multiple outcomes, not just deaths and injuries, and compilation of data from multiple sources.
- Assessment of impact should be seen as an integral component of all road safety interventions.
- Determining the aims of the evaluation will help to decide how best to carry out the evaluation. There are a number of different methods that can be used to evaluate road safety interventions. Each method has advantages and disadvantages, and the choice of which to use will depend on the main objectives of the intervention, the evaluation questions, and the resources available.

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