4

Using data to improve road safety

4.1 Dissemination 117

4.2 Using road safety data 121

4.2.1 Advocacy 121

4.2.2 Technical uses of road safety data 122

4.3 Monitoring road safety performance 127

4.3.1 Social costs 129

4.3.2 Outcome indicators 130

4.3.3 Safety performance indicators 130

4.3.4 Process/implementation indicators 133

4.3.5 Setting targets 133

4.4 Assessing interventions 135

4.4.1 Study types for impact and outcome evaluation 137

4.4.2 Conducting an economic evaluation 139

4.5 International cooperation on road safety data 140

Summary 144

References 145

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	11.89	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).

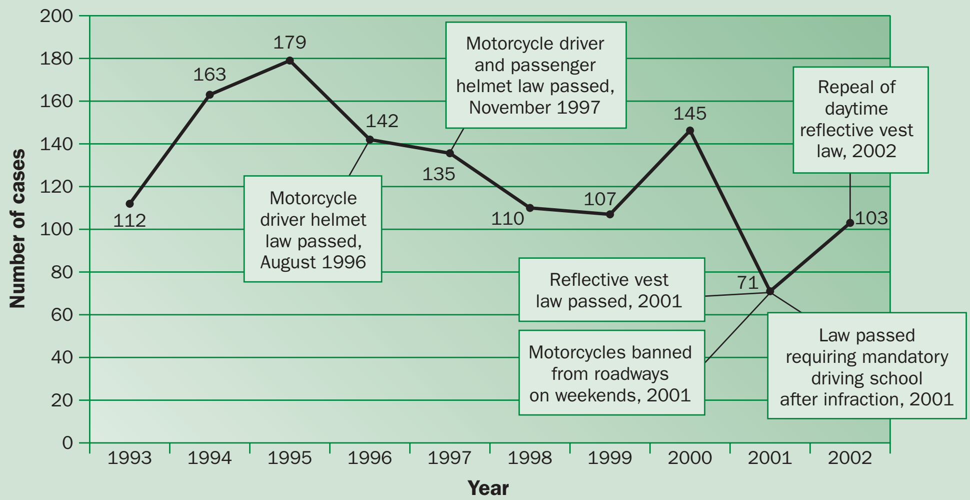
Data analysis has been performed periodically, and disseminated to decision-makers and the various sectors involved (e.g. police department, transport office, forensic medicine department) through statistical bulletins (see http://vigilesiones.univalle.edu.co/informes/boletines.html). One of the more 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/.

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.

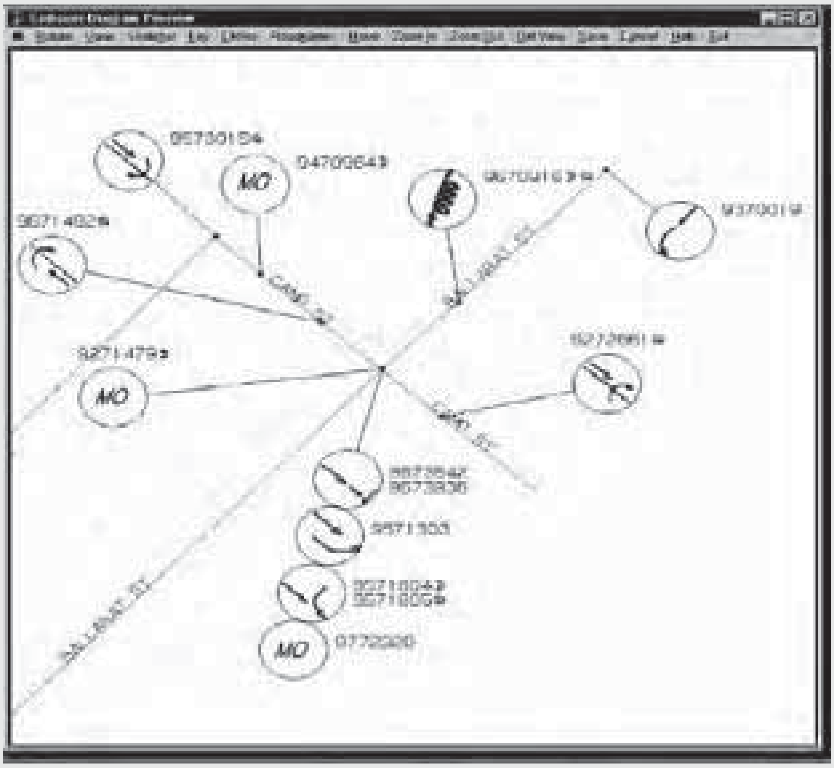
After specifying a time period for analysis (e.g. a three or five year period), sites with high crash numbers and/or rates (e.g. crashes per length or area of road) can be identified. It can be useful to apply statistical analyses to the data so that results at a particular site or section of road can 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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