World Health Organization
European Region

GLOBAL ROAD SAFETY PARTNERSHIP

Road policing for road safety

Technical manual for building enforcement capacity

ABSTRACT
This technical manual provides evidence based guidance to strengthen road policing and enforcement (RPE) as a core pillar of effective road safety systems. It is designed for the wide range of stakeholders involved in RPE, including police and gendarmerie, the judiciary, policy makers, road safety professionals, nongovernmental organizations and the private sector. For the purposes of the manual, RPE is defined as a specialized policing function that applies intelligence led and evidence based strategies to enforce road safety legislation, deter high risk behaviours and deny criminal use of the road network. The manual demonstrates that, despite proven effectiveness, RPE remains seriously under resourced in many countries, particularly low and middle income countries. It addresses all major behavioural risk factors and all road users, and considers the full enforcement chain, from legislation and detection to penalties, data systems and governance. Structured in modular form, it supports capacity building, implementation, monitoring and continuous improvement to reduce road deaths and injuries while maintaining a clear focus on road safety outcomes.

KEYWORDS
POLICE, SAFETY, INJURIES, PSYCHOLOGY

Document number:
WHO/EURO:2026-11317-51089-77774 (PDF)
WHO/EURO:2026-11317-51089-77775 (print)

Suggested citation. Road policing for road safety: technical manual for building global enforcement capacity. Copenhagen: WHO Regional Office for Europe; 2026. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

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Road policing for road safety

Technical manual for building enforcement capacity

World Health Organization
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Corrigendum

Road policing for road safety: Technical manual for building enforcement capacity

Document number WHO/EURO:2026-11317-51089-77774

The following change was applied to the Foreword on page V:

- Adviser and Director, United Nations Police Division was corrected to Police Adviser and Director of Police Division, Department of Peace Operations, United Nations

The following changes were applied to the Acknowledgements section on page IX:

- Naif University for Safety and Security was corrected to Naif Arab University for Security Sciences
- The following additional text was added:
  - The authors acknowledge the technical inputs of participating member states (Albania, Azerbaijan, Belarus, Belgium, Bulgaria, Finland, Georgia, Greece, Hungary, Indonesia, Ireland, Jordan, Kyrgyzstan, Lithuania, Malta, Montenegro, Noth Macedonia, Oman, Poland, Qatar, Romania, Saudi Arabia, Serbia, Spain, Tajikistan, Türkiye, Turkmenistan, United Kingdom, Uzbekistan, Viet Nam) at the 1st High Level Meeting on Road Policing for Road Safety, Istanbul, Türkiye from 8-10 November, 2023
- The following additional text was added:
  - The authors acknowledge the technical inputs of participating member states (Azerbaijan, Austria, Bahrain, Belarus, Bulgaria, Cyprus, Hungary, Italy, Kazakhstan, Kyrgyzstan, Malta, Republic of Moldova, Montenegro, Morocco, North Macedonia, Oman, Poland, Qatar, Saudi Arabia, Serbia, Tajikistan, Türkiye, United Arab Emirates, United Kingdom, Uzbekistan) at the 2nd High Level Meeting on Road Policing for Road Safety, in Baku, Azerbaijan from 10-12 December, 2024

The following change was applied to Table A1 on page 191

- Netherlands was corrected to Netherlands (Kingdom of the)

These corrections were incorporated into the electronic file on 10 February 2026.

Contents

Forewords

In 2021, tragically, more than 62,000 people were killed on the roads of the WHO European Region. That equates to over 170 people each day or one person every eight minutes. There are also a further 11 million non-fatal injuries each year, which represents a major burden to health systems in all countries in the Region. The global picture is even more stark, with someone killed on the roads every 26 seconds.

These are not just unfortunate 'accidents'. The truth is that every one of these deaths and serious injuries was influenced by predictable determinants where intervention is possible - and could have been prevented.

The police are one of the most crucial national stakeholders to strengthen prevention efforts and implement safe systems approaches. Policing has many connections to and similarities with public health, being investigative, data-driven, evidence-based and covering an entire population. In the same way that enforcement is crucial to many public health outcomes, policing can benefit from the systematic processes used in public health.

Although timely and evidence-based road policing has a preventative impact, road safety remains relatively underprioritized by policing agencies globally. Even when the risk of being killed on the world's roads is 2.5 times higher than the risk of death due to violent crime, the collective political and popular view for policing remains focused on prioritizing prevention of and response to violent crime. The causes of road trauma are rarely included in this category.

Recognizing the reality of "road crime" offers an opportunity to ensure that road policing is financed, human resourced and politically and technically prioritized in a manner that is consistent with the impact of road trauma. It acknowledges the enormous preventative potential of road policing and its contribution to safe system approaches and Vision Zero road safety objectives, which hold everyone accountable for creating a road safety system in which nobody is killed or injured on the roads.

We hope that this technical manual will provide policing agencies worldwide with insights to inform road policing policies and practice that make our roads safer for all.

Dr Hans Henri P. Kluge
Regional Director,
WHO Regional Office for Europe

I warmly welcome the launch of this manual, developed by WHO in collaboration with the United Nations Police Division. I would like to express my sincere appreciation to WHO, experts from Member States and members of the United Nations Inter-Agency Task Force on Policing for contributing to the development of this life-saving publication.

Helping national policing counterparts to put in place the foundations for an effective system of road policing and enforcement is an important task for United Nations Police. In peacekeeping contexts, this is often one of the first signs of the return to normality. The population would rather see a traffic officer, a traffic light, a traffic sign and, sometimes, road markings than a checkpoint with armed militia. When roads and roadways – the arteries of life – are getting busier in post-conflict environments, they help transport goods and people, fuelling economic recovery.

There is, however, the other side of the coin. While road safety is a global concern, low- and middle-income countries face unique challenges in implementing effective road policing and enforcement. These include rapid urbanization; increasing vehicle ownership; a mixture of vehicle, pedestrian and animal traffic; increased and mostly uncontrolled roadways; and, often, limited resources. For these reasons, the risk of being killed on the roads far exceeds the risk posed by violent crime.

As a result of these challenges, these countries are particularly prone to high rates of injuries and deaths on their roads. As the manual documents, road crash deaths in low-income countries increased significantly over the decade; over 90% of deaths occur in these countries. Many of the victims are children.

Policing offers vital opportunities for cost–effective saving of lives. Enforcement – coupled with community outreach and education, legislative change and infrastructure development – can make a life-or-death difference.

The manual you hold in your hands provides a concrete road map for making roads safer and enabling police agencies to better reflect the priority of preventing road trauma. It offers a standardized approach that is based on data, rigorous research and global good practice. It lays out effective guidance for advancing and sustaining effective road policing and enforcement.

United Nations Police looks forward to having this manual rolled out in the field. Our officers look forward to working with all stakeholders towards safer, friendlier roads.

Faisal Shakar
Adviser and Director,
United Nations Police Division

Acknowledgements

This manual was written by Soames Job (independent road safety consultant) and Jonathon Passmore (WHO Regional Office for Europe), with Omar Gonzalez (independent road safety consultant) and William Wambulwa (independent road safety consultant). Jonathon Passmore conceptualized and managed the overall project on behalf of WHO and developed the standardized survey tool on police procedures in Annex 2. The literature review for this manual, which significantly guided the final text, was undertaken for the WHO Regional Office for Europe by David Cliff (Global Road Safety Partnership), Judy Fleiter (Global Road Safety Partnership), Clare Freakley (independent road safety consultant), Soames Job, Elisabeth Rubie (independent road safety consultant) and Chika Sakashita (independent road safety consultant). Significant expert input on road policing practices was also received in an unofficial capacity from former senior police officers: David Cliff (New Zealand Police), Michael Cornish (South Australian Police), Marcin Flieger (Polish National Police) and Mavis Johnson (Lancashire Constabulary). Jessica Truong (Global New Car Assessment Program) provided expert input on vehicle safety enforcement issues. Rob Butler, Katrine Habersaat and Veerle Snijders (WHO Regional Office for Europe), provided valuable guidance and input to Module 2 on the psychology of road user behaviour and deterrence.

Led by Dmitri Alechkevitch and Muhammad Faisal Rana, the United Nations Police convened a document review group (DRG) for this technical manual, inviting all United Nations Member States to nominate members. The DRG convened with the following expert members: Fuad Almaaytah (Jordanian National Police), Pedro Area (National Republican Guard, Portugal), Zeki Bal (Turkish National Police), Julian Bianco (Pacific Islands Chiefs of Police), Paola Cestra (Italian State Police), Dave Cliff (Global Road Safety Partnership), Marc Clothier (National Police Chiefs Council, United Kingdom), Fred Gaye Junior (Liberia National Police), Jochen Heiling (Austrian National Police), Fathi Hussein Al Khatib (Naif University for Safety and Security), Rabin Karki (Nepal National Police), Drakakis Konstantinos (Hellenic National Police), Clever Maramwidze (Zimbabwe National Police), Jivago Moretto Pedra (National Police of Brazil), Gerard Mpayimana (Rwanda National Police), Boniface Otieno (Kenyan National Police), Joao Manuel Paula Ramos (Portuguese National Police), Roar Skelbred Larsen (Norwegian National Police Service), Alessander Jackson Tironi (National Police of Uruguay), Ignacio Varela Dela Vega (Guardia Civil, Spain), Damyan Vladinov (European Roads Policing Network), Peter Woods (An Garda Siochána, Ireland) and Elvira Zsinkai (European Roads Policing Network).

The authors acknowledge a small overlap of content on speed enforcement with the Asian Development Bank's road safety manual – *CAREC Road Safety Engineering Manual 7: Why and How to Manage Speed* – which was developed concurrently by Global Road Safety Solutions Pty. Ltd. with funding and support from the Asian Development Bank. The cross-support with the Asian Development Bank is gratefully acknowledged.

The authors acknowledge the generous financial support of the United Nations Road Safety Fund, that contributed to the development of this publication.

Abbreviations

ANPR	automatic number plate recognition (technology)
BAC	blood alcohol concentration
BCR	benefit:cost ratio
COM-B	capability, opportunity, motivation and behaviour (model)
COVID-19	coronavirus disease
DALYs	disability-adjusted life years
DRIVER	Data for Road Incident Visualization, Evaluation, and Reporting (system)
e-mobility	electronic mobility
ESRA	E-Survey of Road users' Attitudes
EU	European Union
GLS	graduated licensing system
GPS	Global Positioning System
GRSP	Global Road Safety Partnership
HIC	high-income country
ISA	intelligent speed adaptation or assistance
L	Learner licence plate
LIC	low-income country
LMIC	low- and middle-income country
MIC	middle-income country
NGO	nongovernmental organization
P1	Provisional 1 drivers licence
P2	Provisional 2 drivers licence
RBT	random breath testing (for alcohol)
RDT	random drug testing
RPE	road policing and enforcement
SOP	standard operating procedure
THC	delta-9-tetrahydrocannabinol
UN	United Nations

Glossary

Benefit:cost ratio (BCR) is a measure of the relationship between the relative costs and benefits of a proposed project, policy or action. If a project has a BCR of 4.0, the action is expected to deliver four times as much benefit as it costs to achieve the project.

Disability-adjusted life years (DALYs), put simply, are the sum of the potential years of life lost due to premature death plus the equivalent years of healthy life lost through people being in states of poor health or disability. More formally, DALYs are the total of the present value of future years of life lost through premature death, and the present value of years of future life adjusted for the average severity (frequency and intensity) of any mental or physical disability caused by a disease or injury. Thus, DALYs are a critically informative measure: the only quantitative indicator of burden of disease (including injury) that reflects the total amount of healthy life lost from premature death or various degrees of disability.

A **fixed speed camera (or fixed safety camera)** is a camera fixed in a location and combined with speed detection equipment that can detect vehicle speeds at a set point, and photograph speeding vehicles to allow penalties to be applied.

General deterrence refers to the deterrence of unwanted behaviour in the general population without necessarily catching each person committing it. General deterrence is based on people's beliefs that they are likely to be caught for a specific offence, and that the punishment is significant (enough to deter), swift and unavoidable. These beliefs can be achieved through effective enforcement and judicial systems, as well as through promoting/advertising these features and punishments to the public.

A **high-income country** is defined (following the World Bank) as a country with a gross national income per capita of US$ 13 205 or more.

Intelligence-led policing (also called predictive, data-led or intelligence-based targeted policing) involves the use of sound data analytics and collaboration across enforcement agencies, which allows police departments to better evaluate crime trends and issues, better target enforcement to relevant locations and times, and assist decision-makers to efficiently deploy resources.

Intelligent speed adaptation or assistance (ISA) involves advanced vehicle technology systems that determine the speed limits applicable for the vehicle in its current location, to assist drivers to stick to speed limits. Technology using a global navigation satellite system, such as the Global Positioning System, is linked to a speed zone database and thus allows a vehicle (or a mobile telephone) to know its location and the speed limit on that road. The actions of the vehicle in response to the speed information can vary.

- In **advisory ISA**, the ISA system provides visual (and usually auditory) feedback to the driver if the vehicle exceeds the speed limit. Some versions of advisory ISA beep to the driver when the speed limit is exceeded, and others provide stronger cues such as a beep and reverse pressure on the accelerator pedal, which requires the driver deliberately to push harder to exceed the limit.

- In **intervening (or governing) ISA**, the ISA system limits the speed of the vehicle to the speed limit, although typically the threshold for the intervention can be changed or the system can be turned off. These systems are being tested.

A **low-income country** is defined (following the World Bank) as a country with a gross national income per capita of US$ 1085 or less in 2021.

A **middle-income country** is defined (following the World Bank) as one with a gross national income per capita above US$ 1085 and below US$ 13 205. The cut-off for lower-middle to upper-middle income is US$ 4255 gross national income per person.

A **mobile speed camera** can be moved from location to location and, combined with speed detection equipment, can detect vehicle speeds at a set point and photograph a speeding vehicle to allow for penalties to be applied.

Road policing is the specialized policing function that utilizes intelligence-led and evidence-based strategies to enforce road safety legislation, deters illegal and unsafe behaviours causally associated with road trauma, and denies criminal utility of the road network.

Road trauma comprises the spectrum of physical, psychological, and functional harm experienced by individuals (or populations) as a consequence of road traffic collisions or crashes, including fatal and non-fatal injuries, disability, psychosocial consequences and downstream health burdens.

A **safe system** refers to a successful approach to road safety based on the principles that human beings inevitably make mistakes and are vulnerable to crash forces. This approach aims to protect people from death and serious injury through roads, vehicles and speeds that limit crash forces to survivable levels.

Shared responsibility refers to responsibility for the safety of road users being shared among those who design, maintain and operate the roads (including those who set policy and laws); manufacture vehicles; and administer safety programmes, including the private sector. These stakeholders must accept and address responsibility for road safety, so that when a crash occurs that results in injury or death, remedies are found throughout the system that address and ideally fully prevent the recurrence of such a crash in the future, rather than blaming the driver or other road users. The early concept of shared responsibility included road users, but for various reasons (including inconsistency with the concept of a safe system itself) this has changed.

Specific deterrence means deterring unwanted behaviours in specific offenders by catching and punishing them. This relies on the punishment being sufficient to deter, unavoidable and quickly applied.

Speed is the occurrence of movement measures as distance/time, such as kilometres per hour.

Speeding refers to travelling at a speed above the legal limit, including limits that may apply to particular drivers (such as a learner driver) or vehicles (such as lorries or buses).

Speed-governing or governor refers to vehicle technology that prevents a vehicle's engine from pushing it past a set upper speed.

Traffic calming involves road design and engineering features to reduce the speed of traffic, especially in areas of higher risk (such as the presence of vulnerable road users, poor-quality infrastructure or entering a built-up area). Examples include speed humps, raised platforms, chicanes, rumble strips, etc.

Vehicle speed limiting or governing refers to technology installed in a vehicle that prevents the motor from moving it beyond a single set speed.

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MODULE
1

Why road policing and enforcement are needed

1.1. Purpose and audience for this manual

This technical manual was prepared to help the many stakeholders engaged in road policing and enforcement (RPE). These include police and gendarmerie at the national, state/province and local levels (including sheriff's and other government departments involved in road policing processes), the judiciary, politicians, law-makers, senior decision-makers, road safety experts, road safety communications and marketing experts, nongovernmental organizations (NGOs) and the private sector involved in enforcement technology. In addition, transport companies and their professional associations may be able to benefit from the information and guidance provided to improve the safety of their internal fleet operations.

With RPE not having an internationally standardized definition, for the purposes of this manual it is defined as the specialized policing function that utilizes intelligence-led and evidence-based strategies to enforce road safety legislation, deter behaviours causally associated with road trauma and deny criminal utility of the road network.

RPE has the vital purpose to avoid the deaths and injuries that occur from road crashes, and is a critical opportunity to achieve these savings. In addition, RPE delivers other societal benefits; speed management improves air quality and reduces greenhouse gas emissions, and on-road enforcement aids in the policing of other crimes, denying criminal use of the road network. These ancillary benefits of RPE can be noteworthy. Nevertheless, care is needed to maintain the focus on road safety outcomes, so this manual focuses on improving road safety.

Such a manual has a powerful potential to save lives and avoid injuries. RPE is one of the major mechanisms for success in road safety, with some of the most dramatic improvements coming from enforcing mandatory seat belt use, helmet use, random alcohol testing and speed limits (including through cameras). Successes are legion, yet RPE operates at a dramatically suboptimal level in most countries, especially in low- and middle-income countries (LMICs), which also have the highest burdens of road trauma.

There are many reasons for the lack of resourcing for RPE commensurate with the human and economic costs of crashes, and the manual offers the opportunity for improvement. For example, resources may be inadequate due to a lack of appreciation of the business case for sound investment in RPE, poor understanding of the psychology of behaviour change (replaced by naive and often flawed so-called common-sense decisions), and weak adoption of evidence-based choices in legislation, RPE, policies and practices. Inadequate data collection and analysis exacerbate this situation. Further, many countries have endemic problems of corruption that affect RPE and other areas of government, which dissuade governments and donors from making needed investments.

Many systems are required to create the effective general and specific deterrence necessary for strong behaviour change in road safety: strong legislation, effective detection and enforcement, timely deterrence and unavoidable deterrent-level penalties, promotion of enforcement to create the perception that detection is likely, and robust administrative and judicial systems that swiftly apply penalties. Understanding that the enforcement system is a chain that is only as strong as its weakest link is vital; corruption or failure of any one of the systems involved can render the rest of the effort ineffective.

This manual facilitates and guides more effective RPE by delivering guidance, based on evidence and country best practices, on what works and what does not, on improving the activities of the many relevant stakeholders, and on policies and processes for implementation across management, monitoring and continuous improvement. It also provides practical advice on how to implement interventions.

However, this manual also has important differences of approach from other WHO road safety guides. As RPE encapsulates a broad, often underappreciated range of activities, the manual addresses all the major risk factors arising from road users' behaviour, unlike others that usually focus on one: speed, restraints, helmets, drink–driving, etc. It also addresses all road users (drivers, passengers, motorcycle riders and passengers, cyclists, pedestrians and users of micromobility). Moreover, this manual goes beyond the role of road user behaviour change: it considers many pillars of the road safety system. The collection of crash data by police guides every pillar of road safety activity in terms of the causes resulting injury or death, the locations to be addressed as a priority and the evaluation of all contributing factors. While health-based data systems may also perform some of these functions, they have their own validity problems and typically have less effective information on crash locations. Further, RPE personnel are also commonly involved in advocacy, talking to the public and the media.

While this manual is styled on other manuals in the Good Practice series *(1–5)*, it is not a formal part of that series. It:

- addresses the broad range of many risky behaviours, with a module dedicated to each set;
- considers all road users: pedestrians and users of motorized vehicles, including powered two- and three-wheelers, bicycles, personal mobility devices such as wheelchairs, and the recently popular electric scooters and bicycles;
- covers the large range of RPE activities, including first aid, community policing and crash data collection, although enforcement is primary;
- provides more detailed guidance to serve as the basis of RPE capacity-building programmes, which are urgently needed in many countries; and
- provides many case study examples.

For these reasons, this manual is inevitably larger than many, although the content is presented in distinct modules to facilitate the use of particular sections as the point of focus for particular audiences and stakeholders, or for particular areas of improvement (such as enforcement of speeding or of drink–driving laws). Where relevant, the introduction to each module specifies who is most likely to be involved in the implementation of the guidance discussed.

1.2. Introduction

1.2.1. The Road Safety Challenge

1.2.1.1. Global road safety

Globally, road crashes cause an estimated 1.19 million unnecessary deaths and at least 50 million serious non-fatal injuries each year *(6,7)*. They cause not only deaths, injuries, disabilities, grief and suffering, but also substantial yet poorly recognized costs and retarded long-term economic growth.

In the first United Nations (UN) Decade of Road Safety (2011–2020), high-income countries (HICs) improved their road safety performance significantly overall, middle-income countries (MICs) had mixed results but mostly suffered more crash deaths than before and road crash deaths in low-income countries (LICs) increased significantly. Over 90% of deaths occur in LMICs *(8)*.

1.2.1.2. Global responses to the challenge

Following the third Global Ministerial Conference on Road Safety “Achieving Global Goals 2030” in 2020, the UN General Assembly adopted resolution A/RES/74/299 on "Improving global road safety", proclaiming the Decade of Action for Road Safety 2021–2030, with the ambitious target of preventing at least 50% of road traffic deaths and injuries by 2030. It also called for a global plan for the decade, which was subsequently developed by WHO and the UN regional commissions *(9)*, addressing actions across all aspects of the safe system, including RPE.

1.2.2. Economic costs of crashes

The economic costs of road crashes are profound and wide reaching, yet poorly understood and generally underestimated because many areas of crash costs are overlooked. Advocating appropriate prioritization for road safety action can be challenging without a comprehensive understanding of the economic and social cost of road trauma.

Road crashes have dramatic costs from lost labour/productivity due to deaths and injuries. Road crash deaths and debilitating injuries are much more costly per victim than those from the most common causes of death and illness because of the age at which they most commonly occur: 18–25 years. Such crashes cause the loss of many people who are about to become or have recently become economically productive, usually after many years of costly education; thus, whole lifetimes of productivity are lost. On the other hand, deaths from the most common causes (cardiovascular diseases and cancer) typically occur near or at postretirement age, generating much less productivity loss per case *(10,11)*.

As the evidence highlights, the real question for LMICs is not whether they can afford to invest in road safety but rather whether any LMIC can afford not to invest effectively in road safety *(12)*, including effective RPE.

The economic impacts of crash costs include: the annual economic costs of crash deaths and injuries, retarded long-term economic growth, the impoverishment of families and the costs of exacerbating social inequity. Each is considered in turn.

1.2.2.1. Annual economic costs

Methods exist for reasonably estimating the costs of crash deaths and injuries for any country, but these are not the full costs of crashes, even though they constitute the largest share of the total. Of the costs in Box 1, only the costs of death and injury are included. They are based on methods available for the general estimation of costs *(13)*, which have been refined by the World Bank *(11)*. Thus, while a valuable guide, these calculations significantly underestimate the full costs of crashes.

Box 1. The areas of cost of road crashes

The costs of death and injury as a result of road crashes are outlined below.

Labour/business

- Loss of labour/productivity in workplace due to deaths.
- Loss of labour/productivity in workplace due to permanent and temporary disabilities.
- Workplace productivity losses and additional processes: hiring of new temporary or permanent employees, training.
- Loss of labour/productivity due to caring for injured or disabled crash victims.

General

- Travel delays (human time, crash-generated congestion, additional greenhouse gas emissions, health costs of added air pollution).
- Insurance administration for property damage and injuries.
- Crash site cleanup.

Rescue, medical and rehabilitation

- Hospital and medical.
- Ambulance.
- Rehabilitation.
- Long-term care.
- Fire and emergency services.

Human

- Reduced quality of life with pain, suffering and disability.
- Funeral costs.
- Grief and stress.
- Costs of inequity generated by crash injuries or deaths (see section below for explanation and evidence).

Legal

- Police time and resources.
- Coronial processes.
- Legal and court costs in civil and criminal proceedings.
- Correctional services/jail costs for those given jail sentences for causing crashes.

Property damage

- Repairs or replacement of vehicles.
- Unavailability of vehicles.
- Towing.
- Damage to roads and roadside infrastructure.
- Damage to private property along roadsides.

1.2.2.2. Retarded long-term economic growth

The substantial economic costs of crashes for countries retard long-term national economic growth: a detailed economic analysis of various LMICs in Africa and Asia showed that meeting the UN target for 2030, by halving deaths and injuries, would increase gross domestic product per capita by varying amounts over 24 years across countries: 7.1–22.2% *(14)*. All countries will benefit from improved long-term economic growth by reducing crash deaths and injuries, some by almost 1% each year for 24 years *(11)*.

1.2.2.3. Impoverishment of families

Road crash victims in every country are most likely to be male and, despite increasing gender equality, are therefore more likely to be the only or a key source of income for their families. Such people's deaths, or permanent or even temporary inability to work (which can cause job loss) following crashes, can dramatically reduce family incomes and increase debt to pay for medical treatment. These effects have been identified in LMICs and have been shown to force many families into poverty *(15)*.

1.2.2.4. Costs of increased inequity

By forcing many families in LMICs into poverty, road crashes also add to inequity. For many reasons, those with the least resources are the most vulnerable to crashes. Because crashes often cause direct costs (for treatment, property damage and possibly payment of penalties) and loss of income, they reduce the resources of the poorest people, adding to social and economic inequity.

Inequity is well recognized and well documented to impose substantial costs on societies *(16)*. The economic costs of inequity in the European Union (EU) are estimated to comprise a significant proportion of gross domestic product each year *(17)*. While much of the research has been conducted in HICs, the economic costs of inequity are also substantial in LMICs *(18)*.

1.2.3. Road policing and road user behaviour change

Road user behaviour (error and intentional) has long been recognized as a major contributor to road crashes *(19)*, including in LMICs *(20,21)*. The type of error also contributes to crash severity *(22)*.

In many instances, the substantial life- and injury-saving benefits of RPE described in this manual highlight both the role of human behaviour in serious crashes, and the role of enforcement and deterrence in addressing it. Even in the EU, where road users are somewhat more compliant with road rules than in many other regions, enforcing road safety laws has been estimated to have decreased road crash deaths by 50% *(23)*. To assess the value of RPE activities in another way, the benefit:cost ratios (BCRs) of various activities have been shown to generate economic savings that greatly exceed the costs of the activities in many specific instances *(24)*.

1.2.4. Safe system approach

Safe system principles recognize that human beings, speeds, vehicles and road infrastructure must interact in a way that ensures the safety of all road users. A full safe system therefore:

- recognizes that human error is inevitable and accommodates it, rather than blaming victims;
- requires speed limits, road designs and vehicle safety features that limit crash forces to levels that are survivable for the human body, in the inevitable event of errors and crashes;
- motivates those who design, maintain, operate and utilize the roads; manufacture vehicles; and administer safety programmes to accept and address their shared responsibility for safety (see next section); and
- adheres to the underlying premise that the transport system should not compromise safety for the sake of other factors, such as cost or faster transport times (in addition, the many and substantial costs of higher speeds, including costs of crashes, commonly make higher speeds worse for an economy, as explained in Module 5).

This description is partly from the Global Plan for the Decade of Action for Road Safety 2021–2030 (Fig. 1) *(25)*, but also adopts the revised position on shared responsibility recently advanced as more internally consistent with a safe system *(26)*.

Fig. 1. The principles and implementation of a safe systems approach to road safety

Source: Global Plan for the Decade of Action for Road Safety 2021–2030 (25).

Those who design, maintain and operate the roads (including those who set policy and laws); manufacture vehicles; and administer safety programmes, including the private sector, share the responsibility for the safety of road users *(27)*. These stakeholders must accept and address this responsibility, so that, when a crash causes injury or death, they find remedies throughout the system that address and ideally fully prevent the recurrence of such crashes, rather than blaming drivers (a term that includes motorcycle riders) or other road users. Nevertheless, the safety of the road system is imperfect; thus, while countries pursue a safe system, improving road user behaviour can save many lives, even though improving the other elements of the road system (to protect people from inevitable errors) ultimately delivers safety more sustainably and completely. The push to the ultimate safe system, in which road users are protected from death and disabling injury even in the event of error *(27)*, should continue, although no country has yet reached this and it is many years away for most. Within current road systems, especially in LMICs, the evidence presented in this manual demonstrates that effective RPE (combined with the interventions required for general deterrence, as explained later) for behaviour change remains a critical, powerful and cost–effective tool for road safety gains.

Being a front-line emergency first responder, road police make an important contribution to all dimensions of the safe system approach.

- Safer speeds: Road police manage speed risks. This includes contributing to assigning appropriate speed limits, enforcing across all speed limit zones and balancing the relative risk of harm with the public interest in criminal justice in the high-speed pursuit of evading offenders.
- Safer people: Road policing creates deterrence and changes road user behaviours.
- Postcrash response: Road police are routinely the first emergency response on scene, stabilizing survivors until emergency medical services arrive. Police are also routinely responsible for crash investigation and appropriate criminal justice responses.
- Safer roads: Road police routinely patrol the entirety of the road network, reporting damage/unsafe locations for timely remediation.
- Safer vehicles: Road police role model cutting-edge vehicle safety technologies and introduce technologies into government fleets and ultimately into the secondhand vehicle market.

1.2.5. Role of behaviour change in the context of the safe system

Safe system principles highlight the importance of recognizing that, while serious crashes may involve road user error, they also involve failures of other elements of the road transport system. As a simple example, a driver may make the mistake of travelling too fast to safely negotiate a curve and thus move across the centre line, causing a head-on crash with multiple deaths. Had the road included a median safety barrier, a crash into it would almost certainly have occurred, significantly reducing (but not eliminating) the risk that anyone would be killed or seriously injured. Nevertheless, changing behaviours (through enforcement of speed limits in this case) remains a powerful, cost–effective and contributory tool for improving road safety.

1.2.5.1. Opportunities for improving road user behaviour or avoiding the consequences of error

The safe system approach highlights the many opportunities available for improving road safety, including:

- making roads safer: for example, by installing crash barriers;
- making vehicles safer: for example, by installing air bags to help protect occupants in a crash, or electronic stability control to help avoid loss-of-control crashes;
- ensuring safer speeds, through road engineering (such as speed humps, lower speed limits), vehicle technology such as intelligent speed adaptation or assistance (ISA), and behaviour change (such as speed limit enforcement);
- improving safer road user behaviour: for example, through drink–driving or helmet enforcement;
- improving postcrash care: for example, by reducing response times or making emergency hospital treatment free for all; and
- reducing road use and thus exposure to risk of death or injury: for example, by providing and incentivizing the use of alternative mass-transport options, such as rail or metro (28).

1.2.5.2. When to prioritize RPE versus managing safety through other elements of the system

Road safety decision-makers should consider all the opportunities before committing to action on road user behaviour change. This requires a clear understanding of the nature of the problem to be targeted. What are the main causes of road trauma and the effective evidence-based interventions that will address them?

This section considers two examples: one from a rural road or highway, and one from an urban road. Six aspects should be considered in both cases: information, road user behaviour, speed management, road design and engineering, vehicle safety and finding the best actions.

In the first example, a driver makes a mistake and fails to safely negotiate a curve at night on a rural road. On the curve, the car (or motorcycle) travels across the centre line, causing a head-on crash with multiple deaths. Perhaps the curve is a crash blackspot with a history of such crashes.

First, in such a crash, it may be difficult or impossible to know the nature of the driver error. For example, was the driver travelling too fast for the curve (speeding or the speed limit is too high), under the influence of alcohol or drugs, fatigued or distracted, or unable to see the curve at night? The behavioural problem in such cases cannot be addressed without knowing more about what it was. Such information is available in some cases, although it may be unreliable.

Second, if it can be established that the problem was a particular risk factor related to road user behaviour, and that this risk factor features in a number of the crashes at this curve, then enforcement may be feasible.

Third, if the problem is speed, which does not necessarily mean drivers travelling above the speed limit, then many solutions related to speed management are possible, depending on the circumstances. They include lowering the speed limit (if the limit is high for the curve), adding speed enforcement on the approaches to the curve, or (much less effectively) installing a warning sign to slow users down or giving an advisory speed limit. Installing speed-lowering traffic-calming measures before the curve is also effective.

Fourth, even without knowledge of the nature of the driver error, road design and engineering may offer a solution. For example, regardless of the error, installing a median barrier at the curve would prevent all head-on crashes, resulting instead in mostly non-injury crashes into the barrier. If crashes involve motorcycles, barriers suitable for them (such as those with motorcycle skirting) are needed. Alternatively, if the cause is lack of visibility of the curve, then clear markings (improved lane lines, warning signs) may be an effective solution.

Fifth, improving vehicle safety will help people to survive many such crashes, as well as others. For example, by increasing the safety requirements for vehicles to be imported into or manufactured in the country.

Sixth, if all required information is available, and several of the above options are feasible, the task is finding the best actions. Ideally the decision will be based on feasibility (including funding and political acceptability), the effectiveness of the action for the particular problem, the BCR, time for implementation and possibly other relevant local factors. The need for evidence-based interventions and the possibility that multiple interventions may be ideal should be kept in mind. For example, if the crashes are commonly due to speeding, then a speed camera or other speed enforcement measure may be the most cost–effective option, especially if speed-related crashes are also occurring in other locations along the road. If some crashes are due to speeding

and others are due to fatigue or distraction, then the best solution may be the combination of a median barrier and speed enforcement on the curve.

In the second example, a driver makes a mistake and fails to give way, fatally injuring a pedestrian on a pedestrian crossing on an urban road. The area is already a 30-kilometres per hour (km/h) zone and the crossing is clearly visible. Similar crashes have occurred at this crossing and at others nearby over the last 2 years.

First, in such a crash it may be difficult to know the nature of the error made by the driver or in some cases possibly the pedestrian. For example, was the driver travelling too fast to stop (which means speeding is involved, because at 30 km/h there would easily be time to stop), under the influence of alcohol or drugs, fatigued or distracted? Such information is available on some crashes at this and at nearby crossings.

Second, if it can be established that the problem was one or more particular risk factors related to road user behaviour, and that these risk factors feature in a number of crashes, enforcement (related to speeding, drink–driving or mobile telephone use, etc.) may be the best intervention.

Third, if speeding is a likely contributing factor in some of these crashes, speed management (installing speed humps on approaches to the relevant crossings and raised platform crossings) will greatly improve safety.

Fourth, as to road design and engineering, the crossing is already visible, but may not be well lit at night, which could be addressed through better street lighting.

Fifth, improving vehicle safety helps people to survive many crashes. In this case, improved pedestrian protection on vehicles will reduce the severity of pedestrian injuries at this and many other locations.

Sixth, if all required information is available, and several of the above options are feasible, the task is finding the best actions. Ideally the decision will be based on feasibility (including funding and political acceptability), effectiveness of the action for the particular problem, the BCR, time for implementation and possibly other relevant local factors. The need for evidence-based interventions and the possibility that multiple interventions may be ideal should be kept in mind. For example, if crashes here are commonly due to speeding (which seems likely), a speed camera or other speed enforcement measure may be the most cost–effective option, especially because speed-related crashes also occur in other locations in the area. The combination of traffic calming and enforcement is likely to be the most effective approach.

The most cost–effective feasible solutions will vary depending on the circumstances and will often include RPE. The evidence shows that crash numbers decrease as the amount of enforcement increases *(29)*.

1.3. The many other roles of RPE

RPE has multiple additional roles and purposes, which are presented briefly here to highlight the breadth of roles covered in this manual.

In addition to enforcement for road safety, RPE can make roads feel safer and facilitate increases in active transport, reduce traffic-related noise and air pollution, reduce the contribution of road transport to climate change and assist crime reduction. Because people drive as they live *(30)*, those who disobey road laws are likely to disobey other laws, and road safety and other risks correlate: not being vaccinated against coronavirus disease (COVID-19) is a strong predictor for a driver's risk of being involved in a serious-injury crash *(31)*. Thus, users detected in road offences are more likely to be wanted for other offences, which police may detect through warrants/records associated with drivers' licences and vehicle registrations. The most critical of all purposes, however, remains improving road safety, saving lives and preventing injuries.

Measures to determine priorities across the broad remit and responsibilities of police agencies are not standardized, and thus indicators in this manual to rationalize the relative priority for road policing are based on comparative human harm as well as the frequency of perpetration of criminal offences. Globally, mortality rates for road trauma are more than 2.5 times higher than those due to violent crime (that is, homicide) *(32)*, and across the WHO regions the difference ranges from 0.1 to over 36 (Table 1).

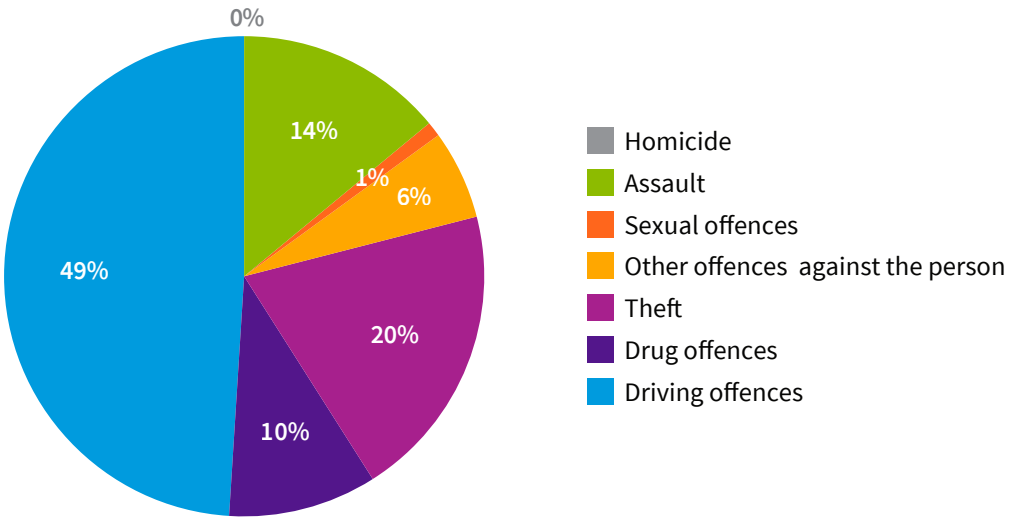
Table 1. Ranges of comparative mortality rates for road trauma versus violent crime in the WHO regions

WHO region	Lowest mortality rate ratio (road injury: interpersonal violence)	Highest mortality rate ratio (road injury: interpersonal violence)
African Region	Seychelles: 0.5	Malawi: 12.1
Region of the Americas	Saint Vincent and the Grenadines : 0.1	Suriname: 3.3
South-East Asia Region	Maldives: 0.7	Nepal: 14.6
European Region	Türkiye: 1.4	Croatia: 11.2
Eastern Mediterranean Region	Pakistan: 2.00	Bahrain: 36.7
Western Pacific Region	Philippines: 0.8	China: 23.1

Source: WHO Global Health Estimates 2021.

In the Australian state of New South Wales, data on police prosecutions highlight that between 1995 and 2023, almost one half of all prosecutions for serious offences, involved crimes relating to driving and vehicles (Fig. 2) *(33)*.

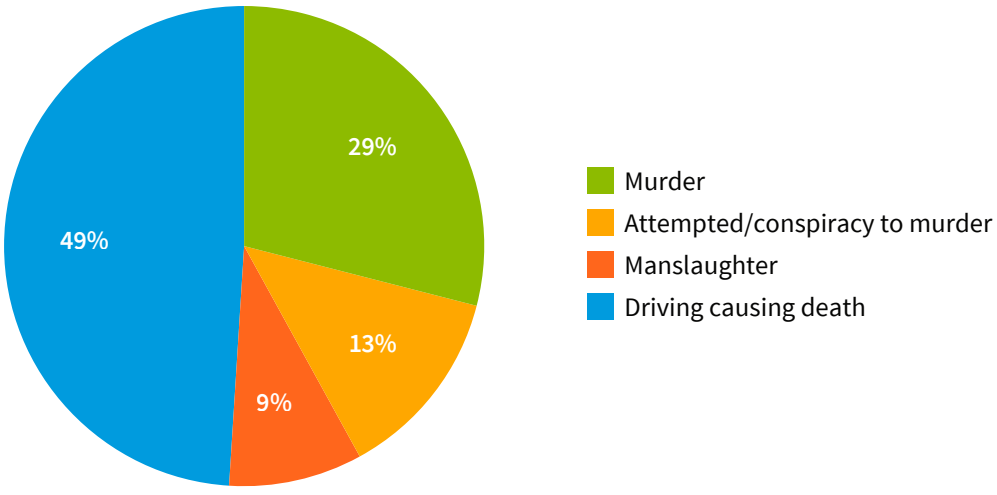
Fig. 2. Proportions of prosecutions for select serious criminal offences in New South Wales between 1995 and 2023



Source: Based on data from the Government of New South Wales *(33)*.

Similarly, data from the Western Australia Police show that between 2007 and 2024, almost one half of all cases of homicide were caused by drivers (including, but not limited to, dangerous and negligent driving) (Fig. 3) *(34)*.

Fig. 3. Proportions of cases of homicide in Western Australia between 2007 and 2024



Source: Based on data from Western Australia Police *(34)*.

The UN defines policing as a "function of governance, responsible for the prevention, detection and investigation of crime, the protection of persons and property and the maintenance of public order and safety" *(36)*. While there are no standardized measures of relative priority for various policing functions and disciplines, it is widely recognized that RPE has limited political and population priority *(37)*, with the allocation of human and financial resources by policing agencies far from commensurate with the burden of road trauma and the risk of it occurring, nor the effectiveness by which RPE can prevent road trauma.

While official data may indicate otherwise in some countries, official records miss a large proportion of road crash deaths: a much higher proportion than records of homicides. Comparing countries' official numbers for road crash deaths with independent estimates by WHO reveals that, globally, official data miss on average 84% of crash deaths in LICs, 51% in MICs and 11% in HICs *(7)*. In most countries, the level of resourcing put into road policing is not commensurate with the size of the problem or the opportunity for human and economic savings, compared with other areas of policing.

RPE fulfils the following roles in supporting road safety as well as other agendas:

- enforcement of all pertinent legislation in a road environment, effectively denying criminal utility of the road network;
- the enforcement of road safety legislation by issuing penalties or initiating prosecutions, which not only influences specific identified road user behaviours but also can improve vehicle safety via road access restriction of unsafe vehicles;
- follow-up, including in judicial processes, to ensure that prescribed penalties are applied and adhered to;
- advocacy for enforcement and its impact;
- visibility in the road environment to reduce risky behaviour and improve perceptions of safety (although non-visible RPE is also critical);
- collection of casualty crash data to inform every aspect of road safety activity, including identifying causes of and contributors to a casualty crash, not only in road user errors but also in road infrastructure (ideally evolving to include causes of the severity of a crash);
- management of crash scenes to reduce the risk of secondary crashes; and
- provision of first-responder aid to the injured and of transport to hospital (or arranging for bystanders to provide such transport) in many countries.

This list omits education and non-causality-related traffic management, because they are either ineffective or take valuable policing resources away from road safety for the sake of traffic flow, which is better managed in other ways. The evidence and rationale for both these aspects are outlined in later sections.

1.4. Summary and recommended actions

This module outlines the devastating and economically draining costs of injuries, disability and loss of life caused by road crashes. It describes the safe system approach and sets the scene for the vital role of road policing in the context of a safe system and road safety. This module also notes the many non-enforcement roles of road policing that contribute to the total effort to improve road safety and the move towards a safe system.

Recommended action 1.1: The burden and human impact of road trauma, relative to other political and public policing priorities (for example, violent crime) should be recognized and used to rationalize greater priority for RPE within policing agencies.

Recommended action 1.2: The many roles of RPE in relation to road safety – which go beyond changing road user behaviour and include collecting data to guide many other areas of road safety activity – should be appreciated and prioritized.

Recommended action 1.3: On-road enforcement should be maintained as a vitally effective arena of road safety intervention.

Recommended action 1.4: Appreciate and prepare for the gradual evolution of enforcement and behaviour change activities with the growing implementation of a safe system. For example, mandatory speed-governing ISA will require a shift from pure enforcement of speeding limits to enforcing laws against or attempted override of in-vehicle safety technology.

Recommended action 1.5: A safe system perspective should be considered before deciding on road user behaviour change (safer road users) as the best opportunity to manage a particular road safety problem. This requires a clear understanding of the nature of the problem to be targeted, as shown by the case studies in this module.

Recommended action 1.6: In rationalizing RPE activities, the profound economic costs of crashes and estimates of crash cost savings – as well as reductions in death, suffering, grief and loss – should be fully acknowledged.

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MODULE 2

The psychology behind unsafe road behaviour and good policing practice

2.1. Introduction

This module looks at the underlying factors influencing road safety behaviour, using evidence from behavioural and cultural sciences, such as psychology. With a better understanding of road safety behaviour evidence-based interventions and approaches to RPE can influence these behaviours.

This module shows why road safety decisions must be based on evidence on what works to prevent road trauma, not just evidence for what the problem is.

2.2. Problem behaviours for road safety

Within safe system approaches for road safety, a central principle is that humans are fallible and make mistakes, and that the consequences and outcomes of those errors can be accommodated through simultaneous actions achieving safer vehicles, safer infrastructure safer speeds and postcrash care. While human error may result in a crash, deaths and serious injury can be prevented through a safe system, which is our primary road safety objective.

It is therefore important to distinguish between error and at-risk road user behaviour in the context of RPE. Unlike error, which is a non-modifiable behaviour, at-risk road user behaviours are those made when road users have lost an appropriate perception of the risk and consequences associated with the behavioural choice, or they mistakenly believe the risk to be insignificant or justified *(1,2)*.

An example of error, one commonly cited in road crash reports, is the behaviour "looked but did not see", which is where a driver looked in all directions, as required of a diligent and alert driver, but failed to perceive a road hazard such as another road user or vehicle in their path before moving on. While such instances may decrease in frequency with cognitive and attentional training, such occurrences are not amendable to RPE. Another example is where a driver becomes distracted by a child or pet in the rear passenger seat of a vehicle, involuntarily taking their eyes of the road ahead of them and subsequently drifting into oncoming traffic. Conversely, at-risk behaviours are intentional deviations from mandatory road safety practices, such as speeding, using a mobile phone, or driving while under the influence of impairing substances such as alcohol or drugs.

Here, we summarize some of the high-risk behaviours that can result in serious harm:

- risk-taking, such as:
  - drink– and drug–driving;
  - deliberate distracted driving, such as using a mobile telephone;
  - speeding;
  - failing to give way or failing to obey traffic light signals or signs;
  - aggressive driving such as failing to give other road users sufficient roadway space; and
  - crossing roads outside designated pedestrian safety infrastructure.

- non-use of mandatory protective equipment, such as:
  - driving a vehicle without correctly wearing a seat belt;
  - transporting a child without using an appropriate child restraint;
  - riding a motorcycle or bicycle without correctly wearing a standards-compliant helmet; and
  - driving an unroadworthy vehicle.

This module considers these deliberate behaviours in terms of the psychology behind them and how to address them through effective RPE.

2.3. Factors influencing road user behaviours

Road safety behaviours are contextual, and the factors influencing them may be different for different countries and subgroups. However, in this section, we discuss some of the most common factors that influence road user behaviour using an adapted COM-B (capability, opportunity, motivation and behaviour) model *(3,4)*. This model looks at the determinants of behaviours across four categories: capability (are people able to comply with the required behaviour), physical opportunity (is the environment supportive of the required behaviour), sociocultural opportunity (are social networks negatively or positively influencing people's behaviour) and motivation (whether people are incentivized to a required behaviour). While all these factors are relevant to road safety, motivation is a particularly essential factor for road user behaviour because it is influenced by the three other factors and is the most directly influenced by RPE (Fig. 4).

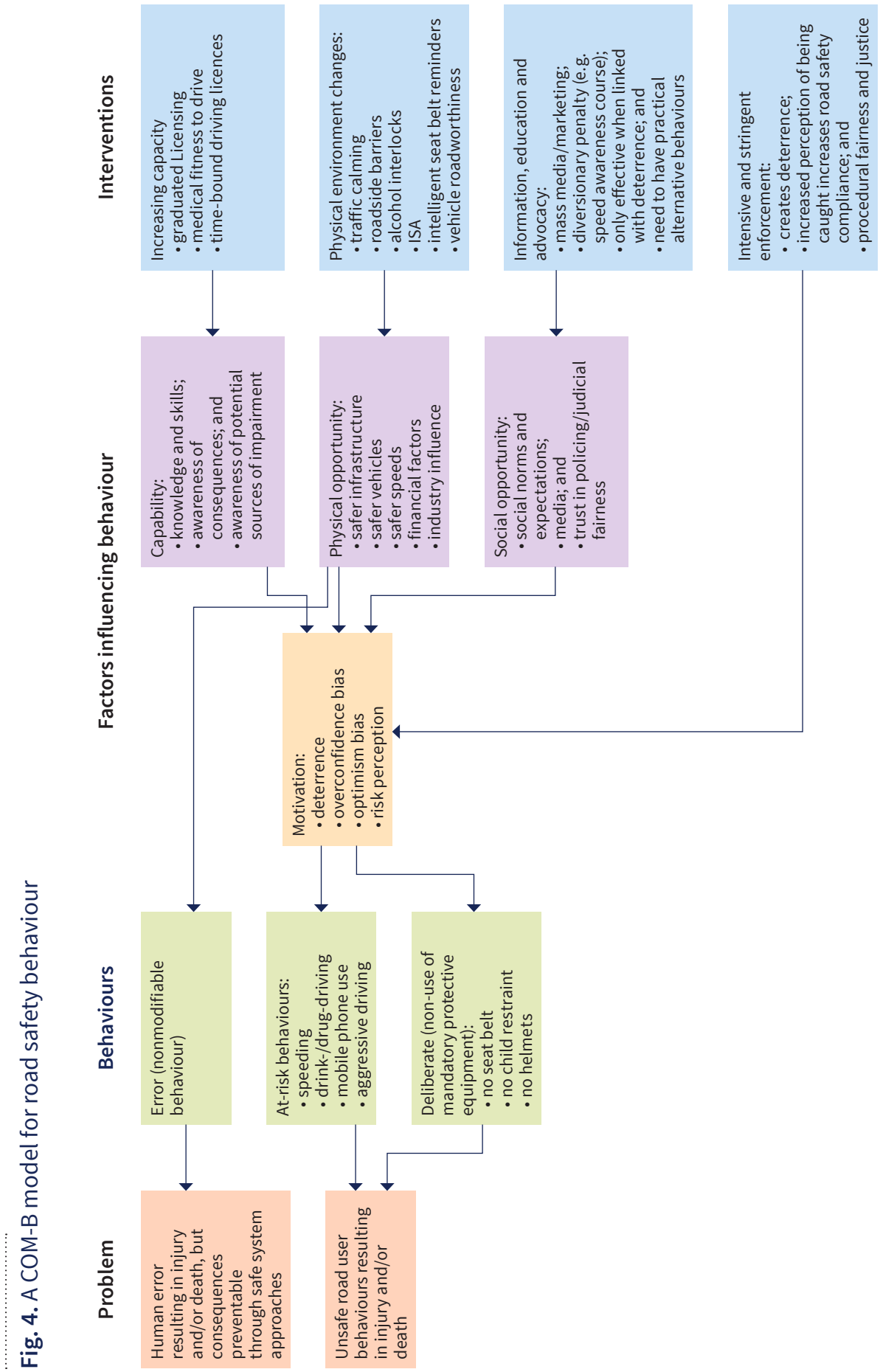

Fig. 4. A COM-B model for road safety behaviour

Source: Produced by the authors.

2.3.1. Capability

In a road safety context, capability refers to whether people have the mental and physical capacity to drive safely, including the correct knowledge, training, skills and experience. It is important to note in this context that, in the majority of legal jurisdictions, holding a driver's licence remains a privilege (as opposed to a right) and comes with capability conditions and restrictions intended to maximize road safety for all.

Drivers at both ends of the age spectrum are influenced by capability factors. For example, elderly drivers may experience impairment associated with age or medical-related cognition, while the capacity of young drivers is influenced by their limited amount of on-road experience.

In addition, drivers may find themselves in a situation where they lose the capability to consistently make correct road safety decisions. For example, people may underestimate the impact of prescription medications on their ability to drive, an increasing road safety problem and associated with a lack of information and lower health literacy *(5)*.

And although this is not an excuse for drink– or drug–driving, the use of drugs or alcohol can impair people's abilities to make good decisions, such as not to drive *(6)*. In this instance, interventions may need to be placed prior to the occurrence of the impairment, such as the use of alcohol interlocks and/or advocating drivers preplanning alternative transportation prior to a night out.

Although unsafe road behaviours are rarely a knowledge or skills problem, most drivers will be aware they are driving above the speed limit. A lack of awareness of the consequences of speeding can influence people's motivation to violate these rules.

2.3.2. Physical opportunity

Physical opportunity refers to how the physical environment encourages and restricts behaviour. This includes how roads are built and maintained, but also the rules and regulations governing road safety, industry influence on road safety and even the financial status of the road user.

2.3.2.1. Road and vehicle environment

Road lane width, road signs, road conditions, lighting and time of day all have major impacts on road user behaviour *(7)*. It should be no surprise that the physical shape of roads – with or without a centre line, or with or without segregated lanes for vulnerable road users (for example, pedestrians and cyclists) – are common interventions to improve road safety and decrease vehicle speed. Many of the most effective interventions for road safety fall into this category, such as roadside and central barrier systems, medians, traffic-calming measures like speed breakers and roundabouts, and segregated pedestrian and bicycle facilities. For example, in San Francisco, the speed of dangerous left turns decreased by 17% at select intersections by adding rubber speed breakers and waist-high yellow posts *(8)*.

While changing these physical attributes of road infrastructure may be considered outside the remit of RPE in some jurisdictions, it remains a well-established role of RPE to make intersectoral and interdisciplinary recommendations on opportunities where safe system actions can improve road safety outcomes. Further, the use of road infrastructure treatments to reduce speed will reduce the need for police presence at critical intersections, facilitating the dispatch of limited human resources elsewhere.

Adaptations to vehicles can also have an impact on road safety. The introduction of intelligent seat belt reminders, a visual and audible alarm that can only be disabled by fastening the seat belt in all occupied seats, was found to be more impactful than providing information on the importance of seat belts for safety; speed warnings in professional vehicles like taxies and minibuses *(9)*; or alcohol ignition interlocks for people convicted of drink–driving, which decreased recidivism by 65% *(10)* and alcohol-related crash deaths by 15% *(11)*.

2.3.2.2. Industry influences

A significant part of the road transport system is delivered by private sector entities. These have a deliberate and profound influence on risky on-road behaviour, requiring action to limit both political will and management of these behaviours. Examples are listed below.

The alcohol industry has long attempted to influence governments in regard to the blood alcohol concentrations (BACs) permissible for drivers of various ages, experience, licence classes and vehicle types. Reflective of its business models, its primary objective has always been to maximize alcohol consumption by drivers, while simultaneously limiting the liability of establishments that serve alcohol to individuals well beyond levels of driver impairment.

The approach of the alcohol industry towards the prevention of drink–driving is based on ineffective non-evidence-based interventions, such as education, self-regulation and designated driver programmes that maximize consumption, rather than supporting policies and legislation that reduce BAC limits (for example, 0.08 g/dL down to 0.05 g/dL for the general population, and 0.03 or 0.02 g/dL for novice and probationary drivers) and maximizing their implementation through intensive RPE *(12,13)*. The practices of the alcohol industry contribute to misinformation about the road safety risks and consequences of driving under the influence of alcohol.

The vehicle manufacturing industry can generate market forces for vehicle standards in the absence of enforceable government regulations. This can be either negative or positive for road safety.

Vehicle manufacturers can encourage negative road behaviours through their marketing.

They market and advertise their vehicles based on speed, power and acceleration, which are presented as exciting, macho and fun. In many countries, vehicles are still advertised by showing them driven at high speed, referring directly to their racing heritage with comparisons of race and street cars *(14,15)*, stressing their power/acceleration and top speed. Unfortunately, risk-taking (including speeding) has more perceived positive value for young drivers *(16)*.

They promote speed capability through technologies that make cars more comfortable at high speed *(17)*.

They manufacture vehicles capable of speeds greatly in excess of the maximum speed limits in most countries in which they are sold.

They install speedometers that show extremely high speeds and reduce the visual sizes of speed differences around the levels of speed limits.

They resist implementation of key longstanding technologies to help manage speed (speed-governing at a maximum speed or with sensitivity to speed limits, via ISA) while making voluntary/advisory ISA, which informs the driver but does not limit speeds, available in some vehicles *(18)*.

Many private sector media outlets promote speed and criticize regulation of it *(19,20)*, while simultaneously receiving substantial revenue from car advertising. In relation to road use, faster is also misunderstood as better from an economic perspective (see Module 5 for evidence that higher speed is worse for economies overall).

Many transport companies (especially trucking/logistics companies) encourage governments to resist lowering speed limits, from which they appear to reap economic benefits. This advocacy often misguides understanding of the net costs of speed to societies, and limits political will to reduce speed limits and to treat speeding more seriously.

While lower speed limits would maintain an even playing field across road transport companies, road transport would become less competitive with other transport modes (rail, maritime and air). In addition, considerations of government policies to facilitate modal shifts to safer forms of transport generally neglect the external costs of road transport, which include the costs of high speed such as crashes, deaths, injuries, air pollution and emissions of greenhouse gasses *(21)*.

2.3.2.3. Financial factors of road users

Although not excuses for unsafe or illegal driving behaviours, the financial situation of road users can influence both road behaviour as well as their response to enforcement. For example, rural youth without routine access to public transport may choose to drive without a licence or in an unregistered/uninsured vehicle, due to the high financial costs associated with obtaining licences and maintaining cars. With the barrier to road safety in this example being financial, the potential for consequential financial penalties being effective is limited and a non-financial deterrent can be implemented. Such an approach would be similar for people in economic hardship who may already have a multitude of fines they cannot pay; an additional fine may be ignored. Instead, alternatives, such as demerit points or income-specific fines, may provide stronger deterrence *(22,23)*.

Similarly, the levels of fines do not serve as equal deterrents for all population groups. For wealthier populations, a fine will not serve as a deterrent if it does not penalize a speeding driver. In Finland, as well as some other European countries, the values of road safety infringements are based on the reported taxable incomes of the offending drivers *(24)*.

2.3.3. Sociocultural opportunity

This refers to how people's social environment and their cultural background encourage or discourage safe road user behaviours. The impact of these factors is highly context-specific. For instance, some population subgroups, such as young males, may view some at-risk behaviours as positive, especially speeding (25,26). Some social groups have a positive view of drink–driving, seeing drivers caught and charged by police for driving under the influence of alcohol as unlucky rather than dangerous (27). Differences can also be seen between countries. For example, drivers from Türkiye reported drink–driving to be less socially acceptable than drivers from Norway; however, the views were reversed when considering speeding *(28)*.

How speed limits are set is also influenced by social norms. In several countries, speed limits are set in a manner that is inconsistent with safe system principles, but the ability to reduce speed limits may be impeded by public resistance or protests *(29)*.

Similarly, the use of protective equipment is also strongly influenced by social norms. For instance, a COM-B analysis of barriers to helmet wearing among farmers using all-terrain vehicles in the United Kingdom identified social norms ("nobody else wears one") as a major barrier to utilizing

this protection *(30)*. While a review on beliefs about helmet use in adult cyclists across 17 countries identified that perceived social norms were the strongest predictors of helmet use *(31)*.

Finally, the trust the driver and community have in the legitimacy of road safety laws and in the police influences how likely people are to comply with road safety rules. For instance, seeing traffic laws as valid and necessary, the police as protecting the safety of road users and the enforcement system as fair is likely to increase road safety compliance, as well as fine payments, compared with those who perceive the police as magnifying their revenue through unjust fines *(32,33)*.

2.3.4. Motivation

Finally, motivation refers to people's willingness to comply with road safety regulations as well as the emotions and psychological biases that may be influencing their behaviour. Motivation is influenced by other factors (capability, physical opportunity and social opportunity); for example, wide roads and peer pressure can motivate individuals to engage in more risky driving behaviours. Understanding the motivations of drivers is crucial to determining effective deterrence, which will be explained later in this module.

2.3.4.1. Psychological biases influencing motivation

There are several psychological biases that influence road safety behaviours, here we discuss a few of the most important ones.

- Optimism bias refers to people's belief that they will have better lives than others and experience fewer setbacks, including being involved in a road crash. Therefore, a crash due to speeding or unsafe driving is something that may be believed to happen to others, but not to oneself *(34,35)*. This is in part because people are strikingly bad at estimating actual probabilities, especially small ones *(36)*.
- • Overconfidence bias is the related phenomenon, in which most drivers believe that they are better-than-average drivers. This has been identified in many studies in many countries *(15,37–40)*. This bias may result in a belief that speed limits and road rules are to ensure other, worse drivers do not make mistakes, but do not apply to oneself. Similarly, there is direct evidence of driver overconfidence persisting after consuming alcohol, with drivers generally seeing themselves as performing better than average in that circumstance *(38)*. In addition, there is evidence that higher levels of overconfidence are associated with decreased safety *(41)*.
- If people are optimistic about their outcomes and overconfident about their ability, it is likely that that their risk perception of dangerous driving is lower. Previous experience with a lack of consequences of road safety violations or a lack of protective equipment may reinforce the belief that these behaviours are acceptable and safe. These perceptions of risk strongly affect people's willingness to adopt protective behaviours *(42)*.
- The intention–action gap refers to the difference between what people intend to do and what they do in practice. Although many people intend to use the road safely, evidence suggest they fail to do so in practice. For example, the 2023 E-Survey of Road users' Attitudes (ESRA) showed that only 4.2% of those surveyed found drink–driving acceptable, while 14.8% admitted to drink–driving in the past 30 days. Similarly, although only 6.2% found driving over the speed limit in built-up areas acceptable, nearly 48% admitted to breaking this rule in the past 30 days *(43)*. Pointing out people's gaps between their intentions and actions, and encouraging people to make specific plans, can help them overcome this bias.

- Habits are the day-to-day practices people follow, often without conscious consideration. For road safety, much of the driving is habitual, particularly for daily commuting, and requires little thought by the person. This means that the driver often does not make a conscious decision to wear a seat belt or not; it is automatic behaviour. Overcoming bad road safety habits can be difficult; however, when positive behaviours become habits they are likely to stick.
- Present bias refers to people's preferences for things that happen now and the tendency to discount things that happen in the future. Therefore, the enjoyment of dangerous driving now can be preferred over a potential crash in the future. This bias is also why messages focusing on long-term harms of dangerous driving, such as environmental costs or road maintenance costs, are limited in their effectiveness.
- Motivation to avoid penalties with all the above-mentioned psychological factors; improving road safety may not be an important, or effective, motivator to improve safe driving behaviour. Instead, drivers may be more motivated to avoid punishment for unsafe road behaviour. The fact that so many drivers slow down when they see or think they see a speed camera or police car, and speed up once past it (see Section 5.4), highlights that drivers know when they are speeding and choose to do it regardless. This part of motivation is discussed in more detail in the next section.

2.4. Road safety interventions and enforcements

2.4.1. Education and training needs to be part of a larger road safety programme

The road safety impact of education and training interventions can range from dangerous to ineffective to impactful. For example, requirements for obtaining a driver's licence that include on-road supervised instruction as well as graduated licensing systems have been demonstrated to improve the skills, experience, and safety of young and novice drivers *(8)*. However, school-based education ("drivers ed") and postlicence training is often ineffective or may even increase risk-taking behaviours *(8)*. Paradoxically, training in "advanced" driver and motorcycle rider skills can cause an increase in crashes *(44,45)*. The evidence shows that increasing driver and rider skills increases driver overconfidence, which subsequently increases risk-taking *(46–48)*.

Approaches that focus exclusively on education, such as standalone mass-media communication, are broadly considered an ineffective method to achieve road safety objectives. That said, campaigns that combine risk communication with enforcement have been demonstrated to decrease the frequency of behaviours that put road users at increased risk of trauma *(27)*.

2.4.2. Deterrence through enforcement can promote road safety behaviours

The challenge for road safety is that many of the psychological mechanisms introduced in this module diminish the perceived risk of road trauma as a motivator for safer road user behaviours, such as adhering to speed limits, never driving under the influence of alcohol or drugs, and always correctly wearing a seat belt or helmet. In practice, the likelihood of enforcement and legal consequence can be more effective in changing behaviour than the potential of a crash resulting in serious injury or death *(49)*.

RPE is successful as a road safety intervention because it provides an alternative motivation to drivers to refrain from at-risk behaviours. In countries where the observed frequency of road policing is high, and the belief in procedural fairness and justice is assured, this corresponds with a widespread public perception that any offending will be swiftly detected and punished with stringent financial penalties and/or driving sanctions (for example, loss of their driver's licence). The deterrence created by this perception can be far greater than the deterrence from the perceived risk of injury or death due to violations of road safety legislation.

Random breath testing (RBT) for alcohol has been a highly successful road safety intervention. The randomness and intensiveness of RBT has been reported to counteract driver overconfidence, because police have the power to stop and test drivers for BAC, regardless of whether a driver exhibits probable cause or denies the existence of any impairment *(27,38)*.

The general deterrence impact of RBT, and its contribution to road safety outcomes, is profound. In Australia, where police in all state jurisdictions have RBT (and random drug testing (RDT)) powers, police implemented more than 175 million breath tests between 2008 and 2019 (ranging from 12–16 million RBTs per year) (Fig. 5). Over this time period, the proportion of drivers detected under the influence of alcohol decreased from 0.9% to 0.4% *(50)*, and the percentage of alcohol-associated road deaths decreased by 40% *(51)*. Conversely, the intensity of RBT during the years of the COVID-19 pandemic was markedly reduced, with the frequency of RBT in 2020 52% lower than the frequency in 2019. Associated with the reduction in enforcement and the loss of general deterrence, the proportion of drivers under the influence of alcohol increased from 0.4% to 0.9% in a single year. The intensity of RBT has slowly increased up to 2024; however, it still remains significantly lower than prepandemic levels. While interruptions to the intensity of enforcement have contributed to periodic increases, overall, the intensity of RBT reduced alcohol-associated road deaths in drivers and motorcyclists by 62% and 72 %, respectively, between 2008 and 2023. In comparison with RDT, which has steadily increased in intensity from 92 000 drivers tested in 2008 to over 500 000 drivers in 2023, the proportion of drug-impaired drivers killed increased from 4% to 18% over the same time period.

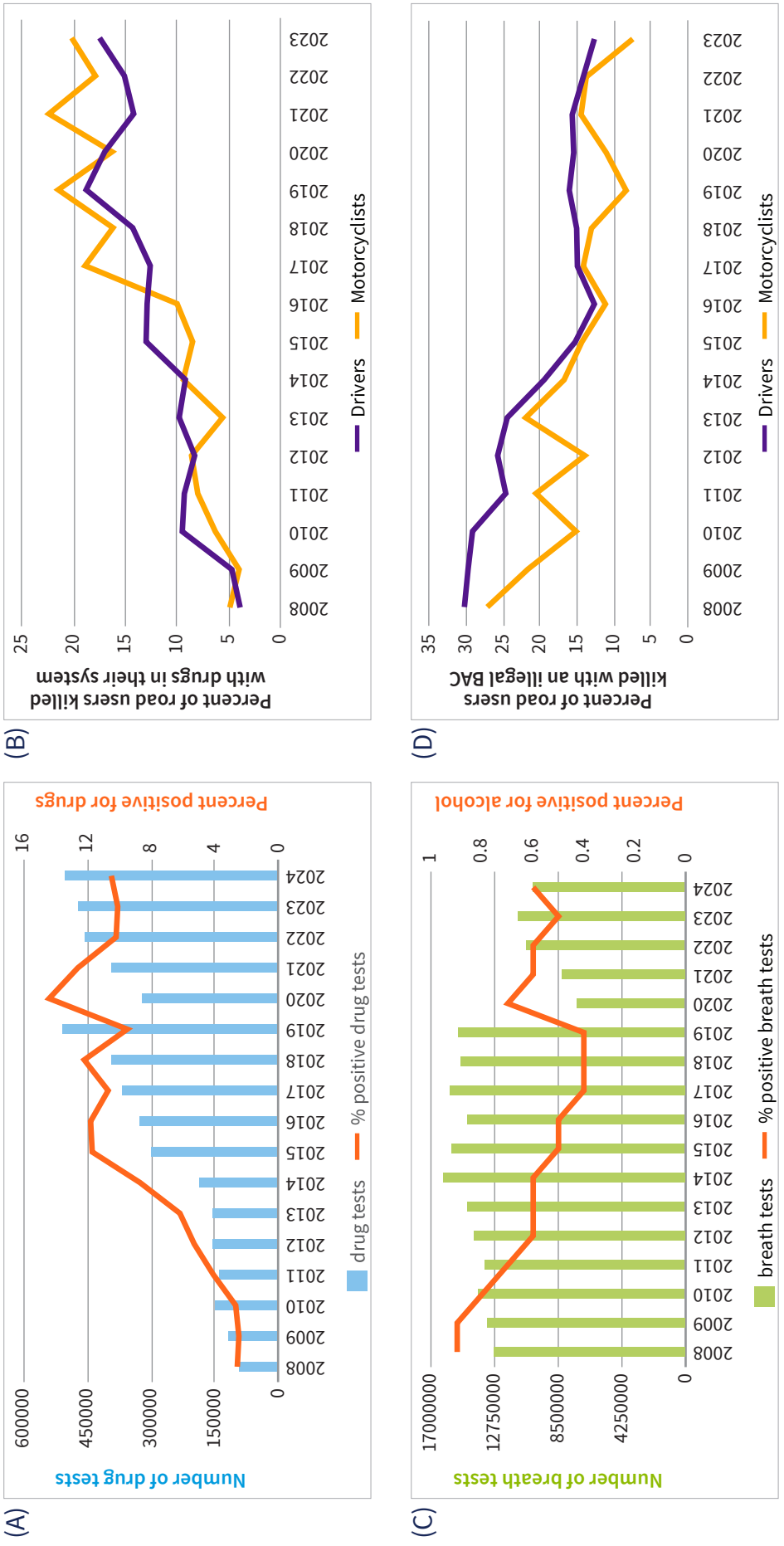

Fig. 5. Intensity of enforcement for alcohol and drugs and road safety outcomes in Australia, 2008–2024: (A) drug tests conducted versus positive results, (B) proportion of road deaths with drugs in their system[a], (C) random breath tests conducted versus positive results and (D) proportion of road deaths with an illegal BAC[b]

Source: Australian Government, Office of Road Safety, Department of Infrastructure, Transport, Regional Development, Communication, Sport and the Arts (*52*). Reproduced with permission.

[a] Data not available for Western Australia and Victoria due to data quality issues.
[b] Data not available for all states in all years due to data quality issues.

2.4.3. How to increase the impact of deterrence

With the demonstrated effectiveness of RPE in influencing road safety behaviour, this section considers how to make enforcement as mainstream and intensive as possible.

2.4.3.1. General and specific deterrence

Enforcement can work through two distinct mechanisms: specific and general deterrence. Formally defined, specific deterrence refers to deterrence of law-breaking behaviours in specific offenders achieved by catching and punishing them. It works by changing the behaviour of a road user who is caught and fined and/or otherwise punished; it is specific to each road user who is caught. General deterrence refers to deterrence of unwanted behaviours in the general population without necessarily catching each individual involved; for example, through an increased police presence on roads. General deterrence is applied across many road users.

Widespread specific deterrence, such as that created when large numbers of speeding drivers are intercepted and receive penalties, also contributes to the creation of general deterrence when it generates widespread publicity that, in turn, creates a belief in the population that speeding is likely to be detected. The threat of being caught can change the behaviours of road users who have not yet been caught. Of the two mechanisms, general deterrence is more powerful for road safety because it influences more people than just the offenders, but both are essential ingredients of an effective road policing programme. Again, appropriately publicizing the results of specific deterrence creates general deterrence.

The most effective enforcement generates the threat (fear) of detection and penalties: general deterrence. General deterrence is improved by maximizing the perception and reality that offences are *(53)*:

- likely to be detected (the perceived risk of apprehension);
- punished with consequences that are unavoidable (punishment certainty);
- punished with penalties that genuinely deter people from that behaviour (punishment severity); and
- punished swiftly, through penalties that must be paid or are applied soon after the offence (punishment swiftness).

From a behavioural perspective, the most important of these factors in influencing behaviour are the certainty of detection and the certainty of punishment, rather than the severity of the punishment, because they increases the risk perception that leads to a change in behaviour *(54)*.

Penalties applied to road users after a crash has occurred do not generate powerful general deterrence, and so cannot be relied on for general behaviour change. Because causing a crash is seen by most drivers as highly unlikely, the risk of detection (and application of more serious penalties after a crash) is also seen as highly unlikely. Thus, the first requirement for general deterrence (perceived probability) is not met. For general deterrence, it is critical that enforcement and penalties are applied for behaviours without a crash having to occur. However, strong penalties after a crash do provide opportunities for behavioural barriers to further risky behaviour by serious offenders, through sanctions such as licence loss and/or vehicle impoundment.

One way to increase the perception of certainty is through media depictions and campaigns *(55)*.

2.5. Summary and recommended actions

This module explores the factors influencing road safety behaviours by looking at people's capability, their physical and sociocultural opportunity, and motivation. Although all factors have important implications for road safety behaviours, motivational factors are key and most are readily and effectively influenced by RPE. The educational and deterrence-based interventions introduced in this module are discussed in more depth in subsequent modules.

Recommended action 2.1: Road policing should prioritize road safety outcomes, noting the profound loss of life and injury that can be avoided.

Recommended action 2.2: Police should design road enforcement and messages relating to it to generate maximum general deterrence, as well as specific deterrence, even though general deterrence is more powerful because it influences many more road users.

Recommended action 2.3: Police and other road safety experts should employ the psychological understanding of road safety, of human behaviour change and of human misjudgement of risk outline in Module 2 to explain why many actions that one might expect to work actually do not work in road safety, and why and how enforcement works to change behaviour. This includes highlighting the need for road safety decisions to be based on the evidence for what works; not just evidence for what the problem is, but what actions work to fix the problem.

Recommended action 2.4: Police and road safety experts should align interventions with the factors influencing the road safety issue. For error-based outcomes, the gaps in the safe system environment (infrastructure and vehicle) should be further considered, but for intentional at-risk behaviours, capacity, motivation, social norms, physical environment and industry influence should be the basis for intervention.

Recommended action 2.5: Police and road safety experts must recognize that due to common psychological biases, educational campaigns and training alone are likely to be ineffective. Instead, campaigns should be linked to increased enforcement, whereby the effective component is the increased risk perception of being caught.

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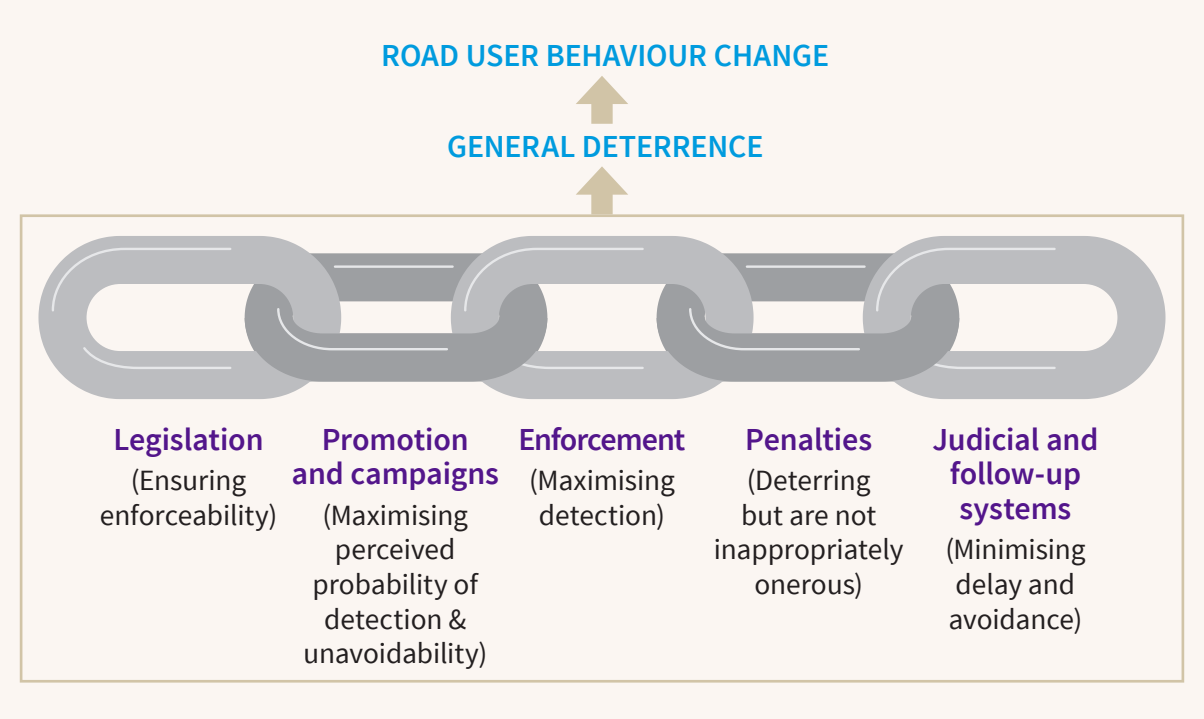
MODULE 3

The total enforcement system required to deliver deterrence

3.1. Introduction

In road safety, the most effective means of behaviour change is general deterrence, as outlined in Module 2. This module goes further to describe each of the critical links of processes in the criminal justice chain that are required to ensure strong general deterrence (Fig. 6), as well as the decisions and processes required in each link.

Fig. 6. The criminal justice chain is only as strong as its weakest link: processes required for general deterrence and behaviour change in road safety



Source: authors.

A common, yet ineffective, approach is to focus on particular links/processes because they are easier to fix. For example, when faced with a lack of effective behaviour change, many governments of LMICs opt to increase penalties because this is readily within their control. This may be useful if a perceived laxness of penalties was the weakest link, but this is not commonly the case. One must appreciate that, like a chain, the total RPE system is only as strong as its weakest link. This has powerful practical consequences:

- to improve the system, the weakest link(s) must be identified and strengthened;
- spending resources on improving strong links is a waste;
- in principle, there is no way to determine which process/link each country should focus on for improvement; and
- the weakest links(s) can be identified through the collection and analysis of relevant data on enforcement procedures, practices and outcomes.

3.2. Identifying the weakest link

The collection and analysis of relevant information help to identify the weak link(s) in the system. While there is a tendency not to collect the information required because of the small costs generated, a small expenditure on getting the required information can avoid wasting resources on already strong links while missing the key issues that contribute to the overall weakness in the system. Having data as the baseline also allows assessment of the efficacy of actions taken to address the weaknesses: for example, whether the rate of relevant behaviour (such as wearing motorcycle helmets) improved or the relevant belief (that wearing a helmet prevents head injuries) changed.

Examples of relevant features to be determined, framed as questions, and the results that indicate the strength or weakness of the link are provided here.

3.2.1. All links/processes

Two key steps provide vital general information. First, conducting on-road surveys is critical. These determine: the compliance rate with the law and with whom, when and where compliance is weakest. Securing data through representative observation-based on-road surveys, not just self-reporting of behaviours, is also critical. For example, roadside surveys can easily observe the use of helmets, seat belts and child restraints. However, counterfeit helmets may look genuine and physical inspection is often necessary to identify when these are being used. Speeds can easily be monitored with readily available measurement equipment.

Use of seat belts and helmets tends to be higher in large cities than in smaller communities or on rural roads, so survey locations must be selected to represent these different situations. Data collection should also include estimates of basic demographics (age and gender) that can be reasonably estimated via on-road observations *(1)*, so that relevant target audiences can be identified. For example, younger or older males may be less compliant. This knowledge helps to frame actions targeting a particular audience to improve the situation. In addition, academic researchers and others who are paid to collect data often observe too many people. Surveys for seat belt or helmet use may cover 60 000 people, while a much smaller sample may be enough to provide a sound guide, provided that the sample is representative. Too much emphasis on the total sample size can also invite unrepresentative samples: for example, by focusing on large numbers at major intersections in major cities, where the data can be collected easily, instead of also including road users in villages and rural areas. This point refers to types of locations, not representing every major city of every province/state if they are reasonably similar.

Second, a survey of the beliefs and attitudes of road users (drivers or motorcycle riders, etc., or the particular demographic group shown to be the least compliant) is necessary to determine whether the law, its enforcement and the penalties are well known. This allows broad identification of possible weaknesses. Again, a huge sample is not required. The sample size will depend on the target group addressed and the spread of different types of locations to be represented. The ESRA, managed by the Vias Institute in Belgium, is an example of a standardized multicounty survey that can provide invaluable insights to road safety and RPE policy and practice *(2)*.

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3.2.2. Legislation

Does the law clearly specify the offending behaviour in a way that allows for effective enforcement? Are police and enforcement personnel able to enforce the law with minimum challenges to the offence in the courts? Interviews or a survey of these personnel may clarify issues or identify a lack of them. Ideally, the police should be routinely consulted on all new or revised legislation to ensure its continuing enforceability.

3.2.3. Promotion and campaigns

Has visible promotion and campaigning occurred? Has it been based on enforcement and the threat of penalties (which support the system and behaviour change), or based on the fear of crashes (which is ineffective, as explained in Section 3.7)? Do the relevant audiences believe the messages?

Promotion and campaigns can be designed to strengthen other links in the chain using the information collected. For example, if many people are detected exhibiting a particular risky behaviour (such as speeding) but there is a general belief to the contrary, publicizing the large numbers of people being detected may be helpful. If surveys reveal that people believe that a fine is much smaller than it really is, publicizing the size of the fine may help, etc.

3.2.4. Enforcement

Are efforts to detect and punish unsafe behaviours sufficient? To assess this, obtaining data on a range of indicators (stratified by age, sex and road user type) – such as the number of drivers intercepted, the range by which violations are spread (for example, the level of BAC for drink–driving or the travelling speed at which drivers are measured) and the penalties issued – should be mainstreamed. The standardized survey tool on road policing practices and enforcement in Annex 2 outlines a range of indicators that could be considered for routine data collection on enforcement practices.

A survey of relevant road users regarding their beliefs about the risk of being caught is also informative. Do they see the risk as low or high? For example, research in Serbia found that one of the reasons for common illegal behaviour was the perceived lack of risk of detection *(3)*.

3.2.5. Penalties

Are road users wary of incurring penalties or do they see them as a minor matter? A survey of road users' beliefs about penalties can reveal that they are understood to be lower than their real level, and that the real penalty levels should be publicized.

3.2.6. Judicial and follow-up systems

Of the penalties and other consequences issued, what percentage are paid/implemented? If these percentages are not high, then the follow-up systems are weak and must be strengthened. Similarly, what percentage of penalties issued are dropped by judicial/appeal systems or relevant authorities?

This section identifies multiple survey issues. After initial data collection (on-road observations), the required survey questions can be combined in one survey to target the least compliant sectors of the population.

3.3. Facilitating safe behaviour

In some cases, information from a survey can reveal that the levels of detection and penalty are enough to change some behaviours, but not to secure the particular behaviour required. For example, purchasing a motorcycle helmet may be seen as too costly. Such a finding should be interpreted with caution because it may be a common excuse, especially if people are seen carrying but not wearing helmets. However, if it is accurate, other policies may help, such as reducing taxes on helmets to make them cheaper, designing helmets for use in hot and humid conditions (such as the lightweight, low-cost ECE22 helmet developed by the FIA Foundation for use in LMICs) *(4)*, or requiring the purchase of a helmet with each motorcycle purchase. In some countries, loans of child restraints, or programmes on fitting child restraints are used to support the right behaviour and ensure that restraints are properly fitted to cars *(5)*. As a final example, the provision of rest areas, where drivers can stop and take a break along highways, facilitates driver management of fatigue.

Some jurisdictions seek to reward safe behaviour. While this is consistent with the core psychological principles of behaviour change, it is challenging to apply in road safety. There is no evidence that reward schemes work, so they are not encouraged. The challenges relate to three elements of the processes required. First, identifying habitually safe drivers is difficult. These schemes typically reward drivers for not being booked for an offence in a given period, such as 1 year. However, this often means that the driver has not been detected engaging in unsafe behaviour or, where corruption exists, has bribed a relevant official to avoid the penalty and any record of the offence. Thus, the schemes may inadvertently reward unsafe behaviours and/or corruption. Second, as a core psychological principle for effective behaviour change, the reward

must be closely associated with the safe behaviours to be strengthened. Driver reward schemes fail in this because they include a long delay (up to 1 year or more) before the reward is applied. Third, affordable rewards for the desired behaviour are quite small in real terms. For example, a typical reward scheme allows for a discount on or free driver licensing for 1 year after having no driving offences detected; the reward typically amounts to a tiny amount per day. For example, a saving of US$ 50 equals less than 14 cents per day.

3.1.1. Evidence of the importance of ensuring the operation of all the links

The evidence clearly indicates the importance of the effective operation of all parts of the system in creating behaviour change. In a number of LMICs, penalties are issued but simply not paid because there is no strong or timely follow-up: for example, not allowing the relevant vehicle to be re-registered for the next year. This is not sufficient, because:

- the delay is too long even if the penalties are paid after 1 year;
- the number of penalties accrued over 1 year can exceed the value of the vehicle, especially a cheap motorcycle;
- the owner may choose not to register the vehicle again, thus avoiding all the penalties for the year; or
- the owner may sell the vehicle, leaving the new owner to deal with the penalties owed.

As an indication of the importance of combining legislation, promotion/education and enforcement, a longitudinal study conducted in Canada showed that this combination was especially successful in dramatically increasing the wearing of bicycle helmets. With this approach, helmet use was not only sustained after the legislation was passed but improved from 75.3% soon after the legislation was enacted to 94.2% 14 years later *(6)*. Box 5 in Module 7 (on drink–driving) describes a case study on the full use of all the links in the system.

3.4. Legislation, including regulation

Legislation, which is taken to include regulation, must define offences and set penalties. Regulation refers to the process by which rules are set through an agency or position, such as the transport minister or the commissioner of police, assigned the authority to do so. Enforcement is neither legal nor feasible without legislation, so it is the essential first step for RPE, although not sufficient in itself to achieve road safety outcomes.

Legislative processes and outcomes are not considered in detail here, because legislation is a critical prior step and because the WHO manual Strengthening road safety legislation: a practice and resource manual for countries describes what to do about this topic and how to do it (7). Thus, the following sections cover recent developments that are most relevant to RPE.

In addition, WHO global status reports have highlighted inadequate road safety legislation in many countries *(8,9)*, with examples including the lack of a requirement to wear a seat belt in the rear seats of cars, the absence of legislation on child restraints, legislation on motorcycle helmets that does not include passengers and legislation on drink–driving that is still based on impairment rather than BAC or excessively high BACs, such as 0.08 g of alcohol per 100 mL of blood. There

is clearly opportunity for improvement in many countries. Module 7 explains the weaknesses of impairment-based drink–driving laws. Further, Annex 2 comprises a survey tool that is intended to be a resource to standardize the review of how legislation on risk factors in road safety is enforced across Member States and subnational police jurisdictions.

3.4.1. Strong effectiveness of legislation and enforcement in LMICs

While most scientific evaluations still come from HICs, where good data and research funding are more readily available, an increasing body of evidence shows the strong value of clear legislation and enforcement in LMICs. For example, cost–effectiveness assessment of various interventions showed that the cost of saving each disability-adjusted life-year (DALY) was worthwhile for several legislative/enforcement interventions in LMICs (10). The modules on speeding, drink–driving, etc. present the evidence for the effectiveness of many RPE-related interventions in LMICs.

3.4.2. Enforceability of legislation and the roles of road police and the judiciary

Sound legislation is enforceable, and the way in which legislation is framed and written can significantly influence enforceability. Thus, consulting with police for their expertise in the practical enforceability of proposed laws is a critical part of preparing legislation for road rules.

The court system can also play a key role in sustaining the enforceability of road law. For example, Brazil conducted BAC testing, but the law allowed drivers to refuse the test until a Supreme Court ruling resolved the issue (Box 2).

Box 2. Case study of the role of the Supreme Court in enforcing drink–driving law in Brazil

Brazil's 2012 drink–driving law specified a zero-tolerance approach, with drivers required to have zero alcohol in their blood. Unfortunately, drivers' ability to refuse to undergo BAC tests deeply constrained the police's ability to conduct them. The law was challenged using the 2012 American Convention on Human Rights, arguing that forcing a driver to take roadside BAC tests, with results to be used in criminal proceedings, violated the drivers' right not to incriminate themselves.

After considerable debate, Brazil's Supreme Court, declared the country's Drink–Driving Law to be fully constitutional 10 years later, deciding unanimously that the societal benefits of allowing the police to administer BAC tests greatly outweigh the concerns raised about individual rights. This decision ratified the enforceability of the law and empowered police to administer a breathalyser (BAC) test if a driver behaves erratically.

Improvements to Brazil's enforcement in this area were supported by the World Bank, which recommended strengthening drink–drive laws, including offering specific solutions *(11)*, and by WHO as part of the Bloomberg Philanthropies Initiative for Global Road Safety *(12)*. explanation and evidence).

3.4.3. Treating driving as a privilege, not a right

One of the challenges some countries face is the inadequate appreciation of the importance of interpreting driving as a privilege, rather than a right. The presence of licensing systems that people can pass or fail in all countries, prerequisites for having that privilege, highlights that driving is a privilege under law. There is established precedent for police to interpret operating a vehicle on public roads as implied consent to cooperate with all enforcement activities *(13)*.

Acknowledging driving as a privilege allows solutions to some concerns about civil rights. For example, in some countries, tests such as RBT for alcohol are regarded as unlawful. Compliance with RBT can be set as a requirement for gaining the privilege of driving (see also Box 2 for another solution). Because the evidence shows that RBT is a profoundly successful form of enforcement (as presented in Module 7), a lack of effective RBT is highly costly in avoidable deaths and disabilities.

3.4.4. Graduated licensing systems: creating additional requirements and penalties for novice drivers

Extensive experience in many countries over the last 2 decades has repeatedly shown the life- and injury-saving value of graduated licensing systems (GLSs): licensing systems that set extra requirements for novice drivers before they attain a full licence. This is covered in a later section of this module on licensing, and is noted here because it requires special legislation and mechanisms to allow effective enforcement.

3.4.5. Standards and guidelines for road safety interventions

In many countries, legislation sets standards and these can greatly influence road safety, including enforcement. Legislation that sets standards for safety equipment (such as motorcycle helmets, bicycle helmets and child restraints) is very important in saving lives and preventing injuries. Some countries require the wearing of helmets but have no standards for the protection offered, thus allowing the sale and use of helmets that do not provide effective protection in a crash. This situation must be improved.

Some countries use legislation to set guidelines related to road safety. While this gives the guidelines clear authority it has two disadvantages. First, engaging in a political process can hinder effective guidelines. Second, lengthy and, again, political processes are required to update the guidelines as society and technology advance. In road safety, an important example is the development of guidelines for setting speed limits. Such guidelines are strongly encouraged, but may be most effectively developed and updated if they are not set in legislation. For example, some states in the United States of America set speed-zoning guidelines in legislation, which constrain the use of more modern lower speed limits for pedestrian safety. In contrast, in other countries, road safety authorities set guidelines that are still relevant and followed, yet have allowed more effective updating and adoption of 30-km/h zones for vulnerable road users, such as close to schools.

3.5. Enforcement

Well-delivered enforcement works, especially when supported with the right communications/campaigns, as many examples in this manual demonstrate. The evidence reveals a clear relationship between the volume of effective enforcement and rates of serious crashes, with research showing that increased enforcement leads to significant reductions in crashes *(14)*.

The ideal outcome of enforcement for general deterrence is that road users come to believe (through personal experience, experiences of people they know, and through news and campaigns) that certain behaviours (such as not wearing a helmet or speeding) are likely to be detected and to incur a penalty. Module 4 on good practice provides more information on effective processes for enforcement.

3.6. Penalties

3.6.1. Penalty types and penalty setting

The Global Road Safety Partnership (GRSP) published a guide on penalties in 2021 *(15)*, and so this section is brief and, in places, based on it. A range of penalties is available with the capacity (to varying extents) to achieve the following possible outcomes:

- general deterrence of offences;
- specific deterrence of offences;
- creation of barriers to reoffending (for example through licence loss, or vehicle impoundment);
- complete prevention of the behaviour by offenders for some time, for example through imprisonment;
- helping to manage underlying causes of offending (for example, treatment for alcohol dependence); and
- playing of a role in education by signalling the level of risk that is involved with various offences.
- Riskier, more dangerous behaviours should result in more severe penalties *(15)*, which are also important in deterring more extreme versions of behaviours. For example, the penalties for speeding (and for drink–driving-based BAC) increase with increasing speed or BAC. If this is not done, a driver who chooses to speed may decide to drive 40 km/h over the limit instead of just 10 km/h over because the penalty for both is the same.

Table 2 provides a list of possible penalties for road related offences, a description of the penalty type and which of the above six outcomes it is designed to produce, and comments on advantages and disadvantages. An increasing body of research examines relationships between the efficacy of penalties and personality. This is not considered in detail because it has limited practical consequence for RPE, and because personality tends to have small effects on road-related offences and penalties *(15)*.

Table 1. Available penalty types, objectives, advantages and disadvantages

Penalty type	Description	Primary objective	Advantages	Disadvantages
Fines (predetermined and graduated monetary penalties)	A monetary sanction to be paid by the offender to a given department by a specified date. The amount of the fine should increase according to the severity of the offence (for example, higher levels of speeding should attract higher monetary fines). The amount of the fine should be set in a schedule, and publicized so that offenders know the amount, which assists with general deterrence, and so that police are less able to change the amount of the fine when interacting with offenders.	General deterrence: to deter would-be offenders from offending Specific deterrence: to punish offenders to deter future offending	May provide revenue to directly support investment in road safety activities (for example, enforcement). Less costly to manage than imprisonment, or licence and vehicle penalties.	Fines issued by the police at offender interception points create opportunities for corruption that must be managed. Socioeconomic status may determine how impactful a fine is for individuals. A later section considers equity issues.
Demerit points	Points accumulated from zero to a higher number when a driver commits an offence, which remain on the driver's record (usually for a number of years). When a set threshold number of demerit points is reached within a defined period (for example, 12 or more points within a 3-year period), another penalty is imposed: usually licence suspension or disqualification.	General deterrence: to deter would-be offenders from offending Specific deterrence: to punish offenders to deter future offending	The impact of points is likely to be more equitable across different income earners than a monetary fine *(16)*. Repeated offending attracts more points, providing good specific effects *(17)*. This may be perceived to be a fairer penalty and receive good public support *(18)*.	There is a risk of offenders transferring the collected points to another individual (for example, with no or few points) if detected by a camera *(19,20)*. This can be managed through taking photographs including drivers and/or imposing heavy penalties for false declarations of who was driving. This penalty relies on an effective licence system that can follow offenders' offence records and effectively apply suspension when a threshold is reached.

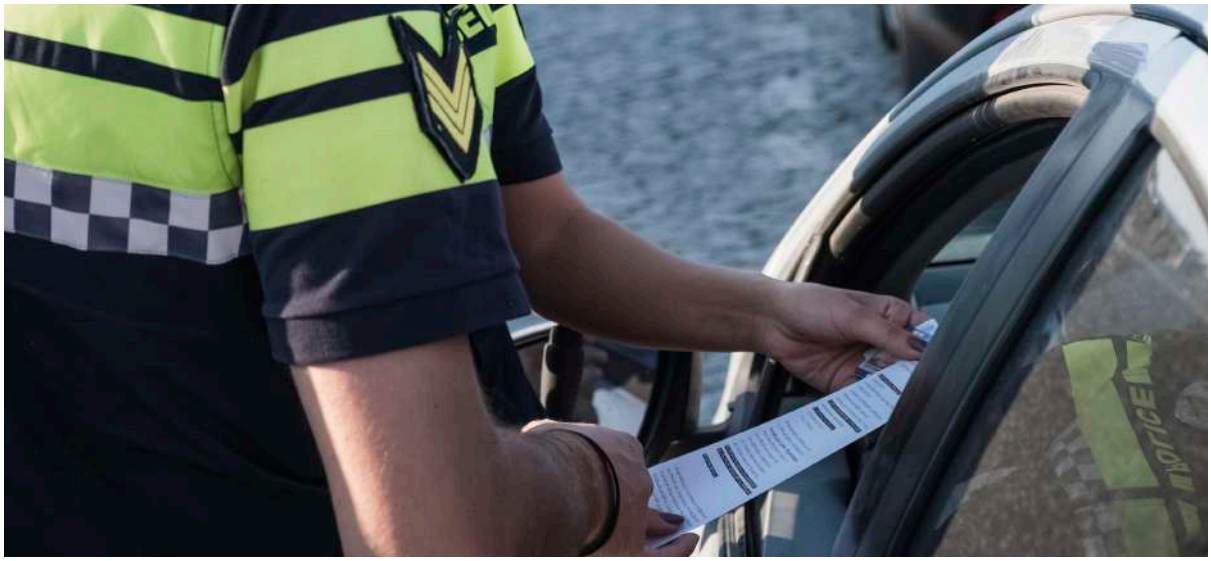
Penalty type	Description	Primary objective	Advantages	Disadvantages
Merit points	Points are lost from a set number (for example, 100) until they reach zero when a driver commits an offence. The credit of points usually remains valid for a number of years. When the credit drops to zero, another penalty is imposed: usually licence suspension or disqualification.	General deterrence: to deter would-be offenders from offending Specific deterrence: to punish offenders to deter future offending	The advantages are the same as for demerit points.	The disadvantages are similar to those for demerit points.
Licence suspension	Suspended licence holder is banned from driving at all times during the period of suspension. The licence is automatically reinstated after the suspension period.	General deterrence: to deter would-be offenders from offending Specific deterrence: • to punish offenders to deter future offending • to prohibit offenders from further offences by reducing or minimizing driving while their licences are suspended	The penalty minimizes opportunities for reoffending during the term of the sanction if it is obeyed or even partly obeyed.	Suspended drivers may continue to drive even though not legally licensed *(21–25)*. Suspension may be perceived as unfair, especially in relation to its impact on an offender's capacity to earn a living if this depends on driving. It relies on an effective licence system that keeps accurate records and communicates with the offender and enforcement agency. For all licence penalties, this includes a system that prevents the offender from obtaining another licence.
Immediate licence suspension/ Roadside licence suspension	Police suspend and confiscate the licence on the spot for a serious offence (for example, high-level speeding, drink–driving, offences causing death and serious injury), generally for a defined period (for example, 28 days).	General deterrence: to deter would-be offenders from offending Specific deterrence: to punish offenders to deter future offending • to prohibit offenders from further offences by immediately reducing or minimizing driving while the licence is suspended	In contrast to traditional suspension (above), the deterrent effect of immediate/ roadside suspension is swift, one of the critical elements of increasing deterrence.	Police officers can suspend a licence immediately, which cannot happen with camera-detected offences. It requires a system where the immediate suspension of a driving licence is recorded so that authorities are aware of the suspension.

Penalty type	Description	Primary objective	Advantages	Disadvantages
Licence disqualification/ revocation	This penalty bans the former licence holder from driving at all times during the period of disqualification. The licence is reinstated only when the driver reapplies for it at the end of the disqualification period. Nevertheless, a lifetime disqualification bans a driver from ever driving again.	General deterrence: to deter would-be offenders from offending Specific deterrence: to punish offenders to deter future offending • to prohibit offenders from further offences by reducing or minimizing driving while the licence is revoked	It minimizes opportunities for reoffending during the term of the sanction.	Disqualified drivers may continue to drive *(21,22,26)*. It relies on an effective licence system that keeps good records and communicates with offender and enforcement officers. It requires a system where court-imposed disqualifications are recorded in the licence system in a timely manner.
Licence restriction	The licence holder is banned from driving during the period of restriction except for certain purposes (for example, to drive to and from employment or medical treatment) that may be determined by a court or other authority. Offenders are usually required to demonstrate that they would suffer unnecessarily from being prohibited from driving in order to be granted a restricted licence.	General deterrence: to deter would-be offenders from offending Specific deterrence: • to punish offenders to deter future offending • to prohibit offenders from further offences by reducing or minimizing driving while the licence is restricted	It reduces opportunities for reoffending during the term of the sanction and may increase caution and vigilance when driving.	Widespread use of restricted licences may undermine both specific and general deterrence because the offenders do not experience the full impact of punishment *(27)*. It relies on an effective licence system that keeps good records and communicates with the offender and enforcement officers. Licence restriction provisions must be visible on the driver's licence. If not, police officers who intercept such drivers on subsequent occasions may miss seeing the restriction.

Penalty type	Description	Primary objective	Advantages	Disadvantages
Vehicle sanctions	The vehicle is confiscated, impounded, forfeited or immobilized on the offender's property, with a boot or club on a wheel. Vehicles may be returned/released after the sanction period with payment of a fee. Alternatively, the licence plate may be seized, or a sticker attached to the licence plate to show that anyone but the offender is permitted to drive the vehicle. Usually applied to serious offences and/or repeat offenders for whom other penalties did not stop reoffending.	General deterrence: to deter would-be offenders from offending Specific deterrence: • to punish offenders to deter future offending • to prohibit offenders from further offences by reducing or minimizing driving while the vehicle sanction applies	This reduces opportunities for reoffending during the term of the sanction. Drivers may find it more difficult to continue driving without a vehicle than without a licence. Evidence suggests that vehicle impoundment increases compliance with licence suspension *(28)*.	This is less directly punitive for offenders who do not own the vehicle concerned. The owner may be punished, although the option to allow some drivers to use the vehicle may resolve this. The offender may be able to use another vehicle. Issues can arise when the value of the vehicle is less than the total cost of impoundment and the offender chooses to abandon the vehicle rather than pay the fee.
Alcohol interlock	This is technology fitted to a vehicle so that it cannot be started until the driver passes a preset breath test. These devices can also determine if the breath is from a person (versus a pump) and can require further tests during the drive. The technology is designed to modify the behaviour of drink–drivers, especially those with high-range BACs and/or repeat offenders, rather than to perform a general deterrent function.	General deterrence: to deter would-be offenders from offending Specific deterrence: • to punish offenders to deter future offending • to prohibit offenders from further drink–driving in this vehicle as long as the interlock is applied	It removes opportunities for alcohol-related reoffending during the term of the sanction in the vehicle that has the interlock fitted.	Access to interlock equipment and maintenance may be limited in rural locations. Recording of the interlock condition on the driver's licence must be easily visible, or intercepting police may overlook it.
Remedial programmes (treatment/ rehabilitation)	Remedial programmes may be educational (focused on knowledge) and/or psychological (focused on behavioural change), and run over weeks or months.	Primarily designed to modify the behaviour of offenders, especially drink–driving offenders, to reduce the risk of future offending rather than to perform a general deterrent function; to the extent that these programmes are mandatory and not desired they may also create general and specific deterrence.	Remedial programmes may more effectively address the factors contributing to alcohol- and drug-specific offences.	Good assessment procedures are required to match offenders to the most appropriate interventions *(29)*. Cost–effectiveness of different approaches is unclear. Access in rural and remote settings may be limited.

Penalty type	Description	Primary objective	Advantages	Disadvantages
Imprisonment	Offenders are imprisoned for some (serious) traffic offences such as drink–driving, driving while disqualified, or dangerous driving causing death or harm.	General deterrence: to deter would-be offenders from offending Specific deterrence: • to punish offenders to deter future offending • to prohibit offenders from committing further offences while in prison	This highlights to the community the seriousness of the offence. It removes opportunities for reoffending during the term of the sanction.	This is more costly to implement than other penalties.
Warning letters or text messages (not recommended as a regular form of penalty for deterrence)	Letters sent to offenders provide them with information on their offence and the penalties they face in the event of continued offending. Different jurisdictions use warning letters for different purposes. For example, a letter may warn offender that: • they have accrued a level of demerit points that approaches the threshold for licence suspension and one more offence will result in loss of licence; • their next offence will result in a gaol term or a higher fine than the last offence; • new penalties apply for the offence and that, after a limited period (e.g. a six-week warning) the new full penalty will be applied.	Specific deterrence: to deter offenders by informing them of the penalties they face for continued offending These can be used to announce that a new law will soon be enforced and that all subsequent offending will result in receipt of a penalty instead of a warning letter; this can allow the community to see a new enforcement process as fairer, by providing warnings instead of penalties for a short time after beginning the new process	A letter informs offenders or others of additional penalties they face, of which they may have been unaware, aiming to increase specific and general deterrence. Warning letters can be automatically generated and implementation costs kept low. Providing information increases procedural fairness.	There is small cost to the offender (that is, limited or no direct deterrence effect). The penalty relies on having addresses on record for people, in order to send letters. Text messages can be an alternative in countries where this is a more common method of communicating with drivers.

Source: Developed from the GRSP penalty guide *(15)*. Reprinted with permission.



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vidence on the effects of penalties is difficult to gather for two main reasons. First, evaluation studies commonly examine the effects of a package of sanctions, rather than an individual sanction *(15)*. Second, changes in penalties are applied to a whole country or state, so there is no ideal control group for comparisons, while comparisons across countries carry the risk that sociocultural differences can confound results. Isolating the specific effects of individual penalty types is therefore difficult, and one must rely on imperfect evidence and country experiences, which suggest multiple ways to increase the impact of penalties to bring about desired behaviour change.

Further, there is no specific way to determine easily how severe a penalty should be to deter people from committing a traffic offence. Various penalties have different impacts on people depending on their circumstances. A fine that has minimal impact on wealthy people may be quite a deterrent for those with fewer resources. While care is required not to exceed a reasonable penalty, road safety evaluations show that stronger penalties reduce offending, save lives and prevent injuries. For example, the addition of licence loss to existing fines for any speeding by novice drivers reduced speeding-related crash deaths involving this group by 34% *(30)*. In Serbia the introduction of a demerit point scheme along with substantially increased fines led to a 33% reduction in deaths, although benefits dissipated over time, possibly owing to reduced enforcement *(31)*.

In these circumstances, some rules of thumb may provide guidance.

- It is important to strike a balance between deterring people and avoiding creating too much hardship, noting that some discomfort paying the penalty is required for deterrence. Some guidance for setting the amount of a fine may be obtained from the average level of income, the range of incomes, and the consideration of who drives and thus could receive fines for offences. In many LICs, people with the least resources do not have access to a vehicle (even a motorcycle) and do not have jobs as drivers. In these circumstances, the very lowest incomes do not need to be considered in penalty setting.
- Experience with the extent of deterrence being achieved can provide a guide on penalties if the other conditions for general deterrence are met: detection is seen as likely, and penalties are seen as unavoidable and swift (see Module 2).

- If the problem behaviour continues to be common, the reality is that general deterrence is weak and changes are needed. Nevertheless, increasing the penalty will have little effect if enforcement detection is unlikely and/or the penalty can be avoided (for example, through corruption or simply by not paying it).
- Combining penalty types can assist to ensure that even wealthy people are deterred. In many countries, effective deterrence is achieved though the combination of a monetary fine with driver's licence loss and vehicle sanctions, including impoundment, in some cases.

3.6.2. Follow-up enforcement of unpaid penalties

Allowing an offender to avoid paying a penalty (such as a fine) greatly weakens deterrence. For example, in Colombia and a number of countries in Africa, fines go unpaid because systems do not connect unpaid penalties with drivers' licences (with points, for example, or suspension or cancellation of the licence), and there is inadequate or non-existent follow-up to ensure penalties are paid.

Several policies assist in avoiding this problem:

- creating an incentive for early payment, such as a reduced fine if it is paid promptly, or further deterrence for late payment, such as an additional penalty;
- ensuring a reliable and efficient processing system that tracks and collects unpaid fines, as well as processes that track the status of demerit/merit points and licence loss or suspension periods *(15)*;
- facilitating the tracking of drivers with unpaid penalties through automatic number plate recognition (ANPR) technology and sound record keeping to allow police on the road to know which drivers (and the vehicles they own) have unpaid penalties;
- suspending a driver's licence if fines are unpaid after a reasonable time;
- creating penalties that prevent the completion of operational processes, such as registering a vehicle or renewing a driver's licence, unless all fines are paid, although this alone is not good practice because it allows a lengthy delay before fines are paid; and
- when a driver is unable to pay a fine, considering the provision of alternative consequences, such as requiring set hours of unpaid work for the community, although these alternatives must be deterrent rather than easy ways to avoid paying penalties.

3.7. Social marketing and social media campaigns for behaviour change

Because police (and ministries of justice or interior) may be involved developing campaigns and media messages for road safety, they are covered briefly here.

The evidence shows the importance of appreciating the oddities of psychology and dismissing the mistaken belief that changing attitudes is required to change behaviour. Clear evidence indicates that the best way to change behaviour is often a direct approach to the behaviour, which will result in later changes in attitudes to match. Research on psychology and road safety contains many examples where a change of attitude or belief does not result in the expected change in behaviour (32), and forcing a change in behaviour, such as through strong enforcement, results in a change in attitude (see Box 5 in Module 7 for more detail) *(33)*.

As a further example, a study of boda boda [motorcycle taxi] riders in United Republic of Tanzania found that only 73% reported consistent helmet use, even though 95% agreed that it reduces injury severity *(34)*, while other studies show that self-reported use exaggerates actual use *(35)*. Thus, the attitude/belief that helmets are effective does not translate to wearing a helmet in the way common sense would suggest.

Almost always, the true aim of road safety campaigns and communications must be behaviour change. Without it, campaigns and messages cannot improve road safety. The communications and advertising industry strongly argues that it aims to change attitudes and beliefs, and with surveys it is easy, fast, and relatively cheap to show that this happened or appeared to happen. However, too often, people report that although a particular message has changed their view of speeding, drink–driving or driving while tired they continue these behaviours as before. Changes in attitude and belief will not prevent crashes or deaths unless the right behaviour change follows, and usually it does not.

Road safety campaigns mainly focus on one of two types of message: they may explain, publicize or show the risk of a serious crash through the particular behaviour (such as speeding or drink–driving), or the risk of being caught by enforcement. In the first type, the more extreme fear messages typically fail to deliver effective benefits to road safety *(32)*, highlighting that human beings are not good rational decision-makers in road safety and other fields *(36)*. For reasons explained earlier (see the discussion of the psychology of risk perception in Module 2), messages focusing on the risk of being caught by enforcement work much better to change driver behaviour. Unfortunately, political decision-makers see dramatic messages about crash risk (based on intuition, not evidence) as better and often promote them as comprising hard-hitting campaigns.

The evidence clearly supports an enforcement focus for campaigns and messages. For example, a review and meta-analysis of evidence from many countries shows that campaigns with enforcement messages are most effective and that campaigns based on crash-risk messages are of limited value *(37)*. In particular, many examples of the life-saving benefits of introducing speed enforcement involved campaigns warning that changes in enforcement were coming soon (see Module 5 on speeding). Similarly, evaluations of campaigns on drink–driving and seat belt use have shown that the promotion of improved enforcement has led to dramatic, life-saving change, while campaigns on crash risk have failed to produce any improvement (see Modules 6 and 7 for details).

Occasionally, a communications campaign may be needed to explain the need for enforcement, typically to a vocal minority opposing it *(38)*, to strengthen the political will for enforcement. Such a campaign should not be expected to improve road user behaviour as well, but only to change attitudes and verbal expressions to allow the enforcement actions that will really change behaviour.

Finally, campaign messages must be based on information on current beliefs and attitudes. For example, promoting information has no value if the community is already well aware of it. Care is required, however, to ensure that messages used are not simply ones that the public likes or thinks will work. For example, communities generally support high-fear advertising based on showing serious crashes, even though it is not effective in changing behaviour. Such messages can encourage drivers to think that only other people have bad crashes, and thus reinforce drivers' overconfidence and illusions of invulnerability. Also, the intended audience for high-fear messages often deliberately avoids them: according to a joke, the driver who reads a frightening article about the dangers of heavy drinking resolves to abandon reading, not drink–driving.

3.8. Advocacy: talking to the community and the media

Police are often asked to comment in the media on particular crashes and enforcement, and sometimes talk to the community about road safety. These are important opportunities for advocacy and the right messaging on road safety. Here are a few guiding notes.

As to enforcement, police are most typically asked to justify a particular operation, such as strong enforcement of speed limits in a particular area or on a particular road. Police typically emphasize extreme behaviours as justification: for example, announcing the apprehension of two drivers travelling at speeds above 120 km/h in a 50-km/h speed zone. Unfortunately, psychological principles indicate that this type of messaging is not helpful for road safety for three reasons.

1. It normalizes less-extreme speeding. When drivers who often travel 10 km/h above the limit hear such messages, they are likely to feel that their behaviour is quite safe and acceptable in comparison.
2. Extreme examples may be taken to indicate that the speed limit is too low: after all, two drivers travelling at more than double the limit did not crash.
3. This shifts the debate to focus on what is an acceptable speed to higher levels, and thus anchors it on consideration of the unacceptable nature of extreme speeding (see the psychology of Tversky's anchoring heuristic) *(39)*. Thus, a message on extreme speeding facilitates debate on levels of speeding that should be beyond debate, and can reduce support for strong enforcement of low-level speeding in the community and in political circles. Disapproval expressed by politicians of extreme speeding only is common and not helpful. As shown in Module 5, low-level speeding is a major contributor to deaths and injuries.

Instead, it is most helpful for police to help normalize compliant speeds, not condemn extreme speeding, and to remind everyone of the risk speeders cause to others and thus the need to stop them. A better message would be along these lines: "The large majority of people driving/riding on this road are travelling within the speed limit. Their safety should not be compromised by speeding by other drivers. Our enforcement aims to keep everyone safe."

Owing to the enforcement role of police, they inevitably and correctly focus on the behaviours of people involved in crashes. Commenting on wrong behaviours as the causes of fatal crashes adds credibility to the need for enforcement. However, to facilitate the adoption of a safe system approach and the required acceptance of shared responsibility by road system operators, it is also helpful if police point out other interventions that could have avoided crash fatalities. For example, speeding may have contributed to a head-on fatal crash, but the addition of a median barrier on the road could perhaps have prevented it.

3.9. Individual warnings/information

Police can provide warnings to drivers as well as issue penalties for infringements, and should often do both. A warning about the risk of the behaviour explains the penalty. The GRSP guide on penalties *(15)* gives advice on these elements and is recommended.

3.10. Robust Systems for Driver Licensing and Vehicle Registration

Effective road safety enforcement is greatly facilitated by robust, honest systems for driver licensing and vehicle registration, with valid data on driver and vehicle owner contact details (addresses, etc.) for contact and issuing penalty notices, and the requirement to clearly display a vehicle registration/licence number. These systems facilitate many elements of on-road policing, including camera enforcement, the identification of vehicles involved in crashes and incidents, the issuing of penalty notices, follow-up of unpaid penalty notices and proof of offences in disputed cases. Placing the onus on the driver/vehicle owner to notify relevant authorities of changes in contact details in a formal and timely manner is also good practice.

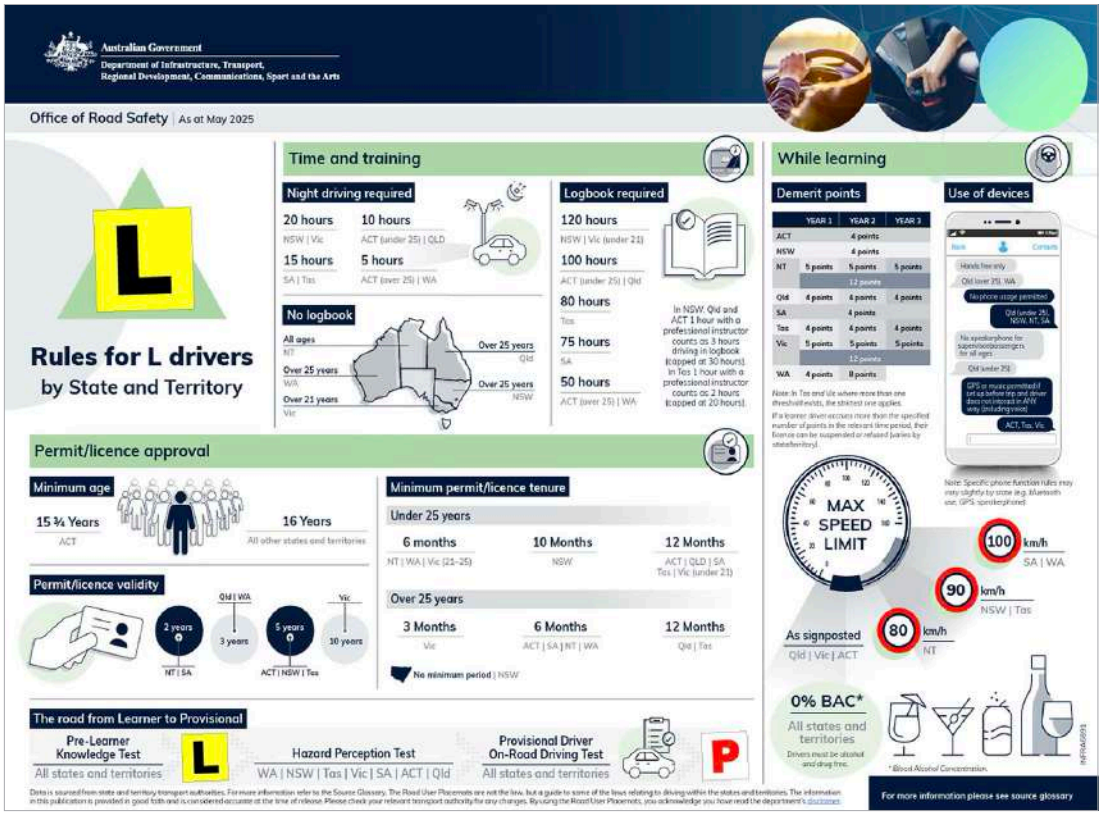
3.10.1. GLSs: creating additional requirements and penalties for novice drivers

In GLSs, novice drivers must pass a series of tests over time, with each allowing gradually more freedom, before drivers receive full licences. This is in contrast with drivers passing a single test and then being fully able to drive within all the usual laws. One substantial advantage of a GLS is that extra restrictions are possible for particularly risky behaviours. For example, novice drivers may initially have a zero BAC limit, instead of the normal limit of 0.05%, and may have lower speed limits and lose their licences for any speeding instead of only receiving fines.

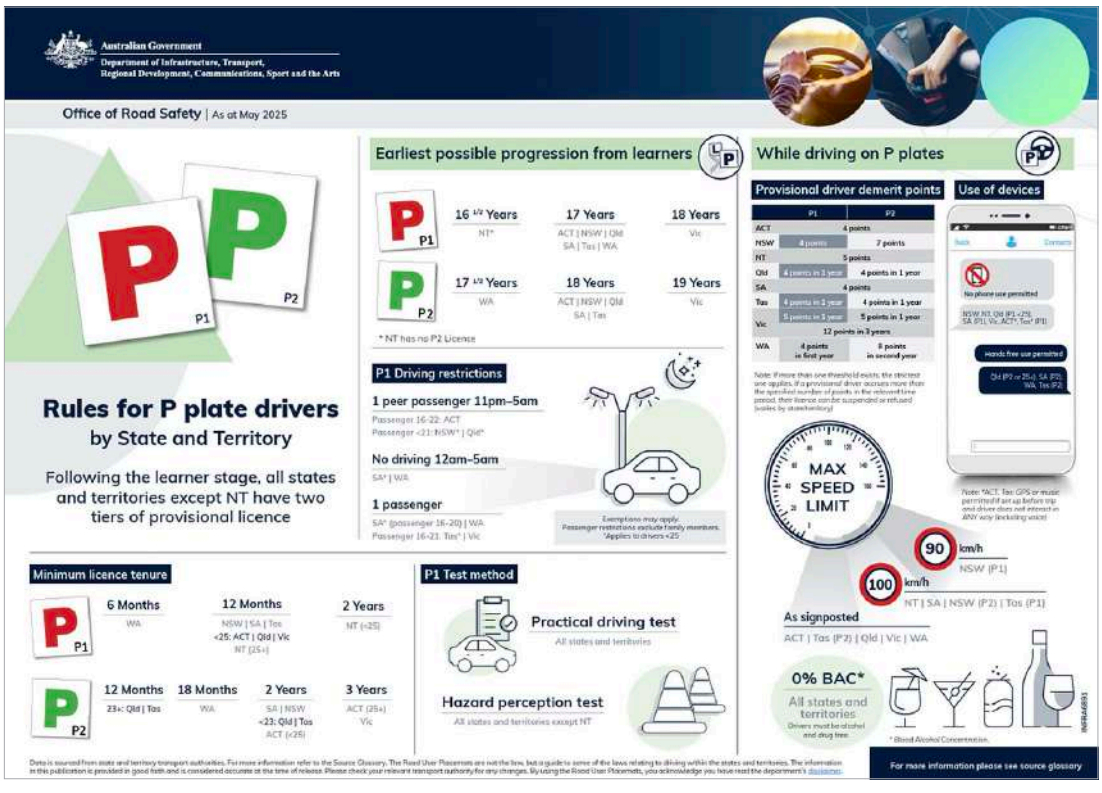
Extensive experience in many countries over the last two decades has repeatedly shown the value of GLSs to road safety *(40–44)*. Fig. 7 provides a good-practice example of a GLS, in which novice drivers must pass four sequential tests to obtain a final, full licence. Novice drivers have extra restrictions on their driving, which can be enforced because they are required to display signs showing their status on any vehicles they are driving, until they reach full licences.

Fig. 7. Factsheet comparing the GLS requirements for learner (A) and probationary drivers licences (B) across Australian jurisdictions

(A)



(B)



ACT: Australian Capital Territory; L: learner (plate); NSW: New South Wales; NT: Northern Territory; P: provisional (plate); P1: provisional-1 (plate); P2: provisional-2 (plate); Qld: Queensland; SA: South Australia; Tas: Tasmania; Vic: Victoria: WA: Western Australia.

Source: Australian Government, Office of Road Safety, Department of Infrastructure, Transport, Regional Development, Communication, Sport and the Arts *(45)*. Reproduced with permission.

For example, a learner driver must prominently display learner (L) plates on the front and rear of the vehicle (see Image 1) and have the extra restriction of driving only when accompanied by an experienced driver for supervision. Provisional-1 (P1 plate to be displayed on the car) drivers can only drive at a maximum speed of 90 km/h, even on roads with a higher posted speed limit, and the penalty for any level of speeding is not only a fine, such as those applied to other drivers, but the loss of their licences for 3 months. Provisional-2 (P2 plate to be displayed on the car) drivers have a maximum allowed speed of 100 km/h, even on roads with a limit of 110 km/h, and lose their licences for any two speeding offences in addition to the usual penalties. The penalty of licence loss was added in the state of New South Wales after the GLS system began operation, allowing for an evaluation of the effects of this change on P1 drivers. A comparison showed that the addition of a licence-loss penalty for any speeding delivered a 34% reduction in fatal crashes involving P1 drivers, with the largest reduction being for those resulting from speeding.

Image 1. Examples of L and P1 plates that must be displayed on cars

Other policies that have been implemented as good practice in GLS schemes include:

- a curfew for novice drivers, based on the evidence of much higher rates of serious crashes at night for young drivers; and
- restrictions on the number of similar-age passengers that a novice driver is allowed to have in the vehicle, based on the evidence that young drivers are more influenced to take risks when more peers accompany them.

In both cases, exemptions for work are allowed with suitable documentation.

3.11. School-based education and general education/ information

Unfortunately, efforts to improve road safety often show an excessive and unwarranted reliance on education to address the deaths and injuries suffered. As mentioned, despite successes in many other areas and a general faith in using education to fix many issues, education is ineffective in road safety and should not be relied on as a solution *(46)*. Module 2 briefly noted the underlying psychological reasons for this.

This evidence adds weight to the concern that police should not spend time on school education on road safety. Road safety education in schools is supported by common-sense approaches, but not sound evidence. However, because the community's faith in road safety education seems unlikely to disappear, it is likely to be provided in an ad hoc, inconsistent and possibly harmful way by well-meaning people if it is not systematically supplied. Best practice in school education is that it is provided by people who have a sound understanding of the communication and learning needs and levels of their students, and who are specifically trained to educate school children: teachers. There are claims that the real value in having police teach road safety to children lies in their seeing police as helpful, and thus improving relationships between the police and the community. These claims may be correct, yet benefits are unproven and it is not clear that road safety, which may be better served by police enforcing on the road, should suffer to achieve this side-effect.

Education of individual road users by police may be helpful, but should be considered a supplement to enforcement, which has proven benefits, not a replacement. Enforcement is the primary role of road policing in behaviour change. One area where police communication to the public may help relates to supporting road safety enforcement. Some people (including people in the media) see the aim of certain measures, particularly the use of speed cameras and speeding fines *(47)*, as raising revenue rather than ensuring road safety. A vocal minority may often voice this view, while the majority remains silent on the issue. Because this can both damage the political will for effective enforcement and reduce community support for road safety, addressing this issue is important and the police are well-placed to participate in this communication process. A number of messages may be helpful, and have reduced opposition in various countries and states, including the following.

- One can explain the value of enforcement in avoiding deaths and injuries and also give the evidence for its benefits. Ideally, evidence can be gained from before-and-after evaluations of improved enforcement (including speed cameras) by planning for sound evaluations before changes are made (see Module 14 for guidance).
- Having members of the community speak to the media and the community to support better enforcement can be particularly helpful. These advocates can include representatives of relevant NGOs, and victims of road crashes and members of their families.
- Many countries or states (including various states of Australia and El Salvador) have implemented policies to invest all revenue gained from speed camera fines in road safety, rather than any other purposes. Making and announcing this commitment has helped to manage concerns that enforcement measures are used simply to raise revenue.

3.12. Judicial and administrative processes

Judicial and administrative processes must support enforcement related to road safety, while still allowing reasonable appeal processes as a core requirement for justice. Unless these systems regularly uphold penalties related to road safety, they will substantially weaken the efficacy of RPE by damaging the certainty of punishment, which reduces both general and specific deterrence. In addition, discussions with police in countries where these systems allow many offenders to avoid penalties indicate that knowing that penalties are likely to be overturned reduces police officers' motivation for enforcement. In such circumstances, police may see enforcement as a waste of their time: a common and understandable reaction, revealed globally in many discussions with police by the primary author of this manual.

If courts and magistrates issue penalties, another common complaint is that those issued by magistrates are small and weak. One reason for this lies in the contrast that judges and magistrates see between criminals guilty of already harming people and traffic offenders who have not yet hurt anyone, which makes their offences seem minor. In addition, the notion of intent is key to many criminal offences in law, yet traffic offenders do not usually intend to harm anyone. In essence, criminal law is designed to punish after the fact and is weak on processes to prevent harm. Establishing dedicated traffic courts is a solution often suggested and sometimes adopted, although a better name for them would be road safety courts.

3.13. Summary and recommended actions

This module presents the need to consider each of the critical links in the chain required to change behaviour in road safety, and provides details of how to assess and, if required, increase the strength each link. It also offers practical suggestions on campaigns and communications with the media and the public.

Recommended action 3.1: Behaviour change through deterrence should be recognized as a powerful tool for improving road safety, not the only solution for road safety risks.

Recommended action 3.2: Because general deterrence, not education, is the best way to change road safety behaviour, efforts for change should shift their focus from education to enforcement and general deterrence. Enforcement should be maintained as the primary role of road police. However, because road safety education in schools will almost certainly continue, teachers and not police should deliver it, because they understand the learning needs of their students and ways to cater to them.

Recommended action 3.3: The processes highlighted in this module should be used to identify and strengthen any weak links in the chain (including legislation, enforcement, penalties, and judicial and follow-up systems) required to create effective general deterrence. Improving general deterrence and thus changing behaviour depends on identifying and strengthening the weakest link(s) in the chain for each particular country.

Recommended action 3.4: Owing to the practical difficulties in implementing incentives for safe driving in a way that is psychologically effective in changing behaviour, schemes employing such incentives should not be used for this purpose.

Recommended action 3.5: Legislation should be drafted to allow for effective enforceability, so police should be consulted in the drafting process.

Recommended action 3.6: Laws should interpret driving as a privilege, rather than a right, in order to enable effective enforcement processes.

Recommended action 3.7: GLS systems have been proved to save lives and prevent injuries, and should be included in measure to improve road safety. Such systems should include additional restrictions on and penalties for speeding, drink–driving and other identified risks (such as late-night driving and number of peer passengers) for novice drivers, and the requirement that novice drivers display signs of their status on the vehicles they use, with significant penalties for not doing so.

Recommended action 3.8: Legislation should be adopted on standards for safety equipment (such as motorcycle and bicycle helmets), owing to its importance in saving lives and preventing injuries.

Recommended action 3.9: Enforcement and penalties should be strongly publicized to the community through communications and campaigns/advertising, which should have the following features.

- The messages delivered should be developed from surveys of community attitudes and beliefs to ensure their effectiveness.
- New or expanded enforcement processes and additional penalties should be publicized weeks before their implementation, to give people time to change their habits and to increase both the perceived fairness and thus acceptance of enforcement.

Recommended action 3.10: Penalties should both create barriers to risky behaviours by offenders (such as vehicle sanctions) and help to address underlying problems (such as treatment for drug or alcohol dependence). If feasible, a demerit (or merit) point system is good practice.

Recommended action 3.11: Enforcement efforts should strike a balance between deterring risky behaviour and avoiding the creation of too much hardship on offenders; deterrence requires some discomfort from paying fines or being banned from driving.

Recommended action 3.12: Penalty types should be combined to ensure deterrence at all relevant levels of income. The combination of a monetary fine with the loss of a driver's licence and vehicle sanctions in some cases achieves effective deterrence in many countries.

Recommended action 3.13: Penalties should be both applied and paid in a timely way to ensure their efficacy as deterrents, and processes identified in Module 3 for achieving this are encouraged.

Recommended action 3.14: Consistent with the evidence, the approach to behaviour change should accommodate the counterintuitive effects of psychology and dismiss the mistaken belief that changing behaviour requires changing attitudes first. Instead, the approach should be based on the clear evidence that tackling risky behaviour directly (through general deterrence, for example) is often the best way to change it, and will result in a change in attitudes to match the behaviour.

Recommended action 3.15: Almost always, safety campaigns and communications should aim to change behaviour. Because attitude change or increased awareness usually does not result in behaviour change, neither should be seen as a useful aim of a campaign or communications.

Recommended action 3.16: Because explaining, publicizing, or showing the risk of enforcement measures works much better to change driver behaviour than showing crashes and their consequences, the evidence to this effect should be used to resist political and community pressure for the latter.

Recommended action 3.17: While a communications campaign may be needed to explain the need for enforcement, typically to a vocal minority in opposition, and thereby enhance the political will for it, such a campaign should not be expected to improve road user behaviour as well.

Recommended action 3.18: Campaign messages should be based on information from surveys or questionnaires on current beliefs and attitudes, and address them.

Recommended action 3.19: Police comments to the media or community should aim to emphasize and normalize safe behaviours, and should not refer to extreme behaviours. For example, a sound message on speed enforcement would not refer to examples of extreme speeders, but instead stress the need to protect the safety of all road users, including the large majority that travels within the speed limit.

Recommended action 3.20: Systems for licensing drivers and registering vehicles should function effectively and honestly, because this greatly facilitates effective road safety enforcement. They should include the collection and use of valid data on drivers and vehicle owners, in order to contact them and issue penalty notices when necessary, and the requirement that vehicles clearly display their registration/licence numbers.

Recommended action 3.21: Road safety education in schools is not an effective road safety intervention, and the time of police officers (who are highly trained in enforcement not in teaching children) in undertaking such activities is not recommended. School teachers are best trained to teach children, and so teachers should provide road safety education in schools, not police or well-meaning volunteers.

Recommended action 3.22: Measures should be taken to counteract the view that certain penalties (especially for speeding) are imposed to raise revenue, not increase road safety. These could include communications to explain why penalties are imposed, the use of community members as enforcement advocates and policy measures such as devoting all revenue raised by the penalties to improving road safety.

Recommended action 3.23: Rewards for “good driving” are not encouraged. While the logic for these is sound, the practicality of genuinely connecting the reward to good behaviour (rather than not having been caught) and the amount of reward that is normally offered make this intervention impractical. Drivers should not be offered the opportunity to accrue rewards that could be credited against incidents of illegal behaviour: a metaphorical so-called get-out-of-jail-free card.

Recommended action 3.24: Judicial and administrative processes should support enforcement related to road safety, while still allowing reasonable appeal processes as a core requirement for justice. Dedicated traffic courts (more accurately called road safety courts) can strengthen the efficacy of enforcement.

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MODULE
4

Good-practices for creating deterrence

4.1. Introduction

This module presents good practice for general processes that apply to RPE across many areas of road safety behaviour. This informs the modules that follow, which address specific risk factors, such as speeding, drink–driving and fatigued driving. Module 4 particularly considers the importance of managing the safety of police and other enforcement personnel, as well as intelligence-led policing, the use of covert and overt enforcement, the management of corruption and other aspects of good practice in RPE. The aim is to allow RPE staff and leaders to identify the most effective actions for the problems being addressed.

4.2. Challenges for RPE in LMICs

HICs generally, but not uniformly, have better road safety records than LMICs. LMICs face many challenges in delivering effective enforcement and RPE, even though road police often contribute significantly to government revenue through fines *(1)*. On this basis alone – even without consideration of avoiding deaths, injuries and economic losses from crashes – more resourcing for RPE might be expected. Challenges for LMICs include *(1–3)*:

- lack of sufficient funding for campaigns;
- poor media channels to reach people with campaigns and messages;
- lack of enforcement equipment, such as speed guns, and intelligent infringement recording systems;
- lack of patrol vehicles and funding for fuel;
- speed limit signage that is sometimes too infrequent and may be vandalized, or stolen for scrap metal or other purposes;
- use of road police for traffic management rather than safety-related enforcement;
- high risk of other crimes on the roads, including human trafficking and violent crime, diverting road police's efforts away from RPE related to road safety;
- poor data management, preventing the effective application of licence loss and other penalties;
- lack of effective enforcement at night;
- the absence of effective follow-up mechanisms to ensure timely payment of fines;
- police fear of wealthy or powerful drivers, who can thus break the law and not be charged with any offence;
- weak judicial systems that allow offenders to avoid penalties; and
- public perceptions that penalties can be avoided through corrupt means, which reduces the efficacy of enforcement *(2–4)*.

4.3. Intelligence-led policing

Other names for intelligence-led policing include predictive policing and data-led or intelligence-based targeted policing. Intelligence-led policing involves the use of sound data analytics and collaboration across enforcement agencies to allow police departments to better evaluate problem behaviour trends and issues, better target enforcement to relevant locations and times, and help decision-makers to deploy resources efficiently.

Because intelligence-led policing has evolved and improved gradually over the last 30 or more years, clear before-and-after evaluations of its success are rare; one review found none *(4)*. In examining best practice, that review noted the importance of risk mapping. Intelligence-led policing heeds the call for better alignment of data and policing *(5)*, and improves the efficiency of allocation of RPE to times, days, locations and particular problem behaviours for maximum deterrence.

In road safety, intelligence-led policing is best served by sound injury crash data, especially those including time and location, as well as behavioural factors involved in serious crashes. This allows more effective targeting of locations and times for police enforcement, and deployment of speed and red-light cameras.

In addition, and especially as a supplement to incomplete crash data, data on other factors are valuable, such as locations, times of the week, mean speeds of travel, percentages of drivers who speed, and rates of seat belt and helmet use. Many regions and countries collect these data for analysis and use by police and others for intelligence-led RPE, as well as monitoring and evaluation. This process is also called data-driven selection of interventions and targets.

4.4. Evidence-based RPE actions

In addition to being intelligence-led, RPE activities need to be chosen to be maximally effective. This means that the activities undertaken must be based on evidence that they work to reduce crash deaths and injuries, and are the most effective available responses to the problems being addressed. The combination of intelligence-led policing and evidence-based actions results in the maximum benefits by targeting the most critical issues in the right locations, at the right times and with the right actions.

Which actions are right depends on the nature of the problems faced and the opportunities available to address them. For example, there is little value in drink–driving enforcement without the right equipment or legislated means to detect it. As a good-practice example of such an analysis, New Zealand Police assessed the effectiveness of their various enforcement options and other actions to determine their effectiveness, resulting in a framework for prioritizing police activity (Box 3) *(6)*.

Box 3. Case study: the impact of high-intensity road policing in New Zealand

In 2022, New Zealand was among the worst-performing HICs in terms of road deaths per total distance travelled and by population. The lack of progress in road safety performance brought with it scrutiny of both New Zealand Police and the wider national road safety community. In particular, the levels of alcohol breath testing and speed enforcement were viewed as insufficient. In response, New Zealand Police sought to leverage the general deterrence effect and maximize its impact to improve road safety.

In December 2022, New Zealand Police commenced Operation Open Roads, a national effort for proactive road policing for:

- exceeding speed limits in urban and rural areas
- RBT for alcohol during 'high alcohol hours'
- failure to wear seat belts
- use of handheld mobile telephones.

In continuous implementation for over 2 years, with the combined support of police leadership and frontline officers, a deployment dashboard (updated weekly) guided nationwide enforcement operations to assist the planning of road policing activities and to monitor implementation against established performance targets. For example, the dashboard showed geographical areas and roads with below-average previous offence detection or recent breath testing.

As to results, RBTs increased from 2.1 million in 2022 to 3.2 million in 2023, and 4.1 million in 2024. Officer-detected speed notices increased from 326 000 in 2022 to 403 000 in 2023, and 461 000 in 2024. There were approximately 3.6 million licensed drivers in New Zealand as of 2023.

After COVID-19-related travel restrictions ended in 2022, road travel patterns quickly returned to prepandemic levels; tragically, so did the number of deaths on New Zealand roads: 372 in 2022 versus 378 in 2019. With the intelligence-driven enforcement of Operation Open Roads, the number of road deaths declined in 2023 and 2024. In terms of total distance travelled, the figure for 2024 – 5.9 per billion vehicle kilometres travelled – was the lowest in any year in recent history, and a 23% decline from the figure for 2023 (7.7 per billion vehicle kilometres travelled).

Years with a higher rate of offence detection tended to have lower rates of traffic fatalities. The New Zealand data also showed a stronger effect for total enforcement intensity on road deaths compared with serious injuries.

Estimates collectively indicate that enforcement intensity in 2024 was 4.5 times higher for speed enforcement, 4.3 times higher for alcohol, 11.5 times higher for seat belts and 2.9 times higher for mobile telephone offences. The estimated reduction in fatalities from this enhanced enforcement equated to 9.9% (speed), 7.15% (alcohol) and 6.7% (seat belts) *(7)*.

The points of difference in road safety performance between New Zealand and well-performing jurisdictions are likely varied and reach across the implementation of many parts of the safe system; however, according to the current assessment, lacklustre traffic enforcement does not preside among them.

This case study shows that relatively large increases can be achieved in traffic enforcement intensity, notably for speeding (including speeding on rural roads and for low excess speed) and RBT for alcohol.

While the results of the study support the notion that higher-intensity traffic enforcement is associated with a lower rate of fatal traffic injuries, and the enforcement operation was accompanied by the lowest rate of traffic fatalities in recent history, the findings are also cautionary. The traffic enforcement operation was largely successful in lifting traffic enforcement intensity within a relatively short period of time; however, even with four or more times the level of enforcement, New Zealand's record of road safety performance is yet to advance. In 2024, New Zealand experienced 5.5 road deaths per 100 000 population. While that was an improvement on 7.3 deaths per 100 000 population in 2022, it pales in comparison to the improvements in road safety performance that have been realized in many European jurisdictions.

The results obtained from this large-scale traffic enforcement operation further demonstrate why it is important to adopt and implement a safe system approach to road safety, which strengthens all parts of the system to substantially advance efforts for traffic injury prevention.

The process revealed that police activities targeting certain outcome areas were much more effective than others, and that some activities were more efficient than others in pursuing the same outcome. This analysis revealed the following order of effectiveness of policing activities (in order of decreasing effectiveness):

- directed patrols using laser/radar speed detection devices;
- deployment of mobile speed cameras;
- operation of fixed speed cameras;
- compulsory RBT at small and large checkpoints;
- mobile RBT;
- enforcement related to the use of handheld mobile telephones to reduce distracted driving;
- seat belt and child restraint enforcement, and enforcement of helmet use in countries with significant numbers of motorcycles;
- compulsory RDT;
- high-risk targeted enforcement;
- inspections of commercial vehicles;
- enforcement of driving-time regulations to combat fatigue in commercial drivers of heavy goods vehicles;
- intersection enforcement for red-light, stop and give-way violations;
- education on road safety in schools;
- targeted information on illegal street racing;
- enforcement of the laws on street racing; and
- enforcement of lane compliance.

Some of these actions may have differing priority in LMICs. For example, inspections of commercial vehicles may have more value in LMICs owing to the high risks of these vehicles and possibly less rigorous maintenance. However, this must be balanced with the problem of corruption in vehicle inspection processes.

Police activities with unknown or limited effectiveness are:

- patrols for distracted driving targeting the use of hands-free mobile telephones
- directed patrols for fatigued driving by non-commercial drivers
- community engagement programmes
- education programmes on drink– and drug–driving
- promotion of the use of child restraints.

4.5 Mix of overt and covert enforcement

There is a logic to both highly visible (overt) policing versus unmarked (covert) policing. Overt policing reminds road users of policing and the risk of being caught, but may also give the impression that users can avoid detection by changing their behaviour when they see policing: for example, slowing down or putting on a seat belt. Covert enforcement allows the possibility to detect offending drivers without warning them or promoting the feeling that they can temporarily correct risky behaviours to avoid detection.

Unfortunately, the debate on forms of enforcement rarely considers the available scientific evidence, which shows that mixing overt and covert enforcement works well. As to evidence on visibility, even the sight of a police car can cause drivers to slow down *(8)*. However, this is not a strong solution in itself, because it is critical to consider the effect on the whole road network, not just the area where a police car is visible. Drivers often travel faster if they do not see a police car, and such cars cannot be everywhere. Using speed cameras with signage warning drivers of their location has the same effect: drivers slow near the cameras and speed up again once past them (for more details, see Module 5) *(9)*.

Covert enforcement can deliver widespread compliance and is increasingly used. The evidence demonstrates its power, with a critical study showing that adding covert mobile speed cameras to an existing programme of visible mobile speed cameras on high-speed rural roads reduced speeds, crashes and casualties, both where the cameras were used and on roads with a 100-km/h speed limit in general *(10)*. The addition of hidden-camera enforcement was preceded by substantial publicity warning of this change. In addition, community surveys showed that the community did not, in general, agree that all speed cameras should be visible. They also found a decrease in support for the idea that cameras should always be visible in the trial area but not control areas.

4.6. Dedicated specialists

In addition to road policing being recognized as a specialist area of policing, recognition is growing of the need for further specialized training and positions within RPE. Examples include specialists in crash investigation and reconstruction, and evidentiary testing for BAC and drug presence, as well as the management of RPE. It is also increasingly important that specializing in RPE allows for a strong career path in the police by including very senior positions in managing and leading RPE.

Expertise in RPE is difficult to develop in countries that maintain a policy of rotating police across different areas of work, which is not recommended for RPE. *The Global Plan for the Decade of Action for Road Safety 2021–2030 (11)* recommends the establishment of dedicated road policing agencies. This recommendation was included because road policing can become a secondary and low-priority activity in the face of other immediate policing priorities. Establishing dedicated agencies ensures that road policing and the prevention of serious crashes are permanent organizational priorities.

4.7. Procedural justice

Procedural justice refers to the fairness of police procedures. It increases compliance with laws and cooperation with police, including in LMICs *(12)*, and has been shown to positively influence perceptions of road policing among both the community and the police involved *(13)*. Surveys reveal the relevance of procedural justice: drivers who perceive higher levels of procedural justice have lower levels of intention to speed *(14)*.

Training police in the four key elements to maximize procedural justice can enhance compliance with laws and cooperation with police. Care is required for this training to succeed; some scripted training has been shown to be ineffective and a brochure intended to better inform drivers was found to decrease trust in police *(15)*. Training scenarios should include treating people in culturally sensitive ways and managing unconscious bias.

Four contributors to procedural justice are commonly identified. One refers to police (displaying neutrality) and three refer to road users: allowing participation or voice for those being addressed/accused, being treated with dignity and respect, and trusting in the motives of the police *(16,17)*. However, considering a wider set of principles is helpful.

4.7.1. Principles for procedural justice

Police officers can make sure that their contacts with the public are just, open and respectful by adhering to eight principles of procedural justice: fairness, neutrality, trust, respect, accountability, legitimacy, voice and participation, and active listening. This can promote the legitimacy of and confidence in the police, as well as enhancing the results in terms of road safety.

All policing practices, including traffic stops and the enforcement of traffic safety laws, should adhere to the principle of fairness. Police must treat all road users with respect and decency, and all road users must have an equal chance to express their concerns and be heard.

Neutrality in policing when interacting with the public means that police officers must always operate impartially and without bias, regardless of a person's race, ethnicity, gender, sexual orientation or any other characteristic. They must avoid any indication of prejudice or preference.

Building trust between the general population and police officers requires transparency. This entails being forthright and truthful about the practices, processes and actions of police officers. Being trustworthy is important for police personnel when dealing with the public. They must behave in accordance with the law and established norms, keep their word and be dependable.

Police should treat everyone with respect, regardless of their status, line of work or background. This involves showing respect for people when conducting traffic stops and other forms of policing.

Accountability means that police officers need to take responsibility for their deeds and choices. This includes being willing to explain their actions and decisions to the public, and accepting responsibility for any wrongdoing or misconduct.

To secure legitimacy, police officers are required to follow the rules and established procedures for their work. This makes the general public more likely to regard their acts as justified.

The principle of voice and participation involves giving people a voice in decision-making processes and allowing traffic offenders to express their points of view.

Active listening means paying close attention to a speaker and comprehending the message conveyed. It entails paying undivided attention to the speaker, remaining silent, and expressing interest and engagement in what the speaker has to say. Active listeners employ verbal and non-verbal indicators to demonstrate to speakers that they are present, paying attention and trying to comprehend the speakers' perspectives.

4.8. Monitoring and incentives for enforcement

Opposing views exist on how to manage the issue of penalty notices issued by police. On the one hand, some may argue that police must be free to use their discretion when dealing with the public, and thus there should be no monitoring of penalty notices issued by individual officers. On the other hand, this creates the possibility that very few are issued and deterrence is not achieved. In addition, monitoring of notices issued also assists in addressing corruption (see Section 4.9). Monitoring officers' outputs may also be seen as a fundamental requirement for managing performance, as it would be in other areas of staff management.

In highly politicized road safety environments, which are common in HICs, setting infringement notice targets for individual officers can create accusations of revenue-raising. One alternative is to provide more education and motivation for police to issue infringement notices without setting individual targets *(18)*. Nevertheless, incentives have worked with highway police in Pakistan to improve enforcement, which was a likely contributor to observed reductions in crashes and deaths *(19)*.

4.9. Minimizing corruption

Corruption refers to dishonest or fraudulent behaviours by officials, or other people in power, committed to gain benefits. Corruption has many edges: it is not limited to monetary benefits and includes gifts and favours, and pressure on and threats to traffic police from a significant number of offenders, as shown by complaints from police officers.

Corruption of the enforcement of traffic laws can profoundly harm the efficacy of enforcement in delivering deterrence and improving road users' behaviour. Being able to avoid a penalty is well recognized as profoundly damaging its deterrent effect *(13)*, even if a smaller amount is paid as a bribe. This factor is so important that the extent of punishment avoidance – for example, through corruption – predicts the extent of unsafe behaviours *(20)*.

4.9.1. Processes to manage corruption

4.9.1.1. Acknowledging the presence of corruption

Acknowledging the existence of corruption in enforcement and accepting the need to resource its management are vital first steps in such management. In addition, corruption should not be seen as a narrow issue for police or road police, but as a broader societal problem, of which police corruption represents just one highly visible aspect. Showing the broader nature of corruption and the value of broad approaches, an analysis in one province of South Africa showed that a significant reduction in police corruption resulted from a broad crackdown on corruption in general *(21)*.

Corruption can be addressed, including in LMICs. Acknowledgement of the problem and a strong stand against it by police leadership in Uganda led to the removal of 700 officers from the directorate over a few years *(1)*. This section also includes a case study of successful management of corruption in road police in Bogotá, Colombia (see Box 4).

Government efforts are necessary to ensure that all entities participating in the process of corruption control are committed and effective, and to encourage citizen participation in order to holistically address this phenomenon. In addition, the professionalization of road police officers is important to avoid high turnover rates of those who have limited contracts and may be dismissed from the service with a change of government. This leaves officers more vulnerable to corruption.

The government in power must support anticorruption policies and statements, and accompany these with the concrete actions and the resources necessary to manage this risk appropriately at all levels of an organization. A policy that recognizes the existence of the problem and manages it on multiple fronts substantially increases deterrence of corruption, strengthens police legitimacy, decreases the number of drivers who may offer bribes to or yield to pressure from road police officers, and increases compliance with traffic law.

4.9.1.2. Risk assessment

A full risk assessment is recommended to manage corruption effectively. It should comprise three steps.

1. Risk identification includes identifying:
   - the threat (for example, receipt of or demand for bribes, influence peddling, threats based on power);
   - the local context (for example, lack of police legitimacy, social acceptance of inappropriate behaviours, lack of government support, and gaps or failures in the judicial or administrative control systems); and
   - vulnerability (which officers are more vulnerable to participate in acts of corruption).
2. Risk analysis means that – based on the threat, vulnerability and impact analysis – the organization should determine the probability and consequences of corruption, such as weakened deterrence and increased crash deaths and injuries. Based on the results of this analysis, the organization should:
   - determine the level of risk (high, medium or low)
   - identify gaps in critical posts/positions exposed to corruption risk.
3. Risk assessment means considering the management actions required:
   - the need to modify procedures and improve culture
   - the resources needed to adequately manage the risk.

4.9.1.3. Implementing interventions to address corruption

Based on the results of the risk assessment and the resources available, interventions for risk mitigation can be determined and implemented. For example, the government should:

- establish a permanent policy of zero tolerance of corruption
- link all entities with responsibility in the control process, including the judiciary
- secure fiscal resources to ensure the continuity of the programme
- guarantee a living wage for agents and road police that covers their basic needs
- guarantee the professionalization and security of road police officers.

Organizations should implement the following eight actions.

1. At the strategic/command level, establish a zero-tolerance policy supported by the local government/road police administration that prevents and confronts corruption at both the managerial level (due to influence peddling) and the operational level (accepting or demanding bribes).
2. Create an effective channel through which citizens can report acts of corruption by police or other officials and follow up on their complaints.
3. Appoint commissioners to represent the community.
4. Ensure continuous independent oversight.
5. Gain support from the media to link them to a campaign reminding drivers that bribery or influence peddling are crimes that require addressing via government and societal action.

6. Use technological tools that complement the supervision and control process:
   - monitor body-worn cameras
   - Global Positioning System (GPS) with tracking from a command post
   - dashboard monitoring in patrol vehicles
   - polygraph testing or any other technological tools that are considered effective
   - increased automated enforcement, to reduce exposure to corruption opportunities
   - digitization of the notice issuance and fine payment processes.

7. Improve organizational culture by:
   - enforcing police ethics, leadership and standards with training;
   - rotating officers in areas identified as critical;
   - encouraging positive behaviours through special recognition, such as additional days off, honourable mentions or awards;
   - strengthening processes to investigate and sanction undesirable officer behaviours;
   - separating from the road police force those officers with high records of complaints against them;
   - setting up key performance indicators contextualized to local enforcement activities;
   - gaining support from police unions; and
   - as necessary, implementing welfare programmes for road police officers and their families;

8. Improve the work environment of the road police with strategies that:
   - allow officers to avoid work overload;
   - ensure that investigations into citizen complaints are impartial and provide guarantees so that unfounded complaints can be identified and discarded; and
   - ensure that police officers have all the elements that guarantee their personal protection/comfort in enforcement activities.

Box 4 provides a case study of successful management of corruption in Bogotá, Colombia, that followed the processes detailed above.

Box 4. Case study in managing corruption in traffic police in Bogotá, Colombia

The road police in Bogotá faced a significant challenge in relation to corruption, exacerbated by a lack of tools such as body cameras to improve management of officer behaviour.

The Mayor of Bogotá dismantled the body of civil traffic agents in 1997 owing to problems of corruption and weak legitimacy with the public, dismissing 1900 agents. Police officers took over road enforcement. Although this increased police legitimacy and reduced corruption, corruption reappeared at different levels of the police agency over the years, owing to the difficulty of creating effective control strategies for road police. The road police command of Bogotá therefore recently introduced a programme to demonstrate and socialize a zero-tolerance approach to corruption, including zero tolerance of officers accepting bribes from road users to avoid penalties, officers accepting bribes or gifts or engaging in influence peddling (to create more systematic penalty avoidance), and officers at managerial levels demanding money or gifts from subordinates.

The programme was developed in three phases: promotion, examinations and subsequent random controls for 1148 road police officers. The programme included:

- resource allocation;
- polygraph testing of officers, as well as interviews by trained staff designed to facilitate admissions of corruption, with an initial test followed by random repeat tests to generate ongoing fear of detection and thus specific and general deterrence;
- incentives to police officers for good behaviour (vouchers to be exchanged in supermarkets or for expense-paid family trips) based on results achieved and no proven complaints on police procedures;
- recognition and awards for the most distinguished officers, who stood out for their transparency and the fulfilment of their duties; and
- social welfare activities for road police officers and their families.

In Bogotá, the infringement notices issued by the road police are monitored (verified for motorcyclists, pedestrians or cyclists, for example). This is a valuable measure of the individual performance of road police officers.

The results demonstrate successes on multiple levels. In the 5 months following the implementation of the programme, based on the findings from polygraph tests and interviews, 14 officers, who had been found to be repeat offenders in corruption after the first phase, were dismissed from the police, and 150 were relocated from road enforcement. In addition, the number of citizen complaints dropped by 39% after the introduction of the programme and 24 drivers were taken to court for attempting to bribe officers. Further, polygraph testing worked as an effective deterrent, improved the credibility of detection processes within the police, and provided support to officers who refused to give in to pressure not to carry out their duties and were the subjects of unfounded complaints from drivers.

Finally, this programme resulted in an improved working environment for road police by removing undesirable elements and rewarding the good behaviour of the other officers.

4.10. Selectively targeting high-risk offenders

Targeting high-risk offenders is important in many arenas of enforcement, although maintaining the focus on achieving general deterrence is also critical. The emphasis on general deterrence is more important in road safety than in policing of other crimes because key risk behaviours – such as speeding, not wearing a helmet or ignoring stop signs – are common, and some are undertaken by the majority of drivers in many countries. In contrast, assault, robbery and murder are behaviours of a small minority of people in most countries. Because the risk is more broadly distributed in road safety, general deterrence is critical.

Nevertheless, there is value in targeting high-risk groups and circumstances in road safety; in every country the former include young road users, who are much more likely to have serious crashes by taking risks including speeding *(22)*. This can be achieved through higher penalties and extra restrictions on speeds and other behaviours, through GLS and through targeting enforcement to high-risk times for young drivers. These include the night hours, and especially nights with more social activity, such as Friday and Saturday nights in many cultures; however, high-risk times vary between cultures and religions, and must be identified in each country.

Other ways to target high-risk offenders may include following up on drivers who have lost their licences to ensure that they are not driving unlicensed, and targeting enforcement to particular events, such as major national or local celebrations, which include increased alcohol consumption in many cultures.

4.11. Police Safety

The safety of police and enforcement officers is paramount yet remains a challenging issue; many police officers are killed each year when working on the roads. This includes officers shot by stopped drivers, those injured or killed in high-speed pursuits, and those hit and killed by vehicles they were attempting to stop while managing traffic around an incident or helping victims in a crash.

For the procedures covered in the remainder of this module, the coverage below should be treated as broad guidance. This must be supplemented with practical training in each of these processes, including training in local circumstances and regulations, and procedural justice.

4.11.1. Establishing safe checkpoints

Checkpoints are a valuable opportunity to deter drivers from committing offences such as driving under the influence of alcohol or drugs, and to check the use of seat belts and child restraints, as well as driver licences, vehicle registration and insurance. Setting up a safe checkpoint involves careful planning, execution and evaluation to reduce hazards, and to ensure safety for both police and motorists. This section identifies required processes and components (such as enforcement tools, traffic cones, signage, lighting, patrol cars and body cameras) for the establishment of safe checkpoints.

Checkpoints must be designed to maximize safety for both police officers and road users. To be safe, a checkpoint must be visible to approaching drivers and allow officers to stop and interact with drivers, and inspect vehicles, without putting themselves or others in danger. This means that the checkpoint should be in a well-lit area with good visibility, and officers should have ample space to move around safely. Checkpoints must also be clearly marked and well signed so drivers can see them from a distance and know what to expect. Drivers should be able to enter and exit the checkpoint without feeling rushed or pressured.

Extra caution is required at night and in poor visibility or other conditions that make driving hazardous, such as during fog, rain, ice or snow. In some instances, such conditions may dictate that a planned checkpoint is not implemented for safety reasons. How checkpoint safety is ensured may vary between countries, depending on relevant standard operating procedures, practices and in some cases legislation. As an example of sound practice, Annex 2 describes relevant procedures and practices.

4.11.1.1. Permanent checkpoints

In many countries, police set up permanent checkpoints on main roads and highways. These are of limited value for deterrence because their location is widely known, and thus drivers can avoid unsafe behaviours near them. This limits enforcement to checking vehicle registration and drivers' licences; even then, those without a licence or registration can avoid the location. For this reason, permanent checkpoints are not recommended.

4.11.2. Safely intercepting a vehicle and interacting with a driver or other road user

The section on checkpoints covers stopping vehicles from the roadside. This section considers stopping vehicles while police are patrolling in a vehicle. For the protection of police and vehicle occupants, vehicles must be stopped safely. The general principle to follow here is to identify and manage the potential risks that may arise during roadside checks. In some cases, these risks may indicate that the vehicle should not be stopped, at least not in that location.

In addition, police must only undertake vehicle stops where legally empowered to do so; see the next section on random stops.

4.11.2.1. How to stop a vehicle safely

A few notes are provided here, but these are not a substitute for expert practical training in safely stopping a vehicle, which is encouraged.

As a minimum, police personnel should take the following actions to stop a vehicle safely.

- Officers should choose a secure place to initiate the stop. The area should be well lit, clearly visible and offer enough room for police to approach the vehicle safely.
- Officers should turn on the patrol vehicle's emergency lights and sirens if available. Doing this tells the driver that they are being pulled over by police. The driver should then be stopped in a suitable area or instructed to move to a safe stopping point. Other procedures vary from country to country, including hand signals to drivers.

- To reduce their exposure to traffic, police should approach the vehicle from the passenger side if appropriate. They should proceed with caution when approaching the driver's side of the vehicle if it is adjacent to moving traffic. In addition, parking the patrol vehicle in a suitable location behind the stopped vehicle provides more protection to police. In some countries and circumstances, it is also appropriate for police to take steps to avoid personal risk from vehicle occupants, such as shooting.
- To ensure procedural justice, police officers must explain the reason for the stop to the driver and request identification, giving clear instructions. Police should focus attention on specific offences, such as speeding or running a red light, rather than giving general justifications for a stop.

To facilitate safety and procedural justice, police personnel should receive practical training in how to safely stop vehicles and interact with drivers.

4.11.2.2. Random vehicle stops

Random vehicle stops involve stopping vehicles on a random basis to check for potential offences. As described in Module 2, RBT in Australia was extraordinarily successful in reducing alcohol-related crash deaths *(23)*. Random stops are used for a variety of purposes in many countries, including to check drivers' licences and vehicle registrations; see Image 2 for examples of how some random stops are arranged.

Image 2. Example of a police stop for a random breath test in Victoria, Australia

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Random vehicle stops create additional issues; it is important to avoid singling out certain ethnic groups or communities when making such stops. This can be achieved by making sure that traffic stops are conducted impartially and neutrally. To carry out traffic stops impartially and fairly police should:

- use a random selection procedure to choose which vehicles to halt, which can assist in avoiding any perception of targeting particular groups; and
- avoid profiling by refraining from using racial, ethnic or other potentially prejudicial criteria in choosing which vehicles to stop.

Nevertheless, random stops are more effective when they target relevant times of day, days of the week and locations. For example, RBT for alcohol is most effective when focused on times, days and locations in which drink–driving is more likely. These include days and times when social events are held, and areas that contain bars, night clubs and restaurants selling alcoholic drinks. A study conducted in Victoria, Australia demonstrated that RBT conducted during times and days of the week with peak alcohol consumption effectively reduced alcohol-related road crashes, while those conducted during times and days with low consumption showed no effect. The same applies for RDT.

4.11.2.3. Heavy vehicles

Intercepting heavy vehicles creates additional risks owing to vehicle sizes and weights, the high positions of the drivers, and additional requirements for safe stopping locations; these must be managed. Safety is a key priority when stopping heavy vehicles. Here is a brief list of suggestions, although they are not a substitute for specialized on-road training, which is encouraged.

- Before attempting to stop a large vehicle, police should remember that heavy vehicles have longer stopping distances and need more time to come to a complete stop.
- Police personnel should have access to the right tools to stop large vehicles safely, such as tyre deflation devices (spike strips) in cases of drivers who refuse to stop, and proper tools, such as radios or mobile telephones for communication with one another and emergency responders. Particular attention should be paid to vehicles that might be carrying hazardous materials. Police should follow local laws and established procedures for this risk.
- To increase support and safety during an interception, police should consider using a chase vehicle.
- Police should choose a secure area for each stop. They should intercept the vehicle in a position that is well lit and safe, and offers the room required for the vehicle to stop securely. Including paved roadside areas in the building of new roads, for enforcement purposes, is good practice.
- Stopping vehicles on flat locations is preferable.
- To warn the driver of a large vehicle of the need to stop, officers should turn on emergency lights and sirens, provided that this is consistent with local requirements.
- Clear communication is essential. Officers should speak to a large vehicle's driver calmly, plainly and with sufficient volume. They should use hand signals when appropriate.
- Officers should approach the vehicle with caution, ideally from the passenger side and particularly when approaching the driver's side.
- As heavy vehicles create larger blind spots, police officers should take special care to position themselves so that they are visible to the driver.
- At all times, officers should keep well away from the vehicle's wheels, which are a substantial risk in the event of the vehicle moving, deliberately or inadvertently, on a slope.

4.11.2.4. Safely interacting with a dangerous or fleeing driver/road user

After a vehicle is stopped, safety risks remain from attack by a road user or from a driver attempting to flee. A few notes and suggestions on this subject are provided, but these are not a substitute for expert training in this area, which is desirable.

During a traffic stop or other engagement with road users, police officers should:

- conduct the interaction in a safe space, not next to moving traffic;
- maintain a professional demeanour throughout the interaction, being composed, polite and respectful;
- introduce themselves and describe the reason for the stop or interaction in clear terms;
- describe the issue to the driver, including the rationale behind the interaction or stop, what is expected of the driver and any possible repercussions;
- follow the principles of procedural justice, including actively listening to the driver and being receptive to their viewpoint by giving them the opportunity to talk and asking questions;
- use plain and succinct language while communicating with the driver, avoiding the use of technical jargon or overly complex terminology;
- ask the driver for identification, such as a driver's licence, registration or proof of insurance, being specific about what information is required and why;
- give the driver precise instructions on what to do next, such as cutting the engine, getting out of the car or presenting more documents;
- employ non-threatening body language, such as open palms and a relaxed stance, to help the driver feel more at ease;
- respect the driver's personal space by avoiding approaching too closely, which might be interpreted as threatening; and
- conclude the conversation positively by thanking the driver for cooperating and offering any extra details required.

Every encounter with a driver or a road user is different, and police officers should exercise their best judgement to preserve the safety of everyone involved. By following these suggestions, officers can encourage drivers to trust them and develop positive connections, which will increase overall road safety.

Finally, these considerations and suggestions relate primarily to crash risk and procedural justice. Additional and substantial risks to the personal safety of police vary between countries and cities, and include the risk of dealing with firearms and other weapons. Managing these risks and managing difficult scenarios (such as a driver who refuses to open the car window or leave the vehicle on request) requires specialized practical training that considers local law.

4.11.3. Police pursuits

Pursuits are sometimes employed to catch and detain drivers who attempt to avoid police by driving away; however, high-speed police pursuits should only be undertaken as a last resort and under extreme conditions if there is a real and immediate threat to the public. Pursuits pose a greatly increased risk of a serious or fatal crash to the suspects, police officers and other road users. Pursuits should only be considered if police have been trained in driving and pursuit tactics, including updates to skills as needed. Even then, pursuits are best avoided.

In many countries, limits are set not only on the use of pursuits but also on the maximum speed used when a pursuit is implemented. Reaching such a maximum speed limit triggers the abandonment of the pursuit. The speed limits that trigger discontinuation of pursuits should be determined based on the specifics of the chase, such as the nature of the offence, the area, the volume of traffic, the condition of the road or infrastructure, and the weather. When the suspect reaches this speed limit, police should call off the pursuit and use other tactics to apprehend the potential offender. This is an important additional safety measure.

Once finished, a pursuit should be carefully assessed. This can help identify areas where further instruction, rules, policies or equipment might have contributed to a better outcome, or where an alternative approach could have been deployed.

It is important that people appreciate the risks associated with high-speed chases. Police departments should be transparent about their pursuit policies and inform the public of the circumstances behind each pursuit. This can promote confidence between police agencies and the communities they serve. It is also important for police to publicize to the public the cases where fleeing offenders are apprehended through means other than pursuit.

Effective alternatives to high-speed pursuits include the use of technology. As a result of technological advancements, police officers now have more tools to help them catch traffic offenders without high-speed chases. These include video surveillance systems, automatic licence plate readers and GPS tracking devices, which can be used to track and monitor vehicles remotely. Technology can help reduce the need for pursuits while still enabling police to apprehend offenders. In addition, road block spike strips and helicopter assistance can be deployed in serious cases. These options offer police the ability to apprehend suspects with the least degree of risk to the general public and police personnel.

4.12. Summary, conclusions and recommended actions

This module covers good practices in RPE, both in general and in relation to specific behaviours and activities. It highlights the importance of intelligence-led policing and evidence-based actions, and ways to choose the most effective RPE actions, manage corruption and preserve police officers' safety.

Conclusion 4.1: The combination of intelligence-led policing and evidence-based actions results in the maximum benefits by targeting the most critical issues in the right locations, at the right time with the right actions.

Conclusion 4.2: Permanent police stop locations are more easily set up for safety yet are of limited value for deterrence, because their location is entirely predictable and thus drivers can avoid unsafe behaviours near them. For this reason, they are not recommended.

Recommended action 4.1: LMICs face many challenges in RPE, often related to inadequate resourcing. Resourcing to address these challenges in LMICs should be increased to improve RPE and avoid deaths, injuries and large economic costs.

Recommended action 4.2: Intelligence-led RPE should be used to improve efficacy by better targeting activities to the locations, days and times when they will be most effective. This requires sound data on serious crashes and other factors, such as rates of speeding and helmet and seat belt use. The best predictive policing (intelligence-based targeting of enforcement) should be enabled by using both data on serious crashes in hotspots (blackspots) and risk modelling, which considers terrain and the risk of offences *(4)*.

Recommended action 4.3: RPE activities should be founded on clear evidence of their ability to save lives and prevent injuries, and selected for their optimal effectiveness in specific circumstances. For instance, a combination of hidden and visible speed enforcement, when accompanied by public awareness campaigns about their implementation, has proved to be more effective in reducing fatalities and injuries than visible enforcement alone.

Recommended action 4.4: Enforcement plans should be prepared – with annual targets for enforcement and compliance – on speeding, drink– and drug–driving, and helmet and seat belt use *(24)*.

Recommended action 4.5: Because procedural justice is important to RPE, police should be trained in the four key elements to maximize procedural justice, which can enhance compliance with laws and cooperation with police: allowing participation or voice for those being addressed/accused, neutrality by police, being treated with dignity and respect, and trust in the motives of the police. Care is required for this training to succeed, because some scripted changes in procedural justice have been ineffective.

Recommended action 4.6: Corruption should be managed because this is critical for achieving general and specific deterrence. The processes for managing corruption detailed in Section 4.9.2 should be followed.

Recommended action 4.7: Police and enforcement officer safety should be ensured as a fundamental consideration in RPE activities, and requires improved management in many countries. The suggestions on improving officer safety offered in Section 4.11 should be followed, including minimizing police pursuits and having policies to manage their safety.

Recommended action 4.8: General good practices in RPE should be pursued; for example, dedicated specialists should be employed for some areas of RPE activity, including management and leadership. A policy of rotating police across areas of policing hinders the development of expertise in RPE and should be avoided.

Recommended action 4.9: The infringement notices issued by police should be monitored, and officers should be acknowledged and rewarded for good performance in this area. Giving performance incentives to police has worked to improve enforcement. Relevant policies should strike a balance between the requirement to give an infringement notice and officer discretion.

Recommended action 4.10: RPE should target high-risk groups and circumstances to improve road safety. Because young road users comprise a high-risk group in every country *(25)*, they should be targeted by actions that include imposing higher penalties and extra restrictions on speeding and other behaviours, through GLS and focusing enforcement on high-risk times.

Recommended action 4.11: Random vehicle stops should be carried out to increase general deterrence. For maximum yet ethical impact, the procedures followed should:

- ensure the safety of police and road users;
- ensure that the selection of vehicles at a stop location does not target any particular ethnic group through profiling; and
- focus on the days of the week, times of day and locations with high risk for the particular behaviour (such as drink–driving) being targeted.

Recommended action 4.12: The detailed suggestions and guidance on procedures for setting up traffic stops and safely intercepting vehicles (including heavy vehicles) given in Section 4.11.2 should be followed, to ensure the safety of both police personnel and road users.

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MODULE
5

Deterring speeding

5.1. Introduction

More than any other area of RPE, speed enforcement can involve many partners because many delivery and management models exist for speed cameras. This module is relevant to the many partners who may be involved: police; civilian employees; contracted private sector suppliers and operators of speed cameras; the road or transport authorities, or lead road safety agencies or departments of justice, that may operate speed camera programmes; and back-office processing suppliers for the legal and authorized issuance of infringement notices from camera-collected images and evidence.

This module describes relevant evidence and good practice to provide a basis for developing business cases for speed management, justifying many opportunities in this area, and to dispel many mistaken views on this topic and the economic and other consequences of higher and lower speeds.

Speed management is the strongest yet most neglected road safety opportunity available globally, with the potential to reduce numbers of crashes, deaths and serious injuries profoundly, and thus to deliver many other social and economic benefits. Despite this and reports advocating speed management as critical to road safety *(1)*, speed management is commonly poorly understood *(2)*, inadequately addressed and, as a result of misinformation, the most resisted road safety opportunity *(3)*. This module tackles this situation by providing brief summaries of the relevant scientific evidence for the critical role of speed in road safety, the many unexpected additional benefits of interventions to reduce speeds and a demonstration that various feared harmful outcomes of lower speeds simply do not occur. This module also focuses on RPE for improved speed management.

5.1.1. Scientific evidence for the critical role of speed in road safety

Because all people are subject to the same laws of physics and run the same risk of injury and death when exposed to the forces produced in crashes, the effects of speed on crash deaths and injuries are universal to all countries, and the evidence here applies broadly. Because most of the evidence comes from HICs, there is a perception that it does not apply in LMICs. If the two groups differ in this respect, the difference is that speed is even more critical in LMICs, due to them having less-forgiving roadsides and vehicles providing less-effective protection. Thus, speed management can be more cost–effective in LMICs *(4)*. To provide a brief summary of relevant evidence, this section presents a set of conclusions based on it, along with examples of research and evaluation demonstrating them.

Speed and speeding contribute greatly to crash occurrence and severity through many physical mechanisms, including reducing available reaction times, increasing stopping distances, reducing manoeuvrability and increasing the forces involved in a crash *(5,6)*, with higher speeds delivering exponentially more energy into the crash *(5,7)*. For example, when crash impact speed increases from 30 km/h to 50 km/h – a 67% increase – the energy delivered increases by 178%. Research in LMICs confirms the critical role of speed in serious crashes *(8,9)*.

Changes in travel speed generate powerful changes in the risk of death or injury. A study by Nilsson, combining results from many countries, showed that each 1% decrease in speed resulted in a 4% decrease in deaths and a 3% decrease in serious trauma (death or serious injury) *(10)*. Subsequent

reanalyses and follow-up research evaluations have validated these critical influences of speed on safety, and suggest that the graph is essentially correct but may slightly underestimate the importance of speed *(11–14)*. As a practical example, these findings show that changes that produce a 10% reduction in average travel speed will deliver around a 40% reduction in deaths and around a 30% reduction in serious injuries. The curve gradually changes slope as large changes in speed occur. These powerful effects of speed have also been confirmed in LMICs *(9,15)*.

Case–control studies confirm the powerful influence of speed on serious crash risk. Another scientific method for determining the effects of speed on crash risk is to examine the speeds travelled by drivers involved in crashes and compare them with the speeds of drivers (controls) who drive past the location of the crash at the same time of day without having a crash. For example, one study found that in zones with 60-km/h speed limits, each 5 km/h travelled above the speed limit resulted in a doubling of the risk of a casualty crash, with death or injury *(16)*, with other studies showing similarly powerful effects *(17–19)*.

Crash impact speed powerfully determines the chances of survival for each crash type: those involving pedestrians, car side impact or head-on impact. Pedestrian fatality risk is around 100% at 60 km/h, compared with a side impact (90 km/h) and a head-on collision (110 km/h). This research is the basis of setting speed limits under a safe system approach *(20)*, as covered in the next section. Studies carried out more recently have shown slightly higher speeds for the risk of pedestrian death *(21)* and lower impact speeds for the risk of serious injury rather than death *(22,23)*, with the shapes of the curves remaining similar.

Many hundreds of scientific evaluations have shown the benefits in saving lives and preventing injuries from many interventions that reduce speed. These include enforcement and the generation of general deterrence (reviewed later in this module); traffic-calming measures such as speed humps, raised crossings and roundabouts *(24–27)*; and vehicle technologies that limit speed. This includes evidence from LMICs *(15,28–30)*.

5.1.2. Additional benefits of interventions to reduce speed

This section provides a brief summary of relevant evidence by presenting a set of conclusions from the evidence, along with examples of research demonstrating them.

Lower speeds reduce road traffic noise *(31,32)* and thus its many well-established, disturbingly serious, and yet underappreciated harmful effects on physical and mental health, including death *(33,34)*. Noise impairs sleep architecture/rhythm and these effects are associated with other long-term physical health effects *(35,36)*. Noise causes cardiovascular damage *(37–39)* and disrupts the metabolic and digestive systems *(40)*. It holds back learning in children *(41)*, and increased noise is associated with reductions in brain size *(42)*. Noise has chronic effects on health *(41)* – that is, people do not simply get used to it – and the effects being studied exist after any habituation to the noise has occurred *(43)*.

Lower speeds reduce fuel consumption and climate change (greenhouse gas emissions) in most cases. This holds true for reductions from 50 km/h to 30 km/h in stop–start urban traffic, where lower maximum speeds reduce acceleration and deceleration *(44)*, and for much lower speed limits on rural roads, highways and motorways than the limits used around the world. Despite this evidence, climate change is a neglected factor in transport planning (45–48). For example, a study in Iran (Islamic Republic of) found that the ideal speed for minimum fuel consumption on motorways was around 75 km/h (49), well below prevailing global motorway speed limits.

Lower speeds reduce air pollution and associated health effects and deaths. Air pollution causes a large burden of death, disease and disability globally *(50)*, killing over 7 million people each year *(51)*, and road transport is the largest single contributor *(52)*. Lower speeds reduce air pollution from road transport *(44,53)*, which saves many lives, in addition to those saved by reducing crash deaths and serious injuries *(54,55)*.

Lower speeds facilitate active transport and public (mass) transport. Especially when combined with suitable incentive policies, lower speeds can facilitate increased use of public and active transport, by making walking and cycling safer and reducing the time-saving incentive to drive. Thus, cities with high living densities and lower speed limits have more journeys by public and active transport *(56)*.

Lower speeds reduce inequity. The importance of equity to societies is well recognized, making equity a core value for public health *(57)*, as well as cost savings *(58,59)*. In addition, inequity has been shown to have economic costs in LMICs *(60)*. Especially in LMICs, people who can afford safer personal motorized transport reap the personal benefits of higher speeds; in contrast, those with the least financial resources cannot afford such transport, and so do not receive the benefits of higher speeds *(61)* but suffer more of its costs. Poorer people are more likely to be the victims of serious crashes through having to walk, cycle or motorcycle.

Further, research shows that reducing transport pollution and serious crashes – the effects achieved by lower speeds – benefits the economically disadvantaged more than other people, improving equity *(62)*. Another confirmation of the inequitable effects of higher speeds comes from a study in Brazil, which found that the benefits of lower speed limits apply particularly to low-income pedestrians and motorcyclists *(63)*.

Lower speeds reduce vehicle maintenance costs. Higher speeds generate both more maintenance costs, including tyre wear *(64)* and more dust from tyres and road particles *(65)*.

The evidence demonstrates the harmful health effects of motorized road transport generated by air pollution, greenhouse gas emissions and noise. It also points to the global health benefits of lower speeds, increased use of active and public transport, and exercise, as well as of reduced numbers of crash deaths and injuries.

5.1.3. Refuting fears of harmful outcomes of lower speeds

Like its predecessors, this section presents a set of conclusions from the evidence, along with examples of research demonstrating them.

Higher speed is not better for the economy and higher speed limits do not help congestion in general. Increasing speeds does not mean that more vehicles get through a given location on the road to reduce congestion. This arises in significant part because, as speeds increase, drivers should and usually leave longer gaps between their vehicles and the ones in front. Thus, vehicles moving at higher speeds are further apart.

In addition, higher speed limits do not address other common events in traffic: decreased speeds result from encountering vehicles that are moving slowly or turning, intersections and stopped vehicles in the process of parking, dropping off passengers or delivering goods. The evidence shows that, when speeds are above 50 km/h, increasing them makes congestion worse. Decreasing speed does not necessarily increase congestion and can improve congestion *(66)*.

Improving driver skill and training to allow higher speeds is not an effective road safety solution. Many evaluations of training for drivers and motorcycle riders, and a methodologically rigorous review of the research, show that neither training drivers in car-handling skills nor school-based driver education improve road safety, and often produce the opposite outcome: increasing crashes after training *(11,67–72)*. As explained in Module 2, this is understandable: training increases driver overconfidence and optimism bias *(74–78)*, and the increase in these psychological factors increases risk-taking *(79,80)*.

Focusing on extreme speeding alone is much less effective than addressing all speeding. Each instance of extreme speeding has a dramatically higher risk of a serious crash than what is commonly seen as low-level speeding. For example, applying Nilsson's finding – of a 4% increase in fatal crash risk for each 1% increase in speed – reveals that travelling 5 km/h above an 80-km/h speed limit elevates the risk of a fatal crash by 25%, while travelling at 30 km/h above the speed limit raises the risk by 150%: six times as much. However, if there are more than six instances of minor speeding for each instance of extreme speeding, then low-level speeding will contribute to more fatal crashes than extreme speeding in total. In most places this ratio is much higher, with many more than six times as many people speeding by 5 km/h than by 30 km/h; thus, low-level speeding contributes more deaths and serious injuries than extreme speeding.

For example, analyses based on increased risk per instance and the number of instances of speeding show that supposedly minor speeding kills and injures many more people than extreme speeding. In Australia, such an analysis showed that people speeding by 1–10 km/h above the limit caused 67% of speeding deaths, while the rare drivers speeding by 30 km/h or more caused only 3% *(81)*. In general, this pattern of the large numbers of moderate speeders causing the most harm holds, although the exact percentages will vary between countries depending on the number of speeders in each category.

5.2. Making the right behaviour easier

Several actions can assist to facilitate the right behaviour: staying within the speed limit. These include:

- vehicle features, such as highly visible speedometers that clearly show drivers their current speeds, and ISA, which informs the driver or slows the vehicle to the limit if the driver exceeds the speed limit; and
- interventions in road engineering, such as prominent speed limit signage *(82)*, more signs reminding drivers of the speed limit and traffic calming to match the road environment to the speed limit.

A powerful near-future step for road safety globally would be government regulations requiring governing (speed-limiting) ISA in all new vehicles. Strong enforcement of speeding has the potential to support this vital step, because drivers will be more accepting of technology that directly prevents them from speeding if they believe that speeding will result in being caught and penalized, and they thus see speed-limiting ISA as a tool for avoiding the risk of speeding penalties. Without strong enforcement, drivers will continue to value speeding and thus resist speed-limiting ISA. Finally, driver and thus buyer resistance generates vehicle manufacturer resistance to installing speed-limiting ISA.

5.3. What works: evidence-based safe system and RPE actions against speeding

The safe system approach, as described in Module 1, identifies maximum speeds to avoid deaths in specific circumstances. By convention, safe speeds are set at points that allow a 90% survival rate of a crash:

- 30 km/h for impacts with pedestrians and vulnerable road users (for example, cyclists)
- 40 km/h for impacts with solid objects
- 50 km/h for car-to-car direct side-impact crashes
- 70 km/h for head-on crashes.

The practical consequences of speeds above these levels are critical. For example, a pedestrian hit at 30 km/h has a 90% chance of survival, but a quite small chance of survival at an impact speed just 20-km/h faster. These speeds are in fact a compromise, because they accept a 10% death rate and a higher serious injury rate, while a safe system aims to allow no deaths or serious injuries. More recent analyses of speed and the risk of fatal crashes indicate that the impact speed at which 10% of pedestrians will die is around 37 km/h *(21,23)*.

Thus, safe system speed limits work to save many lives; many countries, including many LMICs, increasingly widely use 30-km/h zones and some are adopting 20-km/h limits (see Image 3), although in a small minority of appropriate locations. These speed limits must be enforced unless speeds are well managed with traffic-calming measures such as speed humps.

5.3.1. Police enforcement of speed limits

Police enforcement of speed limits works, and the evidence shows it works better in reducing speeding, deaths, and injuries if it is strong and sustained *(83)*. This has the advantage of almost immediately informing offenders about penalties, because police stop them on the roads at the time, rather than penalty notices arriving later in the mail or by text message; however, police enforcement has the disadvantage of the risk of corruption (see Module 4 for suggestions for the management of corruption).

Increased speed enforcement is associated with reduced average driving speeds, speeding and thus crashes. In Europe, the BCR of stationary speed enforcement is estimated to be 3:1–12:1 *(84)*.

5.3.2. Tolerance in speed enforcement

The efficacy of enforcement and deterrence also depends on the speed limit and the extent of enforcement tolerance of infractions. The purpose of speed enforcement is to lower travel speeds to safe levels, so it can be much less effective if speed limits are too high for safety and if enforcement tolerance is also high, because this creates higher de facto speed limits. In some countries, the media and the public openly interpret guaranteed or, worse, legislated enforcement tolerances of 10 km/h as meaning that a speed limit of 80 km/h is really 90 km/h. An evaluation of reducing enforcement tolerances for speeding shows clear improvement in road safety *(85)*.

Image 3. Examples of 20-km/h and 30-km/h zone speed limit signage

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Good-practice advice for police enforcement of speeding includes adopting a zero-tolerance approach *(86)*. In practical terms, this means minimal tolerance before a penalty is applied. For example, a driver commits a speeding offence and receives a penalty for travelling just 3 km/h above the speed limit in the state of Victoria, Australia.

5.3.3. Low-level speeding

As explained in Section 5.2.3, focusing only on extreme speeding does little to reduce speeding-related deaths. The exact percentage varies between countries, but can be as low as 2–5%, depending on the percentages of drivers at different levels of speeding, which can be calculated using the tool provided by Gavin et al. *(87)*.

Enforcement campaigns and communications must focus on low-level speeding. Of course, this will also address extreme speeding and help to marginalize it as unacceptable.

5.3.4. Crash data: a poor estimate of the role of speeding in serious crashes

Crash data may include the number of crashes reported to involve speeding, which comes primarily from police reports. These data vary from country to country, with speeding generally estimated to be involved in 25–40% of fatal crashes *(5)*, including in LMICs such as Kazakhstan *(88)* and Pakistan *(8)*. The use of crash data to estimate the role of speeding in causing serious crashes contributes to the underappreciation of its vital role in making crashes more severe, because in most countries crash data often miss speeding as a factor.

Nevertheless, discussions with police officers in various countries reveal that they correctly believe that speeding is a much larger factor than their data indicate, often suggesting that it is involved in 50–80% of fatal crashes *(5,89)*. Because police believe, but cannot prove, that speeding was involved in many crashes they do not include it as a factor. For example, if a police officer arrives at the scene of a pedestrian fatality, the driver is the only person who can report what happened. That driver is most unlikely to admit to speeding and may blame the pedestrian, claiming they rushed out into the road and that they did not have time to stop. Unless there are skid marks or witnesses, determining whether the crash involved speeding is difficult *(90)*. Similarly, speeding is difficult to identify in crashes involving a single vehicle running off the road and many other situations.

Fortunately, an evidence-based method can adjust for the likely number of missed fatal crashes involving speeding, and thus provide a better estimate of the real role of speeding in deaths and injuries. Some studies have compared police reports of speeding involvement in particular crashes with better evidence to determine the real level of involvement. Comparing these data from better sources with crash data indicates that speeding is involved in around twice as many fatal crashes as indicated by the latter. Doubling the estimated number from crash data can therefore be used as a correction factor. The better evidence comes from in-depth crash investigations, crash reconstructions and modern event-recorder systems in vehicles, the equivalent of the so-called black box in an aeroplane, which reveal the speeds involved in crashes much more accurately.

If these correction factors are applied to crash data they approximately double the number of those that involve speeding. Such an analysis for New Zealand showed that, while crash data had indicated that speeding was involved in over 29% of fatal crashes, the best estimate of the real number was 60% *(5)*. However, one should remember that some crashes are reported to have multiple causes.

5.3.5. On-road policing and automated enforcement

Automated enforcement (speed cameras) can be especially valuable for providing deterrence. They should be seen as a significant addition to on-road police enforcement, not an alternative. Automated enforcement has clear advantages.

- Cameras can be highly cost–effective to operate, can be used for enforcement in locations unsafe for police and operate at every hour of every day, creating more sustained deterrence.
- Mobile camera operations can create strong general deterrence across the network if they are unmarked. This means that drivers cannot avoid them and can protect themselves from detection only by not committing an offence *(91)*.
- Cameras can detect many offenders without a need to stop to intercept, talk with and issue infringement notices to offenders.
- Speed cameras provide strong proof of offence by producing a photograph along with the record of speed.

5.3.5.1. Assessing readiness for automated enforcement

Introducing cameras without sufficient consideration of existing systems may not deliver good road safety outcomes. For example, if too many vehicles are not registered or do not display a number plate for identification, cameras cannot identify them so that infringement notices can be issued.

Countries can use a guide to assess their readiness to implement speed cameras *(92)*. Even though no country can ensure that every vehicle has perfect vehicle registration and number-plate visibility, perfection is not required. The guide also assists countries to identify what they need to improve in order to introduce speed cameras.

5.3.5.2. Automated enforcement penalties and back-office processes

Automated enforcement raises two matters related to penalties. First, in a few countries the usual penalty may be applied only partially for camera-detected offences. For example, the fine may be applied, but licence loss or demerit points may not be. This weakens the deterrence provided by camera use and gives the impression that speeding is less important when detected by a camera than by police. This is poor policy.

Most countries apply the full penalty, and have legal processes for identifying drivers through photographs or well-regulated processes for the declaration of drivers, with onerous penalties for false declarations. For example, a federal court judge in Australia was jailed for a false declaration of the driver of his car after being detected speeding by a camera *(93)*.

Second, the back-office systems by which penalty notices are generated from camera images must be efficient, ensuring that all offenders receive penalties and that the penalty notices are issued with minimal delay.

5.3.5.3. Enforcing speed limits with fixed cameras

Fixed speed cameras are fixed in place and so enforce speeds at set locations. They are effective for covering particular high-risk locations. However, in general, their use does not result in a broader reduction in speeding and speed-related crashes in other locations, because drivers slow down only in known camera locations. If signs warning of a camera's location are also installed,

drivers are likely to travel at lower speeds for an even shorter distance, slowing for the camera for around 500 m and then speeding up again *(94)*.

These results also highlight that, as previously mentioned, most speeding drivers are aware of the speed limit, know that they are speeding and choose to do it. Even after slowing down for a camera, in this case with reminder speed limit signage as well, speeding drivers still speed up once they are well past it. With sufficient motivation, drivers would make sure that they always know and comply with the speed limit. In a hypothetical example, everyone would be very careful to know and stick to speed limits if every instance of speeding resulted in the driver being immediately imprisoned for 1 month.

The evidence for the benefits of speed cameras in saving lives and preventing injuries is irrefutable: many direct evaluations show that they reduce speeds and deliver substantial reductions in deaths and injuries. Numerous international reviews of the evidence conclude that camera use improves safety, rating it as highly effective *(24)* and as having an impressive BCR of around 14:1 (66). A methodologically rigorous review by Elvik et al. concluded that speed cameras reduce fatal crashes by 39% and injuries by 16% *(11)*, and a highly credible Cochrane Library review concluded that the "consistency of reported reductions in speed and crash outcomes across all studies show that speed cameras are a worthwhile intervention for reducing the number of road traffic injuries and deaths" *(95)*.

Examples abound, so just a few are noted. Fixed speed cameras in the state of New South Wales, Australia, delivered substantial reductions in speeding and mean speed, as well as reducing fatal crashes by 90% and injury crashes by 20% along the road lengths where they were employed *(96)*. This also highlights the finding that the benefits of reducing speeding are much larger than they would be if estimates of the role of speeding in fatal crashes from crash data – around 40% in the Australian state of New South Wales – were correct. In Poland, the number of cameras in operation was steadily increased over some years, reducing crash deaths substantially *(97)*. When many cameras were turned off the number of crash deaths increased *(98)*. An evaluation in Saudi Arabia found that speed camera installation in various segments on a ring road produced an 84% decline in crashes causing injury and eliminated crashes with fatalities *(99)*. The success of fixed speed cameras has also been shown in many other HICs, including Finland, Norway, Spain and the United States of America *(85,100–102)*.

In LMICs, an evaluation in Brazil found that the safety benefits were larger when both lower speed limits and speed cameras were used *(63)*. A programme using fixed speed cameras on a major urban road in Thailand decreased vehicle speeds by 9.6% and the numbers of crashes, injuries and fatalities by 5.8%, 7.7% and 34.3%, respectively *(103)*.

5.3.5.4. Enforcing speed limits with mobile cameras

Mobile speed cameras can be moved around the road network and set up to enforce speed limits in many locations, which spreads the speed-reducing benefits of mobile cameras over more of the road network than is the case for fixed cameras. Thus, even though mobile cameras may reduce fatal and serious crashes by lower percentages, they save more lives because these reductions apply to a much larger proportion of the total fatal crashes occurring before they were introduced. A World Bank review rated mobile speed cameras as highly effective *(24)*, and evaluations in Canada and Netherlands (Kingdom of the) have shown reductions in serious crashes and speeding *(104,105)*.

A seminal evaluation of hidden (covert) mobile speed cameras in New Zealand showed that they are effective, and that a mix of visible and covert speed enforcement works even better than using visible cameras alone *(91)*.

5.3.5.5. Signposting and enforcement predictability

Signposting of speed enforcement, which reminds drivers that speed cameras are in use, is sound promotional advertising (Image 4), as long as it does not tell drivers where they can be caught. Signposting of enforcement that shows where offenders can be caught is fundamentally opposite to the best-practice principles of enforcement and deterrence: that offending can be detected at any place and time.

To be unavoidable, enforcement should be unpredictable. The anywhere, anytime approach spreads deterrence over the entire road network, creating greater benefits. The research on covert mobile speed cameras noted above directly demonstrates the value of this approach. As mentioned, signposting speed cameras only slows speeds for around 500 m of road. This result highlights the problem with signposting locations: telling drivers where they can be caught by speed cameras also tells them where that will not happen (Image 5). Even in countries with many speed cameras, the vast majority of the road network is not covered. As a hypothetical example, even 1000 speed cameras in a country with 250 000 km of roadway means that only 1 km in every 250 km of road length has a speed camera. This would mean that, with each camera influencing only 0.5 km of road length, drivers can speed without the threat of speed camera enforcement on 99.8% of the road length of the country.

Mobile speed cameras are an essential complement to fixed speed cameras, which are effective in addressing known crash blackspots. However, it is important to note that many fatal crashes do not occur at these locations. For example, an unpublished analysis in New South Wales, Australia, that compared all the fatal crash locations in 1 year with those occurring in the previous year showed only a 12% overlap of locations. This means that even addressing every fatal crash location from a whole year, not just blackspots, would only address 12% of the next year's fatalities. Network-wide speed enforcement helps to address the remaining 88%.

Despite the evidence and reasoning that challenges the signposting of speed cameras, the practice has political appeal and persists in many countries. Oddly, this is often justified as being fair. However, applying this logic to other law-breaking activities, especially those resulting in substantial fatalities and injuries, shows how unreasonable this attitude is: few would suggest that informing violent criminals about the specific streets or neighbourhoods under patrol is fair.

Good practice is to provide signage giving general reminders: for example, saying that speed cameras are in use in a particular state/province or municipality, or at most on a particular road. The photographs below show examples of good practice and poor practice, respectively; the latter severely limits the effects of speed cameras to short sections of roadway.

Image 4. Good-practice signposting for speed cameras: not informing drivers of enforcement locations

© S Job.

Image 5. Bad-practice signposting for speed cameras and highly visible cameras: informing drivers of exact enforcement locations

© S Job.

5.3.5.6. Speed cameras showing average speeds

Average-speed (or point-to-point or section-control) speed cameras involve two or more connected cameras along a section of road. They collect an image, the exact time when the photo is taken and vehicle registration data from a vehicle at each point, and match them using ANPR technology. The average speed of a vehicle between the two cameras is then calculated from the known specified distance between them and the time taken for the vehicle to travel between them. If the average speed of a vehicle is found to exceed the legal posted speed limit for that road section, plus any enforcement tolerance, the local processor transmits images and offence data to a central processing unit or back office via a communication network, where human verification assesses the validity of detected infringements and issues penalty notices *(106)*.

Average-speed cameras offer the powerful advantage of enforcing speed limits over long distances, not just at one camera location. The evidence supports this conclusion: a review found strong evidence supporting the safety benefits of average-speed cameras *(106)*. An analysis in Poland showed that average-speed cameras produce stronger reductions in speed than fixed cameras *(107)*, and a study in the Republic of Korea found speed-reduction benefits *(108)*. The use of average-speed cameras reduced speeding by 76% in Belgium *(109)* and crashes by 32% in Italy *(110)*, yielding dramatic predicted safety benefits. Finally, BCRs for average-speed cameras range from 7.4:1 to 12.5:1, that is, each dollar spent yields US$ 7–12 in savings.

5.3.5.7. Combined speed and red-light cameras

Failure to stop at red lights commonly results from speeding, so red-light cameras are also a form of speed enforcement. Combined speed and red-light cameras detect drivers who speed, disobey red lights or both. The logic for their use is that they reduce both forms of law-breaking, especially by drivers who speed up to get through the location before a light turns red. Use of these cameras is increasing, including in MICs (see Image 6).

Image 6. Red-light camera

© S Job.

The evidence for the safety benefits of combined red-light and speed cameras, and of red-light cameras, is clear. Combined red-light speed cameras resulted in a reduction in serious crashes in Belgium *(111)*. Reviews of evidence have reported substantial safety benefits of red-light cameras *(112,113)*, and a large evaluation in the United States of America showed that rates of fatal crashes resulting from running red lights were 21% lower in cities with cameras than in those without them, and these crashes increased after red-light cameras were turned off in some cities *(114)*.

Similar successes have occurred in LMICs and similar areas. In Colombia, combined red-light speed cameras led to a reduction of 19.2% in all crashes and 24.7% in crashes with deaths and injuries at camera locations, and these benefits spread to reducing crashes at untreated intersections *(115)*. Increasing penalties for red-light camera offences in Hong Kong Special Administrative Region resulted in a decrease in disobedience *(116)*. Red-light and speed cameras substantially reduced severe crashes (resulting in deaths and injuries) in Jordan *(117)*.

5.3.6. Speed enforcement for bicycles and e-mobility vehicles

General speed limits apply to bicycles and to electronic mobility (e-mobility) vehicles such as electric scooters and bicycles when they are on the road, although lower limits may apply on paths shared with pedestrians, such as 10 km/h in Australia, to protect pedestrians. Enforcing these limits is important because pedestrians suffer serious injuries and deaths from collisions with bicycles and e-mobility devices; such collisions also cause the deaths of cyclists and e-mobility vehicle users.

Three factors hinder police and automated enforcement of speeding and other infringements by cyclists and e-mobility vehicle users. First, these vehicles are not required to have or display a registration plate as identification. Second, riders are not required to have a licence or to carry personal identification in many countries, meaning that their identity and address cannot be verified for infringement notices. Third, police rarely patrol/enforce on shared paths.

More needs to be done to address this expanding safety challenge, including the provision of safe dedicated spaces, along with enforcement.

5.4. Good practices in suppressing speeding

Module 3 outlines good practices for managing the whole system required for deterrence, and Module 4 details general good practices for deterrence. These clearly apply to reducing speeding behaviour. While speed management is fundamental to road safety and thus a safe system, it remains poorly appreciated and resisted. For this reason, the good practices around campaigns and communications are especially critical for this area of behaviour change. They should include giving both clear warnings of changes, such as lower speed limits, at least 4 weeks before they are implemented and warning notices for a short period afterwards.

Other good practices more specific to speeding are also important. To avoid repetition, they are briefly presented in the recommended actions below.

5.5. Summary, conclusion and recommended actions

This module identifies the fundamental role of speed and speeding in crash occurrence and severity, with evidence showing that speed is the most critical factor in crashes. It describes the many ways in which RPE activities can improve speed management, and provides compelling evidence for their effectiveness.

Conclusion 5.1: Promoting the community-wide economic costs of crashes may reduce the perceived value of high speed.

Recommended action 5.1: The general recommended actions in Modules 3 and 4 should be applied to speed enforcement, particularly because the community sometimes resists it. This particularly applies to the recommended actions on campaigns, communications and warnings.

Recommended action 5.2: The irrefutable evidence for the critical role of speed in crash occurrence and crash severity should be understood, and used in business cases and advocacy for stronger speed enforcement and deterrence.

Recommended action 5.3: The many evidence-based methods for effectively enforcing speed limits should be selected as the best enforcement options for the particular circumstances faced; these include police enforcement and the use of fixed, mobile and red-light speed cameras. Police should take the most effective actions for speed enforcement: directed patrols using laser/radar speed detection devices, mobile speed camera deployment and fixed speed camera operations *(118)*.

Recommended action 5.4: For speed enforcement to be most effective, speed-zoning guidelines should be made and followed. These guidelines should not only allow low-speed zones (with limits at or below 30 km/h) but also require them in areas commonly used by pedestrians: for example, those around schools, shopping areas and markets. The classification of a road as a highway or similar should not be an impediment to setting a speed limit that reflects how the road and the surrounding land are used, along the length of any road.

Recommended action 5.5: As discussed in Module 3, GLS schemes should be established to take advantage of important opportunities to improve the management of speeding by young drivers *(119)*. They should, for example, include setting additional penalties for speeding by novice drivers, such as loss of licence for any offence, which is especially effective in reducing fatal crashes *(120)*.

Recommended action 5.6 Penalties for speeding should be graded by the level of risk, so that higher levels of speeding result in more severe penalties, including loss of drivers' licences and vehicle sanctions for extreme speeding, such as driving 40 km/h over the speed limit. In some states in Australia, for example, drivers can lose their licences for 3 months for speeding by 30 km/h or more, and for 6 months for speeding by 45 km/h or more. As mentioned, having one level of penalty for all speeding offences leaves drivers with the feeling that, if they are risking being caught for speeding, they may as well speed at high levels.

Recommended action 5.7: As high enforcement tolerances create higher de facto speed limits, enforcement tolerances on speeding should be low; a tolerance of 3 km/h above the limit is best practice. The evidence shows that reducing tolerances to such low levels, along with warning to the community weeks in advance of this change, enhances speed enforcement and improves safety.

Recommended action 5.8: Because low-level speeding adds greatly to serious crash risk and is much more common than extreme speeding, enforcement, campaigns and communications

should focus on the former, which will also address the latter and help to marginalize it as unacceptable. To ensure this, a sound performance target for police should be set and regularly monitored. For example, the target may be that 15% or 20% of infringement notices are issued for speeding by 10 km/h or less above the limit.

Recommended action 5.9: Speed enforcement by police requires either following a suspected speeding vehicle to detect its speed or using speed detection equipment, such as a handheld lidar. Particularly in LMICs, police should conduct on-road enforcement by using speed detection equipment at varying locations, to increase anywhere, anytime enforcement. This is far more effective for road safety than standing at checkpoints and stopping selected vehicles, which fails to detect and address moving violations, such as speeding.

Recommended action 5.10: Hidden enforcement should be combined with visible enforcement, and should be publicized to the community weeks before it starts, to maximize compliance.

Recommended action 5.11: Use of the correction factor, available from Job and Brodie (5), to improve the accuracy of estimates of the role of speeding in serious crashes should be discussed with and/or considered by police and, if agreed, applied.

Recommended action 5.12: Before speed cameras are introduced, readiness for them should be checked against established criteria *(92)*. Assessments of readiness should be based on a judgement of when the situation is reasonable for camera use; delaying their introduction while waiting for ideal circumstances can mean the loss of major opportunities to save lives.

Recommended action 5.13: The combination of fixed and mobile speed cameras should be used, as this is more effective in saving lives and preventing injuries than using fixed cameras alone.

Recommended action 5.14: The signposting of mobile speed cameras should be avoided or at least not applied to most cameras. For mobile cameras, combining visible and covert cameras is more effective in saving lives and preventing injuries than using visible cameras alone. To maximize the area-wide safety benefits of mobile speed cameras, warning signs should not be used to signal the presence of at least the majority.

Recommended action 5.15: General warning signage should be posted to inform drivers that speed cameras are being used without indicating exactly where, as increasing reminders to drivers of the risk of being caught increases general deterrence.

Recommended action 5.16: The following principles should be applied in choosing locations for camera enforcement, to maximize their efficacy.

- Fixed speed camera locations should be selected based on evidence of a speeding problem and a serious crash problem, based on numbers of serious crashes, not all crashes. The criteria should include both a history of serious crashes and evidence of a speeding problem from surveys of speeds in the location.
- As the evidence shows, the number of locations where mobile cameras are used should be many times larger than the number of cameras *(121)*, and the rotation of cameras to those locations should be unpredictable. Locations should be chosen on a similar basis as for fixed cameras, but with less need for serious crash numbers, to ensure that many locations are chosen.
- If police carry out extensive speed enforcement, this should continue when cameras are introduced. In this case, an additional criterion for location choice may be places where police enforcement is difficult or unsafe.

Recommended action 5.17: All the usual penalties for speeding should be applied, whether detected by cameras or by police.

Recommended action 5.18: If the penalties applied to drivers on the basis of camera evidence include demerit points or loss of licence, taxi, bus, trucking and transport companies should not be allowed to pay fines for drivers, or fail to give the name of the driver involved in each offence. Such companies should be required to maintain records of the individuals operating their vehicles at all times, which allows for full penalties to be applied and creates an additional incentive for companies to manage speeding. Companies should face heavy penalties for each failure to provide the name of an offending driver.

Recommended action 5.19: Data should be collected and used to evaluate speeding interventions. If crash data are not reliable and comprehensive, before-and-after surveys of speeds can be sufficient, and such data should be collected even if crash data are reliable. Speed surveys combined with the information in this module should be used to calculate reductions in deaths and injuries from the changes in average speeds

Recommended action 5.20: Authorities should consult the community about the locations of speed cameras to reduce the latter's concerns about the choices made. Consultation with the community, including sharing the opportunity to nominate camera locations, proved most helpful in New South Wales, Australia.

Recommended action 5.21: Speed cameras should be regularly calibrated to ensure accuracy of measurement and credibility of enforcement. The evidence of calibration within a legislated set period should be acceptable as grounds to dismiss claims by drivers that a camera is inaccurate.

Recommended action 5.22: Talks by victims of speed-related crashes, or members of their families, should accompany announcements and possibly advertising (depending on research into local attitudes) of speed enforcement programmes, because they generate all-important emotional support for the programmes. NGOs provide especially valuable support in this area; for example, the accountability toolkit of the Global Alliance of NGOs for Road Safety highlights speed management as the most critical area for action (122). Independent surveys of community views on speed and enforcement commonly show more support for enforcement than the mass media present, and thus this can be valuable news in itself.

Recommended action 5.23: Speed camera programmes should be evaluated, and the results published to ease concerns and demonstrate the benefit to road safety of increased enforcement. Camera locations should be legitimately chosen to ensure that this is possible. The first locations for camera installation will be the most carefully scrutinized and should be chosen based on serious crash rates as well as levels of speeding, as mentioned in Recommended action 5.16, to ensure early wins.

Recommended action 5.24: Governments should invest all revenue raised through the use of speed cameras into road safety, as with the Road Trauma Trust Account in Western Australia, because this refutes accusations that enforcement is used solely to raise revenue.

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MODULE
6

Deterring non-use of helmets and restraints

6.1. Introduction

This module considers restraints – seat belts and child restraints – and motorcycle and bicycle helmets. It briefly presents the evidence for the importance and efficacy of seat belts, child restraints and helmets; offers evidence on the efficacy of enforcement and general deterrence to increase usage of these devices; and considers good practices to achieve this aim. The use of these safety devices delivers significant reductions in crash deaths and injury severity. They achieve this by reducing crash forces in the event of a crash and thus represent a key opportunity to deliver a safe system.

6.2. Evidence for device need and efficacy and the value of deterrence

6.2.1. Seat belts and child restraints

Vehicle occupants constitute the largest single share of crash deaths globally *(1)*, so seat belts and child restraints provide dramatic opportunities for saving lives, and preventing debilitating head and other injuries. While rates of seat belt and child restraint usage are high in some countries they remain inadequate in many others. Further, the absence of seat belts remains a significant contributor to crash deaths and injuries, even in countries with the best rates of use. For example, even though seat belt usage is around 99% in the state of New South Wales, Australia, at least 13% of deaths involve people in cars not wearing available seat belts *(2)*. Further, wearing rates are poor in many countries, especially LMICs.

The opportunity for improvement is made more substantial by poor wearing rates (see Image 7) in many LMICs, with little effective enforcement of seat belt and child restraint use. Some LMICs have no laws requiring the use of child restraints; in some cases, the seat belt laws cover only the driver or the occupants of the front seats *(3)*. Many evaluations have proved that the use of seat belts *(4,5)* and child restraints *(6,7)* saves lives and prevents injuries.

Image 7. Failure to use seat belts and child restraints in many countries

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6.2.2. Motorcycle helmets

Motorcycle riders and passengers suffer 28% of crash deaths globally *(1)*. These deaths are disproportionately concentrated in LMICs, and their share of the total is likely to be underestimated *(3)*.

As with seat belts, motorcycle helmets are a well-proved intervention, with many evaluations showing that their use saves lives and prevents injuries *(8)*. A systematic review concluded that high-quality evaluations showed estimated reductions in the risk of death of 42–69% *(9)*. However, even when the rate of motorcycle helmet use is close to 100%, motorcyclists not wearing helmets are overrepresented among crash deaths *(2)*.

As with seat belts, helmet-wearing rates are considerably lower in LMICs, highlighting dramatic opportunities to save lives and prevent injuries through increased use. Failure to use motorcycle helmets is easily detected and common in most LMICs, including instances where riders carry but do not wear helmets, which makes them ineffective (see Image 8). To support this conclusion, a study comparing LMICs showed that higher wearing rates for motorcycle helmets were associated with large reductions in numbers of crash deaths *(10)*. Further, a study conducted in Thailand showed that, across provinces, greater helmet enforcement was associated with higher wearing rates and reduced numbers of injuries *(11)*.

Image 8. Failure to use motorcycle helmets is seen in most LMICs




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6.2.3. Bicycle helmets

Cyclists account for 3% of crash deaths globally *(1)*, and this proportion is likely to be underestimated *(3)*. Even in HICs, the failure to wear a bicycle helmet is common and contributes significantly to deaths: 14% of the cyclists who died from crashes in New South Wales in 2019 were not wearing helmets *(2)*. The problem is especially severe in the absence of laws requiring helmet use (see Image 9) *(12)*. This creates significant opportunities for saving lives and preventing injuries by increasing helmet use.

Image 9. Many HICs without laws mandating the use of bicycle helmets have poor wearing rates

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Many evaluations have proved that using bicycle helmets saves lives and prevents injuries *(13–15)*. Studies making the opposite claim have been shown to be seriously flawed *(16,17)*. In the face of this clear evidence, it is disappointing that many HICs that perform particularly well in other respects do not have laws mandating bicycle helmet use. For example, countries such as Netherlands (Kingdom of the) have low wearing rates and disproportionately high and increasing numbers of cyclist deaths *(18)*, with the numbers of these deaths about equal to the numbers of drivers killed each year *(1)*.

6.3. Making the right behaviour easier

Good practices for facilitating the use of seat belts, child restraints and helmets include:

- making helmets that provide effective protection cheaper through subsidies or reductions in sales taxes;
- designing helmets that maintain high standards of impact protection but are also appropriate for high-temperature regions, such as the tropical ECE22 helmets developed by the FIA;
- requiring child restraint fixture systems (such as Isofix, an internationally standardized child seat/restraint fitting system) in all cars;
- facilitating the correct fitting and use of child restraints through establishing fitting stations *(19)*, educating parents as part of child health-care systems, and setting up schemes that allow parents to rent or borrow suitable restraints; and
- requiring that motorcycle helmets, bicycle helmets and child restraints be certified to meet suitable safety standards, and ensuring that a programme to rate the safety of child restraints exists to inform purchases *(20)*.

6.4. Evidence-based RPE actions

Evaluations show clear benefits from laws for mandatory use and enforcement of each of the safety devices addressed in this module. For example, laws requiring the use of seat belts and child restraints, combined with enforcement, have proved effective in broad credible reviews of the evidence *(21–23)*, and in studies of LMICs such as Lebanon *(24)* and Serbia *(25)*. Laws making use mandatory, combined with enforcement, also increase the use of motorcycle helmets, thus saving lives and preventing injuries *(26)*, including in LMICs *(11)*.

This combination has also been proved to work with bicycle helmets; reviews of global evidence show consistent road safety benefits *(27,28)*. The introduction of a mandatory bicycle helmet law in Victoria, Australia, was immediately followed by a substantial increase in helmet wearing and a large decrease in cyclist deaths from head injuries *(29)*. A comparison of serious injuries to cyclists in Victoria, Australia – with its mandatory helmet law and high wearing rates – and Netherlands

(Kingdom of the), which has no such law and low helmet-wearing rates, showed that cyclists in the latter were significantly more likely to suffer serious head injuries and to die *(12)*. An evaluation demonstrated that mandatory helmet laws in Netherlands (Kingdom of the) would be highly cost–effective *(30)*. Finally, a longitudinal observational study of helmet use in Canada assessed the long-term effects of a comprehensive approach: education, legislation and enforcement of bicycle helmet use for all age groups. It found that this approach resulted in helmet use being not only sustained after the legislation was passed but also improved from 75.3% in the year the law was enacted to 94.2% 14 years afterwards, among all age groups and genders *(31)*.

The advice on how to maximize general deterrence (in Module 2) applies for increased use of these safety devices. A case study from Australia allowed direct comparison of the effects of high-fear advertising, highlighting the risk of death or injury without a seat belt, with the effects of general deterrence through a well-publicized law on mandatory use and the threat of enforcement. While rates of seat belt use remained poor – around 20–30% – after multiple advertising campaigns based on crash and death risk, they rose dramatically to over 90% and, more recently, to 99% with general deterrence from heavily promoted laws requiring mandatory use *(32)*.

6.5. Good practice

Good practices include those listed below.

- Monitoring wearing rates through on-road observations for all relevant devices is important both to assess the problem and to evaluate the effects of actions taken. Self-reported usage rates should not be used for this purpose, because they do not accurately reflect actual usage *(33)*.
- In addition to police enforcement, camera enforcement of seat belt use has been found to work in some countries *(34)*. Because these countries have motorcycle helmet usage rates close to 100%, cameras are not being applied to helmet use, although this also seems feasible.
- Penalties related to seat belt and motorcycle helmet use should include demerit points. The addition of demerit points, higher fines and a strong enforcement-based campaign – starting 2 months before a new law on seat belt offences in Italy came into force – led to a substantial and sustained increase in seat belt use. Seat belt use increased from 54% to 83% for drivers, and from 53% to 76% for front-seat passengers in the first 3 months, with further slight increases 15 months afterwards *(35)*.
- Seat belt laws should cover all vehicle occupants, not just drivers or front-seat occupants.
- Seat belt, child restraint and helmet laws should be primary laws, not secondary. Secondary laws, which exist in some states of the United States of America, mean that a vehicle must be stopped for another offence before a penalty for not using a seat belt can be applied.
- Bicycle helmet laws are effective and should be adopted in all countries.
- The enforcement of seat belt and child restraint laws also requires laws and enforcement on the extent of tinting of vehicle windows, to ensure that occupants are visible. In Belize, the police have equipment to measure the level of window tinting.

- One challenge to enforcing seat belt use by passengers is that they are not required to have a licence and, in most countries, are not required to present identification if a vehicle is stopped. This means that passengers can give incorrect or false names when an offence is recorded, so offenders cannot be traced. A solution to this problem, which has been effectively implemented in some jurisdictions, is to hold the driver accountable for ensuring that all passengers are wearing their seat belts. This is enforced by imposing penalties on the driver, including assigning demerit points for each unrestrained passenger.

Table 3 gives the principles for enforcing laws passed on the use of restraints.

Table 3. Fundamental principles for restraint policing

Principle	Action
Increased visibility of policing immediately after new laws are enacted	Includes highly visible, publicly observable, and strategically located checkpoints and roadblocks that are varied in location, intensity, and time of day or night. There should be many police officers in each working team. Visibility includes signage about the enforcement activity, safety vests for police and adequate lighting at night.
Specific deterrence policing (longer-term approach)	After road users become accustomed to new seat belt or child restraint laws, greater use of specific deterrence-based policing is required, such as: • police officers positioned at the side of the road to observe vehicle occupants; where non-use of restraints is identified, police tasked with stopping vehicles sign drivers to stop and issue infringements or penalties for offences detected; and • police officers using motorcycles or cycles observe vehicle occupants in low-speed zones, stopping vehicles and taking enforcement action where offences are detected. These operations prevent vehicle occupants from correctly wearing seat belts only when they see highly visible enforcement. Operations should operate on an “anywhere, anytime” basis, so that road users cannot predict when and where policing will occur. Enforcement locations should be chosen across the road network but use locations where the visibility of vehicle occupants allows clear observation (for example, daylight or adequate street lighting).
Repetition of enforcement campaigns	Indicates to motorists that the risks of being caught are high anywhere, anytime.
Strict and consistent enforcement	After an initial public warning period, policing should be strict, non-discriminatory, fair and consistent, not only on highways or where police enforcement can be anticipated. If there is no policing there will be limited or no compliance.

Principle	Action
Well-publicized enforcement (general deterrence)	To achieve maximum effectiveness, compliance-driven policing (specific deterrence) must be combined with coordinated education and publicity campaigns (general deterrence), involving engagement of government, local government, mass media and other agencies. Publicity campaigns should be conducted before, during and after policing activities with reinforced safety messages. Safety brochures on correct use of seatbelts and child restraints may be handed out with warnings as an alternative to issuing a fine immediately after new laws are enacted; warnings are not effective in the long term, and should be avoided after road users have had a reasonable period (about 3 months) to be educated about new seat belt and child restraint laws. Education and instruction includes reminders of the benefits of use of seat belts and child restraints, and the constant promotion of safety messages.

Source: FIA Foundation *(36)*. Reprinted with permission.

6.6. Summary and recommended actions

This module examines the significant value of seat belts, child restraints, and motorcycle and bicycle helmets in saving lives and preventing injuries, and identifies many aspects of good practice in facilitating the use of these safety devices and in creating general deterrence to increase their use. Despite their benefits, usage is not yet at 100%, even in countries with high road safety standards. In many LMICs, usage rates are poor. This suggests that improvements in usage have the potential to save numerous lives and prevent many injuries.

Recommended action 6.1: The general recommended actions in Modules 3 and 4 – on the total enforcement system needed for deterrence and good practice for deterrence, respectively – should be applied to the enforcement of helmet, seat belt and child restraint use.

Recommended action 6.2: Good practices to facilitate the use of seat belts, child restraints and helmets should be followed; these include: making effective helmets more affordable, designing helmets for high-temperature regions, requiring all cars to have child restraint fixture systems, facilitating the correct fitting and use of child restraints, and requiring that helmets and child restraints be certified to meet suitable safety standards.

Recommended action 6.3: Laws should be passed and enforced mandating the use of seat belts, child restraints and helmets.

Recommended action 6.4: Wearing rates should be monitored through on-road observations for all relevant devices, both to assess any problems and to conduct ongoing evaluation of the effects of actions taken. Self-reported usage rates should not be used for this purpose, because they do not accurately reflect actual usage rates *(33)*.

Recommended action 6.5: In addition to police enforcement, camera enforcement of seat belt and helmet use should be considered if countries have suitable enforcement systems. An analysis of the efficacy of police activities rated restraint enforcement as the most effective activity that can be undertaken *(37)*.

Recommended action 6.6: Penalties for offences related to seat belt and motorcycle helmet use should include demerit points.

Recommended action 6.7: Seat belt laws should cover all vehicle occupants, not just drivers and/or front-seat occupants.

Recommended action 6.8: Laws on offences involving seat belt, child restraint and helmet use should make them primary, not secondary, offences.

Recommended action 6.9: To enable the enforcement of seat belt and child restraint laws, laws should be passed and enforced regarding the extent of tinting of vehicle windows, to ensure that vehicle occupants are visible.

Recommended action 6.10: To assist in the enforcement of laws on passengers' use of seat belts, vehicle drivers should be held accountable for their passengers wearing their seat belts, and penalized (including with demerit points) for each passenger who is not restrained. This would solve common problems with tracing offending passengers.

Recommended action 6.11: Laws making the use of bicycle helmets mandatory should be adopted in all countries.

Recommended action 6.12: The police should be trained to enforce the use of safety devices, particularly seat belts and child restraints *(38)*.

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MODULE 7

Deterring substance impaired driving: drink- and drug-driving

7.1. Introduction

This module considers the RPE-related management of the harm to road safety done by alcohol and drug use. It offers brief reviews of the evidence for the importance of these factors and the efficacy of general deterrence in managing them. Drugs are taken to include any and all that may impair driving, including illegal recreational drugs and medications.

Several factors limit the coverage of particular topics in this module. They arise from insufficient research, evidence and generalizability. The extent of alcohol and drug use varies greatly across countries, so a broad commentary on the extent of the problem is not universally applicable, mainly due to variations in culture, religion, availability and law. Alcohol is legal and readily available in many countries, and illegal and quite difficult to obtain in others. Drugs – especially cannabis – also vary in legal status, ranging from legal for recreational use, legal for medical purposes with a prescription to illegal in any circumstances. These variations exist even between nearby countries; for example, cannabis was recently legalized for recreational use and is readily available in Thailand, but is illegal and can result in the death penalty in China, Indonesia and Singapore. The legal status of cannabis also varies across states in some countries with a federal structure, such as Australia and the United States of America. These variations can influence policy, laws, and enforcement on drink– and drug–driving.

Drink–driving is a much clearer issue than drug–driving for many reasons, such as the effects of one drug versus many. While the measurement of BAC is valid, reliable, rapid and inexpensive, measurement of the concentration or presence of many drugs is slower and more costly. The dose–response relationships for alcohol and serious crash risk are well established, while the data on dose–response relationships for drugs are, in general, inadequate. These factors greatly complicate drug–driving law and enforcement, although solutions have been found.

While drug and alcohol use may impair pedestrians as well as vehicle operators, there is little evidence on the level of risk or the efficacy of interventions for pedestrians. This module therefore focuses on drivers.

The evidence for impairment varies for different drugs, and the level of practical crash risk seems to vary similarly, even when there is clear evidence for forms of impairment in laboratory studies. Research on the effects of drugs on crash risk has many complexities, which are presented in Annex 4.

7.2. Evidence for harm to safety from alcohol and drugs

The harmful effects of alcohol are not open to sensible dispute. Laboratory studies have long demonstrated impairments to judgement and numerous skills *(1)*. Alcohol consumption has also been shown to impair driving, to greatly increase the risk of serious and fatal crashes in a systematic dose–response relationship *(2,3)*, and to increase both the risk and severity of crashes *(2)*. Drink–driving is a major contributor to crash death and injury in many countries *(4)*, including LMICs, with alcohol involved in more than one in three such deaths in some *(5)*. At social consumption levels, alcohol is more harmful to road safety than any other drug.

While more effective enforcement, for example through RBT, has reduced drink–driving, the proportion of crashes involving drivers intoxicated by psychoactive drugs is increasing in many countries *(6,7)*. Evidence indicates that many medications and recreational drugs impair driving and increase serious crash risk *(8,9)*. Nevertheless, the evidence on the impairing effects of drugs on driving and the benefits of drug–driving enforcement is complex, inconsistent, and difficult to present simply or interpret readily. For this reason, Annex 4 provides a brief summary of the evidence, while the conclusions drawn are listed here.

- Determining the crash risk potential of drugs is challenging for various reasons. These reasons guide and limit much of the coverage and recommended actions in this module.
- In many cases, when drugs are combined with each other or with alcohol, interactions can occur that increase the impairing effects of these substances.
- The lack of a clear dose–response relationship for impairment and cannabis, and the lack of evidence of such relationships for drugs more broadly, present challenges for setting legal concentration limits in drug laws.
- The evidence for cannabis is mixed, but suggests that low concentrations in habitual users presents limited increase in road-risk, but can cause driver impairment at higher concentrations in habitual users and at low concentrations in those who are not habitual users. In addition, a recent meta-analysis found no evidence for escalated risk due to interaction with alcohol. A reasonable speculation explaining the latter outcome is that cannabis creates greater relaxation and thus less aggressive and slower driving, and that this effect counters the mitigates the elevated crash risk created by alcohol impairment *(6)*. More information on cannabis is outlined in Annex 4.

This module concludes by listing cautious recommended actions in relation to cannabis.

7.3. Evidence-based RPE actions and best practice

The evidence and good practices described in Modules 2 and 3 apply for deterrence of drug- and alcohol-impaired driving. Box 5 provides a case study of adoption of these best practices to reduce drink–driving.

In addition, the suggestion that the law should treat driving as a privilege is especially important to the ability to require drivers to undergo random alcohol and drug testing. For example, the police in Canada cannot randomly test drivers but require grounds for suspicion of impaired driving. Research shows that police estimations of impairment were not reliable indicators for alcohol and were even poorer for drugs, especially cannabis and medications, which were missed by police in the vast majority of cases. These findings highlight further problems with requiring evidence or suspicion before blood or breath testing is allowed *(10)*.

Box 5. Case study of full use of all links in the chain to create general deterrence for drink–driving

In 1982, following a smaller-scale programme in the state of Victoria, the state of New South Wales, Australia was the first jurisdiction anywhere to introduce an extensive state-wide programme of RBT, which involves police stopping drivers randomly and requiring an alcohol breath test. The links in the deterrence chain (Module 2) were employed as follows.

Legislation allowed this process to be carried out without requiring any prior suspicion of impairment, and set a penalty for refusal to be tested equal to the penalty for the highest level of drink–driving.

The introduction of RBT was heavily publicized, including a mass-media campaign for weeks before the start date. This campaign was based on a survey of drivers prior to development and was enforcement-based, depicting police stopping drivers and a driver who was over the 0.05% BAC limit being arrested and charged with drink–driving. The campaign promoted the slogan: "Will you be under 0.05 or under arrest?" Over subsequent years of RBT, community surveys of attitudes and beliefs were conducted, which informed ongoing campaigns. For example, a survey the year after the launch of RBT revealed that some drivers believed that, because RBT was highly visible, they could avoid it by using quiet local streets. Based on this information, a campaign was launched showing that RBT had occurred and detected impaired drivers on quiet local streets.

As to enforcement, RBT was expansively and highly visibly conducted to help promote the perceived probability of detection. In association with the campaign on back streets, police practice was refined to increase RBT there. Police aim to conduct as many tests each year as there are licensed drivers in the state, and to conduct most RBT at times when drink–driving is likely (Friday and Saturday nights, etc.) to ensure a high perceived risk of detection.

Penalties increased with increasing BACs. Penalties are determined by a court and include large fines, lengthy periods of licence loss, and jail terms of up to 3 years for extreme or repeat offences.

Judicial and follow-up systems were fully involved. All drink–driving cases appear before a court to highlight the criminal nature of the offence. Follow-up includes issuing arrest warrants for failure to appear before the court as directed or to pay fines, and RBT includes checking for unlicensed driving, as well as for drink–driving itself.

As to the results, RBT led to dramatic reductions in fatal crashes involving illegal BACs and these reductions were improved in the long term, saving thousands of lives and preventing many more injuries.

Before RBT was implemented, many education-based campaigns had attempted and failed to improve drivers' attitudes, and reduce drink–driving, by stressing the risk of crashing and increasing social pressure. In contrast, the introduction of RBT and the associated campaigns, based entirely on enforcement risk, generated both increases in the belief

that RBT could not be avoided and dramatic reductions in drink–driving, clearly shown in annual surveys of drivers before and after RBT and in subsequent years of follow-up. The programme also changed attitudes, increasing disapproval of drink–driving. According to the results of surveys made before and after the introduction of the programme, after RBT was introduced, drivers were more likely to judge drink–drivers caught by police as criminals or potential murderers, and less likely to judge them as simply unlucky. enforcement does not preside among them.

Source: This case study is based on work by S. Job for the Government of New South Wales, Australia on the introduction of RBT, and two published evaluations conducted by Job, Prabhakar & Lee *(11)* and Job *(12)*.

7.3.1. Alcohol

The general recommended actions noted in Modules 2 and 3 stress the need to avoid presenting risky behaviour in its most extreme form, so it is better to call the problem drink–driving rather than drunk–driving. By inferring a more extreme level of behaviour the latter term invites three problems:

- a perception that it is safe to drive if a driver does not feel drunk, which people commonly misjudge when drinking;
- a view that impairment must be demonstrated through clear signs of drunkenness to charge a driver with an offence; and
- a false belief that driving is only impaired at when a driver is drunk.

7.3.1.1. RBT

As shown above, RBT has proved to be a powerful tool for stopping drink–driving, both saving lives and preventing injuries, and significantly increasing social disapproval of drink–driving *(13)*. In some countries where RBT has been optional change may be possible. In Brazil, for example, the Supreme Court determined that mandatory RBT was constitutional, with the value of RBT far outweighing the civil liberty concerns raised (see Box 2).

Drink–driving in most countries is concentrated on certain days and times. These should be established from data for the country and most RBT should occur then. High numbers of tests are required, along with publicity on the numbers of tests, to achieve strong deterrence. For example, best practice in some jurisdictions is that the number of tests conducted each year should equal the number of licensed drivers (see Box 5).

As with other areas of enforcement, best practice in RBT should be highly publicized in the media, and comprises a mixture of highly visible and covert enforcement: for example, setting up highly visible RBT checkpoints that change location regularly to ensure unpredictability, and enabling all police patrol vehicles to conduct RBT anywhere, anytime. To ensure unavoidability, RBT checkpoints must be located carefully, so that drivers cannot avoid testing by turning off the road once they see one. This can be achieved by:

- locating RBT checkpoints where there are no side streets or available turns from the point where the checkpoint is visible until it is reached;
- temporarily closing relevant side streets and turns during RBT enforcement; or
- placing police along relevant side streets to test drivers who turn to evade a checkpoint.

The general recommended actions on random checks in Module 4 are applicable here.

7.3.1.2. Detection methods in enforcement

Two methods of detecting drink–driving are in use:

- field sobriety tests, in which drivers are required to perform certain tasks for police to judge their level of impairment, if any; and
- breath testing of BACs.

Best practice in breath testing is that the initial test screens drivers for further testing, and those apparently over the limit are then subjected to a further high-accuracy test of breath alcohol. Alcohol concentration in breath has a close relationship with BAC, which forms the basis of the evidence for charges laid. Breath testing is used in RBT and (based on laws based on a BAC limit) is best practice for several reasons.

- Field sobriety tests are somewhat subjective and not highly reliable, while breath test results are reliable.
- In order to allow predictability for the community, laws set in terms of a BAC limit provide a reasonable estimate of the amount of alcohol that a person can consume in a given time and still remain below the legal limit, although this varies with the person's size and other characteristics. This information should be provided and publicized to the public.
- Owing to driver overconfidence, people tend to think they are safe when they are not, as shown by driver optimism bias after drinking alcohol. This means that most drivers believe that they perform better than average drivers after consuming alcohol *(12)*. This overconfidence also means that drivers are likely to misjudge their ability to pass a sobriety test; this means that they perceive the probability of detection as low, greatly damaging general deterrence.
- Drivers who exceed a reasonable BAC limit, such as 0.02 g per 100 mL blood or even a higher limit such as 0.05 g per 100 mL blood, and are impaired can still pass a sobriety test.

7.3.1.3. Enforcement settings: BAC

Alcohol impairs driving at all concentrations, so significant serious crash reductions were recorded when BAC limits were lowered from 0.08 g per 100 mL blood to 0.05 g per 100 mL blood *(14)*. Best practice is now a BAC limit of 0.02 g per 100 mL blood or lower, which is in use in many countries. In practical terms, this represents a delivery of close to best approach: a zero-tolerance approach to drink–driving *(4)*.

Commonly, simplistic analyses of the benefit of lowering the BAC limit focus on the numbers of deaths and injuries involving drivers with a BAC reading between the current limit, such as 0.05 g per 100 mL blood, and the proposed new limit, such as 0.02 g per 100 mL blood. This greatly underestimates the benefits to be gained, because lowering the BAC limit reduces the level at which potential drivers decide whether to drive. Alcohol impairs this decision because it impairs cognitive functioning even at low BACs. Thus, where the legal BAC limit is lower, drivers commonly make the decision about whether to drive after drinking with less alcohol-impaired judgement and less alcohol-induced risk-taking. In this way, lowering the BAC limit reduces drink–driving by drivers who decide to continue drinking and then drive while already impaired.

Experience with lowering BAC limits directly supports this conclusion. When the Australian Capital Territory reduced the BAC limit from 0.08 g per 100 mL blood to 0.05 g per 100 mL blood, RBT showed a 34% reduction in the number of drivers with a high BAC (0.15–0.20 g per 100 mL blood), and a 58% reduction in the number with an extreme BAC (above 0.20 g per 100 mL blood).

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Well beyond just affecting the low range of drink–drivers, these results support the logic that lowering BAC limits reduces misjudgement and risk-taking decisions made under the influence of alcohol *(15)*.

While a BAC limit of 0.02 g per 100 mL blood or lower is best practice, a compromise used in some countries involves setting a general limit of 0.05 g per 100 mL blood and a lower limit (zero or 0.02 g per 100 mL blood) for particular groups, such as learners, novice drivers, and drivers of buses and heavy vehicles. If the prevailing limit cannot be changed in the current climate, extending the application of the special limit to more drivers is desirable, in addition to running promotional campaigns aiming to reduce the general BAC limit in the future. One example would be to set the lower limit for all drivers with fewer than 4 years of driving experience, on the basis that alcohol is more impairing for less well-practiced behaviours.

7.3.1.4. Alcohol ignition interlocks

An alcohol ignition interlock is a device fitted to a vehicle that requires that the driver to provide a breath sample, showing the absence of alcohol in their system, before the vehicle will start. Over years of development, these devices have been improved to avoid drivers cheating the test; the device is able to detect the pressure of human lips so that air cannot be pumped in to pass the test, and it can require further tests during a journey to prevent the driver from having someone else blow air into the device.

For some years, alcohol interlocks have been shown to be effective in reducing drink–driving and related crashes by drivers with such devices fitted to their vehicles, and are recommended *(4,16)*. The following points note best practice and its rationale for alcohol interlocks.

- Interlocks can be installed in commercial vehicles to ensure that drivers do not engage in drink–driving. This can include passive detection of alcohol rather than requiring a breath sample. This policy is well accepted where it has been implemented *(16)*.
- Interlocks have been proved to be effective while the they are in place, but do not produce strong long-term effects on drivers, who tend to return to drink–driving once

the devices are removed. For this reason, programmes in which interlocks are fitted for a long period are more desirable, along with a test showing no alcohol dependence as a condition for removal. Such biological tests are available *(17)*.

- Interlock programmes should be combined with interventions for alcohol dependence.
- Maximizing the number of convicted drink–drivers whose cars are fitted with interlocks increases the value of such programmes.

Interlocks are relevant to RPE, because they require enforcement of the condition to drive with an interlock to avoid being banned from driving. Enforcement can be arranged by:

- marking the driver's licence with the requirement that the driver is only allowed to drive a vehicle with a working interlock;
- ensuring that police licence checks include checking the licence for this condition and the vehicle for the presence of an interlock; and
- monitoring of regular calibration of the interlock.

7.3.1.5. Setting penalties

Best-practice features of penalties include:

- grading penalties to BAC levels;
- including loss of licence at the roadside for all levels of drink–driving;
- including the required use of alcohol interlocks; and
- including medical/clinical interventions for alcohol dependence, which afflicts many drink–drivers.

As to alcohol dependence, even mailed correspondence interventions are known to be effective *(18)*. Ensuring that such interventions are applied requires systematic coordination between enforcement, judicial and health departments.

7.3.1.6. Other interventions supported by enforcement

Other policy interventions are known to be effective and require enforcement of good practice; this list is based on the work of Howard et al. *(11)*.

- Increasing the cost of alcohol via minimum pricing or via taxation reduces consumption, and there is some evidence for its effectiveness in reducing road deaths.
- Higher densities of alcohol outlets and longer hours of sales are associated with higher levels of consumption and harm, including drink–driving. The regulation of alcohol sales can address this but must be enforced to be effective.
- Responsible service by venues licensed to sell alcohol is most likely to be effective when combined with the enforcement of liquor licensing laws. The key problem with responsible service is not servers' lack of skill, but their lack of motivation to refuse service, which reduces sales and may alienate customers *(19)*. Training in responsible service is associated with only small reductions in relevant crashes *(20)*. Enforcement motivates increased compliance by alcohol sales venues.

Research from the United States of America indicates that setting the minimum drinking age at 21 years is effective in preventing risky alcohol consumption and drink–driving by young people.

7.3.2. Drugs

This section outlines the suggested approach to drug–driving and its rationale.

- Drug–driving contributes significantly to serious crashes in many countries, yet enforcement remains a challenging area for management and funding due to the costs of drug tests.
- RDT is in use for illegal drugs – cannabis, 3,4-methylenedioxymethamphetamine (also known as "MDMA") or ecstasy, and methamphetamines such as speed – in some jurisdictions, and evaluations have been reported. Despite core consistency with deterrence principles, as well as parallels with highly effective RBT for alcohol, the evidence for safety benefits arising from RDT is weak (see Annex 4). This may arise for several reasons.
  - The number of tests being conducted is insufficient to create an effective perceived likelihood of detection. For example, in Australia, the numbers of drug tests typically amount to less than 5% of the number of alcohol tests per year. Surveys of drivers indicate weak deterrence *(21)* and only small self-reported reductions in drug–driving among drug users with the introduction of random testing *(22)*.
  - Those using the drugs being tested for, which are illegal in the countries concerned, are already willing to act outside the law, indicating that overall they may be a more difficult group to influence via the law. Consistent with this, drug use is predicted by defiance and deviance personality constructs *(23)*.
- The benefits of drug testing may possibly arise through specific deterrence, not general deterrence, but this may depend on having effective consequences for offenders, including evidence-based treatment for drug dependence. In addition, personal experience with drug testing improves deterrence, more directly supporting a specific deterrent effect (21), although this finding is not consistent *(22)*.

7.3.2.1. Detection methods and enforcement

For similar reasons to those noted above for alcohol, enforcement is most effectively conducted though measurement of drug presence or a proscribed level of drug presence, if sound feasible testing is developed, not sobriety testing. In addition, sobriety testing provides poor validity for cannabis *(24–26)*. A zero-tolerance approach to any presence of illegal drugs seems justified, except for cannabis, for which the evidence suggests minimal (if any) impairment at low levels (see Annex 4).

Publicity can correct misinformation on enforcement. Some drugs, especially including various inactive metabolites of cannabis, can remain in the blood for extended periods after use and after any impairment has ended. However, drug tests seek only active delta-9-tetrahydrocannabinol (THC), so roadside drug screening does not detect cannabis use beyond when active, potentially impairing THC is present.

Dose–response or, more directly, concentration–response relationships are proving more difficult to determine for drugs than for alcohol, and misleading, poor-quality research has exacerbated this difficulty (see Annex 4). Concentration–response relationships remain a possible way forwards to identify appropriate enforcement levels for some drugs, especially cannabis, for which a presence-only offence is difficult to justify unless drug–driving enforcement is seen as enforcement in cases where the drug is illegal.

7.3.2.2. Setting penalties

Good-practice principles suggest that penalties should include the following characteristics.

- Penalties should be graded to the level of the drug present, and include higher penalties for multiple impairing drugs and for drugs combined with alcohol. However, according to the evidence (see Annex 4), a higher penalty for the particular combination of cannabis and alcohol is less justified.
- Penalties for all drug–driving offences should include loss of licence.
- Many drug–drivers are drug-dependent so penalties should include treatment. As with alcohol, this requires systematic coordination between enforcement, judicial and health departments.

7.3 Contributions through driver management by the private sector

The private sector can contribute significantly to the management of the risk of drink– and drug–driving. Companies can manage and randomly test employee drivers for alcohol and drugs, with strong management of any cases identified, including appropriately refined adoption of many of the recommended actions below.

7.4 Summary

This module discusses the substantially increased crash risk caused by impairment resulting from the consumption of alcohol, drugs or both. It describes the compelling evidence for the value of RBT, with less compelling evidence available for RDT, and highlights the importance of good practices, notably including treating drink– and drug–drivers for substance dependence.

Recommended action 7.1: The general recommended actions in Modules 3 and 4 should be applied to drink– and drug–driving enforcement.

Recommended action 7.2: RBT or probable-cause-based breath testing should be used for enforcement purposes over field sobriety testing for drink– and drug–driving.

7.5.1. Recommended actions on drink–driving

Recommended action 7.3: Laws on drink–driving should be strongly enforced because this is highly effective. An analysis rated compulsory RBT at small and large checkpoints as among the most effective activities for police *(27)*.

Recommended action 7.4: The many good practices for managing drink–driving described in Section 7.3 should be adopted. These include: carrying out and publicizing RBT, breath testing of BACs and lowering BAC limits; fitting alcohol ignition interlocks on the vehicles of commercial

drivers and drivers convicted of drink–driving; and setting penalties that are graded and include treatment for alcohol dependence.

7.5.2. Recommended actions on drug–driving

Recommended action 7.5: As drug testing is dramatically more costly per screening test than alcohol testing and many fewer drug tests are conducted, it should be carefully targeted by day, time and location to maximize its effect. Even then, the number of tests may not be sufficient for effective general deterrence.

Recommended action 7.6: A well-researched, evidence-based approach should be taken to imposing consequences for drug–driving offences, to ensure that it maximizes specific deterrence effects and includes treatment for drug dependence.

Recommended action 7.7: In countries where both alcohol and drugs pose problems for road safety, policing resources should not be diverted from RBT, which is clearly effective (28), to drug testing, which may not be effective and is certainly less effective than RBT.

Recommended action 7.8: A zero-tolerance approach should be taken to illegal drugs; it is logistically much simpler and likely to produce more deterrence value. However, cannabis should be considered separately.

Recommended action 7.9: Research should focus on behaviour change for drug users, rather than treating this group as similar to others who are influenced by deterrence.

Recommended action 7.10: Some drugs exacerbate the impairing effects of alcohol, so stronger penalties should be applied for using them in combination with alcohol.

7.5.3. Cannabis-impaired driving

Conclusion 7.1: While it is important to appreciate that drivers who are not habitual users of cannabis are not tolerant to the effects of THC, and suffer more impairment from cannabis use, this appreciation is not readily translated into law.

Recommended action 7.11: Overall, there is evidence of a concentration–effect relationship: higher concentrations of THC produce more impairing effects; as a result, enforcement should focus on a concentration threshold above zero, especially where cannabis is legal for medical purposes and/or recreational use. Detailed analyses of evidence should be made and suitable testing developed to achieve this. Until this is done, a zero-tolerance approach should be supported.

Recommended action 7.12: THC has little to no exacerbation effect on the impairing effects of alcohol, so the penalties for combined use of alcohol and cannabis should not be much higher than those for other drugs. This is due in part to cannabis reducing the tendency towards speeding, a particularly high-risk behaviour.

Recommended action 7.13: The evidence suggests that legalizing cannabis use causes an increase in cannabis-related fatal crashes, which should be carefully considered along with how this risk can be managed with evidence-based interventions, including intensive enforcement.

Recommended action 7.14: Sobriety testing has poor validity for THC *(25,26)*, so it should not be used in enforcement.

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MODULE 8

Deterring fatigued driving

8.1. Introduction

Fatigue impairs driving and is well recognized as a significant contributor to serious crashes, despite the concerning issues with quantifying the presence of fatigue in crashes *(1)*. The management of fatigue is a tale with two parts: regulation and enforcement of drivers of commercial and heavy vehicles; and enforcement of fatigue in drivers of light vehicles and motorcycles.

8.2. Evidence-based RPE actions and good practice

Definitive evidence for the effectiveness of fatigue regulations and enforcement is not available, in part due to the difficulty of measuring driver fatigue in crashes. In contrast, best practice based on the known effects of fatigue on human performance exists for commercial and heavy vehicle drivers.

8.2.1. Commercial and heavy vehicle drivers

Many countries have set regulations on the hours that commercial vehicle drivers, such as drivers of buses and lorries, are allowed to work or drive, as well as explicit requirements for rest times and days of no work (Fig. 8). Good practice is allowing fewer hours for shiftwork and nighttime driving than for daytime driving, and limiting changes between day and night work. Assessment of impairment is not recommended as a means of assessing fatigue.

Enforcement opportunities are not simple but several exist, including the following.

- Drivers can be required to carry (ideally, electronic) logbooks of driving and work hours for inspection by police and specialist heavy vehicle inspection officers, who may check for fatigued driving via records of hours and rest.
- GPS or cameras that record heavy vehicles' locations with time stamps can be used for continuous monitoring of their movements, for verification against driver logbooks. These data are available to enforcement officers for a given vehicle and at checking stations.
- The records of commercial transport companies can be reviewed.
- Strong penalties can be imposed on transport companies for inadequate management of driver fatigue, and on drivers for breaches of driving and work limits.

Fig. 8. Infographic from the European Labour Authority of the European Commission on maximum legal driving times for commercial drivers

Reprinted with permission *(3)*.

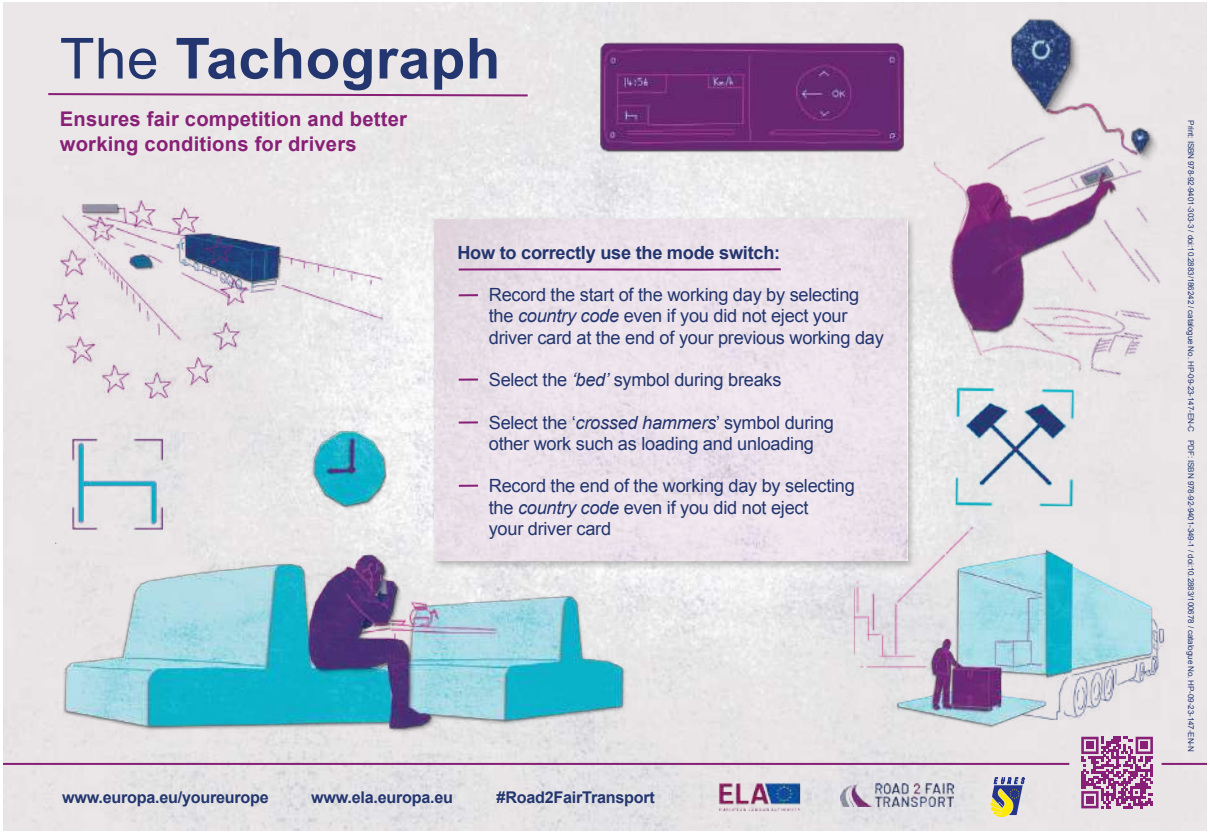
Even with these opportunities, an assessment rated the enforcement of commercial driver fatigue as only a moderately effective police activity, in contrast to the many activities related to speeding, alcohol and restraint use, which were rated as highly effective *(2)*.

Good-practice suggestions include the following:

- making maximum use of technological opportunities to track vehicles and drivers, including smart driver's licences that are connected with vehicles when driven (Fig. 9);
- for heavy vehicles, combining fatigue enforcement with weight and safety checking at both permanent and mobile checking stations; and
- ensuring that communications refer to the problem as fatigued driving.

Terms such as "driving sleepy" or "falling asleep" should be avoided because they set the bar for the problem too high. Drivers who feel tired should stop and rest, but such people may not feel sleepy or that they are about to fall asleep, so using such terms may send an unhelpful message.

Fig. 9. Infographic from the European Labour Authority of the European Commission on enforcement tachographs, required for all commercial vehicles over 3.5 tons



Reprinted with permission *(4)*.

In addition, the private sector has a major role to play in this arena though rostering of driver shifts and hours, and setting expectations of the times required for journeys. Sound fatigue management can be enforced. In some countries, directors of companies face major penalties for failing to manage workplace health and safety effectively. In some cases, crashes due to fatigue and subsequent investigations of company practices have resulted in company directors being sentenced to long jail terms.

8.2.2. Light vehicle drivers and motorcycle riders

While enforcement is most feasible for professional drivers, some jurisdictions have attempted to set criteria to allow enforcement for most motorists. These have employed extreme definitions of fatigue to allow strong enforcement, such as being awake for 24 h. However, this sends a clearly harmful and misleading message to the community: that driving after 23 h awake is legal and may be seen as sanctioned in law. This is another example of normalizing excessive risk behaviour and is not recommended.

Assessments by New Zealand Police rated police patrols for fatigued driving by nonprofessional drivers as being of unknown effectiveness or having limited impact *(2)*. They are not a productive use of RPE time and resources.

Regulating and enforcing the role of the private sector in managing fatigue for employees who drive light vehicles comprises an area of potential value.

8.3. Making the right behaviour easier

A countermeasure for driver fatigue is to make it easier and more pleasant for drivers to stop and take breaks. Good practice includes establishing rest areas for drivers of heavy and light vehicles along major routes, which should:

- be designed for safe entry and exit;
- be well signposted for several kilometres in advance and provide information on the distance to the next rest opportunity, to allow drivers time to consider and plan their stops;
- include toilet facilities, and play equipment for children in some rest areas on holiday routes; and
- separate the rest areas for light and heavy vehicles, to allow drivers of the latter to sleep without being disturbed by the noise of families and the constant movement of light vehicles.

8.4. Summary, conclusion and recommended actions

Significant opportunities exist for the management of fatigue in drivers of commercial and heavy vehicles, including strong RPE activities, although existing management opportunities are not as strong for light vehicle and motorcycle drivers.

Conclusion 8.1: In response to the difficulties of determining effective RPE activities for fatigued drivers of light vehicles, there is a tendency to resort to education. This has not been proved to be effective, and facilitating safe behaviour through providing incentives to stop, pleasant rest areas along major highways and reminder signs along roads may be more effective.

Recommended action 8.1: The general recommended actions in Modules 3 and 4 should be applied to deter fatigued driving.

Recommended action 8.2: The problem should be called fatigued driving, not sleepy driving or falling asleep.

Recommended action 8.3: The suggested good practices listed in Section 8.2 for drivers of commercial and light vehicles should be adopted. These include regulating and enforcing the role of the private sector in managing fatigue for employee drivers.

Recommended action 8.4: Legislation should not be passed to prohibit driving for long periods by light vehicle drivers, because such laws usually set a limit of too many hours in order to ensure that fatigue exists. Such laws send the wrong message about the hours of driving that are safe and are challenging to enforce.

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MODULE
9

Deterring distracted driving

9.1 Introduction

Distraction in drivers and other road users contributes to serious crashes. The research making this point most effectively covers mobile telephone use as a risk factor, including a case–control study *(1)*. Distraction can cause impairment in drivers through them having their eyes off the road, their hands off the wheel or their minds off the driving task, and pedestrians through talking on their telephones and thus not listening to or focusing on traffic. The increasing use of mobile telephones or in-car screens for navigation purposes further complicates the situation.

Deeper problems exist in determining the extent of the contribution of distraction to serious crashes, because claims about this contribution are sometimes exaggerated and, importantly, include all forms of distraction, not just mobile telephone use. Thus, some data on the role of distraction in crashes do not represent the contribution of mobile telephones, which is much smaller. However, because the vast majority of enforcement on distraction focuses on mobile telephone use, specifically considering its contribution to crashes is appropriate.

In addition, based on evidence linking distraction to increased crash risk *(2)*, some countries with high road safety standards regulate the use of advertising signage visible from roads. These regulations may include limiting electronic signage to forbid the use of moving images or to set dwell times (how long an image is shown before it changes to another) because image changes can act like movement and be more distracting. This also requires enforcement of the companies that install signage.

9.2 Making the right behaviour easier

Opportunities exist for making the right, undistracted behaviour easier.

- Limiting the presence of distracting advertising signage helps drivers to avoid being distracted by advertising.
- Vehicle technology that allows for the most automatic connection of mobile telephones to cars, and thus hands-free use, minimizes the worst uses of telephones. Thus, facilitating the increased adoption of such technology may be helpful. Nevertheless, the use of both hands-free and handheld telephones may cause cognitive distraction. There is no evidence for hands-free mobile use being much safer and there is evidence suggesting that both cause distraction *(3)*. Thus, laws banning only handheld telephone use are not well justified, except in terms of enforceability.
- Many mobile telephones have a driving mode that prevents distracting notifications of calls and messages. Using this may also be helpful.
- Proposals to include technology in vehicles that blocks mobile telephone use may be unrealistic because of the challenges of blocking telephone use by passengers and relying on market forces to introduce safety into vehicles. These issues in general act as barriers to real safety improvements in vehicles, such as intelligent speed limiting and passive alcohol interlocks.

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9.3 Evidence-based RPE actions and good practice

Laws on distraction and enforcement in many countries include the possibility of enforcing various common forms of distraction caused by mobile telephone use, eating and drinking, etc. *(4)*. As almost all data and evidence focus on mobile telephone use, this remains the focus of this module.

Evidence suggests that enforcement deters mobile telephone use. A systematic review of evaluations indicates "weak and somewhat inconsistent" effects, but indicates a decrease in the prevalence of telephone use and fatalities overall *(5)*. Limitations of benefits include the difficulty of detection at night or in cars with tinted windows, concealment of telephones while in use and a significant number of infringement notices being challenged in court *(6)*. Telephone use enforcement is usually considered easy to evade, and such beliefs significantly predict engagement in both concealing telephone use and reading of messages while driving *(7)*. Studies employing in-depth driver video recordings show that telephone concealment in Australia, which has mobile telephone enforcement, is common *(4)*. This highlights the importance of increasing drivers' certainty of apprehension, for example, via the implementation of camera enforcement.

Thus, enforcement is supported by evidence but can be improved. Good practice includes a mixture of high-visibility and covert enforcement, and the use of mobile telephone detection cameras (Box 6 and Table 4 outline a successful example) with enforcement and strong penalties publicized to the public for several weeks before changes are implemented (see Module 3) (see accompanying photograph). As in road safety in general, there is no sound evidence for education on distraction and mobile telephone use having benefits on crash risks.

Box 6. Case study: the Mobile Phone Detection Camera Programme in New South Wales, Australia

The New South Wales Mobile Phone Detection Camera Programme began operating in December 2019. For the first 3 months, drivers caught using their telephones illegally were issued a warning letter to encourage them to change their behaviour. Enforcement of illegal telephone use detected by the cameras commenced in March 2020. Across the state, 47 cameras operate, including fixed cameras and trailer-mounted mobile cameras that are frequently moved between enforcement sites. In the first 3 years, the Programme conducted around 260 million vehicle checks. Mobile telephone enforcement is promoted to the community (see photograph below).

Campaign poster reprinted with permission.

The programme aims to achieve general deterrence of illegal mobile telephone use based on best-practice evidence to complement on-road policing, and seeks to reach close to 100% of the state's driving population through a mixture of metropolitan and regional camera deployments. Independent modelling has estimated that the Programme would contribute to a reduction in road trauma of approximately 100 fatal and serious-injury crashes over 5 years.

The Programme uses high-definition cameras and an infrared flash to capture images of the front-row cabin space of passing vehicles in all traffic and weather conditions. The artificial intelligence software used to detect potential offences is a screening tool only; it automatically reviews images and detects potential offending drivers while excluding images of other drivers from further action. If a possible offence is detected, human review and adjudication occur before a fine is issued. Images rejected by the artificial intelligence are typically permanently deleted within 1 h of detection.

Each year in New South Wales, around 29 drivers and passengers are killed, and around 79 seriously injured, in crashes when not wearing available seat belts. Pilot testing undertaken in November 2022 showed that the existing cameras can also be used to detect seat belt offences.

The Programme has been successful in reducing illegal mobile telephone use. The infringement rate has decreased each year since enforcement commenced (see Table 4). Since enforcement commenced, around one in every 522 drivers checked by Programme cameras has been caught illegally using a mobile telephone and given a fine.

Sources: Information and text provided by the New South Wales Centre for Road Safety, Transport for New South Wales, Sydney; the work of Stephan, Stephens & Newstead *(8)*; and the *NSW Automated Enforcement Strategy for road safety (9)*.

Table 4. Number of vehicles checked, fines issued and infringement rates for camera-detected mobile telephone offences in New South Wales

Time	Vehicles checked	Fines issued	Infringement rate (%)	Vehicle checks for each offence detection
Pilot period (non-enforcing) 7 January–7 April 2019 and 27 April–10 June 2019	8 512 659	0 fines, 103 883 likely offences	1.22	82
1 March 2020–28 February 2021	76 919 156	169 311	0.22	454
1 March 2021–28 February 2022	83 536 289	159 011	0.19	525
1 March 2022–28 February 2023	121 937 861	203 978	0.17	597

Source: The New South Wales Centre for Road Safety, Transport for New South Wales, Sydney

9.4. Summary and recommended actions

This module considers the risks and challenges in managing distracted road use, with evidence and enforcement focused on driving. While distracted driving has a broader meaning and data applying it can indicate a larger contribution to crashes, most interventions focus on distraction from mobile telephone use. The evidence indicates that the application of good deterrence practices can significantly reduce mobile telephone use in vehicles on the road.

Recommended action 9.1: The general recommended actions in Modules 3 and 4 should be applied to distraction from mobile telephone use.

Recommended action 9.2: The evidence indicates that police enforcement of mobile telephone use is not as efficacious as enforcement of speeding or drink–driving, so police resources should not be dedicated to this issue in particular. Instead, enforcement of telephone use should be part of general on-road monitoring and enforcement.

Recommended action 9.3: Mobile cameras should be used to detect telephone use and seat belt offences. This can reduce the perception that drivers can hide their telephones to avoid enforcement, which in turn significantly reduces telephone use by drivers where the cameras operate.

Recommended action 9.4: Policies and regulations on vehicle import and manufacturing should be used to facilitate increased access to and use of hands-free telephones.

Recommended action 9.5: Evaluations of interventions to stop handheld telephone use should consider whether increased access to technology allowing hands-free telephone use may act as a confounding factor.

Recommended action 9.6: To reduce distraction, regulations on electronic advertising signage in view of drivers should limit the amount of movement (including regular image changes) in the advertising. Suitable processes should be adopted to approve advertising signage and regulations should be enforced.

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MODULE
10

Deterring failure to give way or obey signage

10.1. Introduction

Failure to give way to pedestrians and vehicles, and to obey stop or give-way signs and traffic light signals, is a major contributor to crash trauma and death. However, it is important to consider the management of this failure in a broader context than just these specific factors, because other risky behaviours often precipitate the failure to give way. Nevertheless, more can be done to encourage giving way, including through good-practice deterrence.

In every country, large numbers of crashes occur when a driver fails to stop or give way to a pedestrian, vehicle or cyclist. This makes intersections the highest-risk locations for crashes. Several points of interpretation are important in analysing these.

First, simply recording such crashes as resulting from a failure to give way, as many crash data systems do, can be misleading as a point of focus, because it commonly reflects the absence of more critical information on underlying factors. While crash investigations may find this critical information almost impossible to collect in some cases, detailed investigations can reveal the underlying factors. These can include speeding and impairment due to fatigue, drink– or drug–driving, or distraction. Focusing on managing these underlying causes is critical.

Second, in other failure-to-give-way crashes, the road delineation is not sufficient to inform drivers that they are approaching an intersection at which they must give way. Addressing this is also important, and police should ideally check for this factor in crash reporting.

Third, for pedestrian crashes in particular, culpability is often not accurately determined and victim blaming is systematically entrenched *(1)*. Blaming those involved in crashes, rather than the road system and especially the speeds allowed, sustains the old-school focus on road users' behaviour, rather than on adopting safe system principles to address the problem. Victim blaming is well recognized as a problem in road safety *(2,3)*, and for pedestrians in particular *(1,4)*.

Two factors exacerbate the tendency towards victim blaming for pedestrian crashes: flawed crash data and victim-directed advice. First, determining fault in pedestrian crashes is particularly difficult for police, which results in systematic bias towards finding the pedestrian at fault, including in crash data systems. As discussed in Module 5 on speeding, police face an unenviable task in investigating serious pedestrian crashes if there are no uninvolved witnesses. Often, the pedestrian is unable to provide their account of events, while the driver can provide an account and is likely to blame the pedestrian. While police may doubt the driver's account, proving it false is deeply challenging, especially in countries that do not undertake detailed crash investigation or reconstruction. Without such an investigation, which may uncover factors such as speeding, the driver is unlikely to be charged with an offence *(1,5)*. Crash reconstructions are rare in LMICs. In these circumstances, pedestrian crash victims are systematically more likely to be seen as being at fault.

Crash data then invite a second problem: once pedestrians are seen as mostly at fault, there is a tendency to fix on them in seeking solutions, which promotes working on what pedestrians should do as the primary solution. For example, the portion of the website of the National Highway Traffic Safety Administration in the United States of America that focuses on pedestrian safety starts with tips for pedestrians on how to be safe and then tells drivers how to drive safely for pedestrians, but does not include tips on advocating or delivering systemic change, safe pedestrian amenities or lower speed limits *(6)*. The National Safety Council website takes a similarly doubtful approach *(7)*. Messages that promote behaviour change of no known value are deeply counterproductive

to a safe system approach to pedestrian safety, and promote views that facilitate obfuscation of responsibility for providing a safe road system *(1)*.

Finally, questionnaire studies show that both drivers and pedestrians misunderstand the rules on the right of way for vehicles turning at signals, and various types of pedestrian facilities such as refuges. In many situations, over 20% of both drivers and pedestrians reported that they would take the right of way, inviting conflict and crashes *(8)*.

10.2. Making the right behaviour easier

Clear vertical and horizontal signage – including stop lines, signals, and signs that are well maintained and well located for visibility – can facilitate giving way. In addition, lower speeds have been shown to increase the frequency at which drivers give way to pedestrians at pedestrian crossings *(9)*. Thus, lower speeds directly facilitate drivers giving way to pedestrians when required by law, noting that speeding drivers commonly ignore the law.

10.3. Evidence-based RPE actions and good practice

Obedience to laws that require drivers to give way can be enforced for improved deterrence and compliance. The fact that pedestrians are not required to carry or present identification creates challenges in enforcing laws that require them to obey a signal not to cross the road. A review of police on-road activities rated the enforcement of stop and give-way violations as being of medium effectiveness *(10)*. Such enforcement should form part of broader patrolling activities, and comprise a mixture of overt and covert measures.

For a consideration of failure to stop at signalized intersections and crossings, see the section on running red lights in Module 5.

10.4. Summary

Failure to give way contributes significantly to road crash deaths and injuries. It can be addressed by making the required behaviour easier, reducing travel speeds and deterring the failure to give way.

Recommended action 10.1: The general recommended actions in Modules 3 and 4 should be applied to the enforcement of giving way.

Recommended action 10.2: In view of the finding that the policing of failure to give way is a much less effective use of resources than other types of enforcement, enforcement of giving way should not divert significant police time from more effective activities.

Recommended action 10.3: Speed limits should be reduced to increase drivers giving way to pedestrians on crossings, as research shows that this is effective.

Recommended action 10.4: Road delineation should be improved to help prevent failure-to-give-way crashes by ensuring that drivers know when they are approaching an intersection at which they must give way. Police should ideally consider road delineation in crash reporting.

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MODULE
11

Deterring use of unregistered and unsafe vehicles

11.1. Introduction

Vehicle safety involves multiple elements, which are briefly covered here to identify the value of relevant regulation and enforcement. Modern vehicle technology for safety includes so-called passive safety features, such as airbags, seat belts with pretensioners and features in the front of the vehicle that reduce pedestrian harm in the event of a collision with a pedestrian. As shown in Module 6, passive safety features save many lives. Active safety features include autonomous emergency braking, which reduces the risk of a crash occurring and/or reduce impact speed in the event of a crash *(1)*; lane departure warnings; and active stability control, which has been shown to be effective in saving lives and preventing injuries, including in LMICs *(2)*. Active travel speed control also delivers substantial safety benefits. ISA is especially effective if it controls speed rather than simply advising drivers that they are speeding *(3)*.

Unsafe and unregistered vehicles, including illegally imported or rebirthed vehicles, contribute to road crash deaths and injuries. Vehicles that are not fitted with the above-mentioned safety technology, or in which it does not work, add to death and injury risk. The enforcement of effective laws on vehicle safety to create deterrence is a key element of managing these risk factors. In addition, safety can be promoted into market forces and customer vehicle choices through programmes such as the New Car Assessment Programme *(4)*. Three spheres of checking and enforcement are involved in the effective management of vehicle safety:

- regulation and checking at the point of import or manufacture
- inspection of vehicles for continued registration for access to public roads
- on-road checking of vehicle registration and roadworthiness.

This module considers all three. A possible fourth sphere involves the regulation and limitation of vehicle advertising, to limit the depiction of illegal, risky behaviours and the irresponsible promotion of speed and risk-taking. This exists in few countries, and where such controls exist, as in Australia, they operate through industry self-regulation, which severely reduces their efficacy.

Heavy vehicles and carriage of dangerous goods also present additional risks to be managed with enforcement being part of the solution. These are briefly covered here.

11.2. Evidence-based RPE actions and good practice

11.2.1. Regulation and checking at the point of approval for import or manufacture

In general, regulations – standards or design rules – specify the features and standards that a vehicle must have to be imported into or made in a country, and sold there. Safety requirements for vehicles vary greatly around the world but are critical. Only through regulation can countries ensure that the vehicles driven on their roads are improving in safety.

In many HICs, these requirements are detailed and extensive, covering many aspects of safety. However, in some LICs the requirements are more limited. For instance, some LICs

import secondhand vehicles with the only stipulation being an age limit, such as 5 years. Such requirements can be ineffective for safety because some new vehicles with poor safety still exist – some receiving zero stars for safety in global New Car Assessment Programme safety testing – and can be imported.

Additional risks arise from illegal imports and rebirthing of vehicles: using repair to make an excessively damaged vehicle, or even two vehicles, into a vehicle that is operational but inherently unsafe.

Vehicle standards/requirements must be enforced for both new and imported vehicles. Good practice involves the inspection of vehicles, and destructive testing of sample vehicles in some cases, before the relevant model is approved. As the cheating of vehicle emissions standards *(5)* demonstrates, rigorous enforcement, rather than trusting the vehicle industry to regulate itself, is required.

11.2.2. Inspection of vehicles for continued registration for access to public roads

Ensuring that vehicles have suitable safety features at the point of manufacture or import is not sufficient: these features must be maintained in suitable working condition. This includes every feature, from the sophisticated technologies to the basic safety features: lights, brakes, tyres, seat belts, etc. Enforcement of the maintenance of vehicles is achieved through inspections of vehicle roadworthiness, which may be required at set intervals, such as annually, in relation to re-registration of vehicles. The safety value of vehicle inspections depends on the features that are inspected, the rigour of the inspection and the rigour of the application of unavoidable requirements to rectify problems identified.

Some studies in HICs have indicated the safety value of vehicle inspections but found that, with short periods between inspections, they are not cost–effective. For example, analysis for New Zealand indicated that requiring inspections every 6 months was too often *(6)*. Thus, longer periods between inspections may be warranted, especially for new cars. However, given that car owners in HICs have more funds to spend on vehicle maintenance than those in LMICs, these findings may have limited applicability in the latter.

Most countries operate vehicle inspection schemes by licensing private sector operators to conduct the inspections, often with some – for heavy vehicles or vehicles left unregistered for some prior period – undertaken by government agents. These important processes are vulnerable to corruption in many countries. Irregular on-road checks provide some management of this risk. Digitization of inspections can also be used as an avenue to reduce corruption within inspection systems, and more suggestions for good practice are provided by the assessment of vehicle inspection systems *(7)*.

11.2.3. On-road checking of vehicle registration and roadworthiness

On-road patrols and enforcement can check that the vehicle is registered, in support of the above processes, and may also include enforcement of visible faults – such as non-functioning turn signal lights or headlights or bald tyres, a common vehicle fault in LMICs – along with problems with vehicle structural integrity *(8)*.

On-road checking that a vehicle is registered is important to safety from three perspectives:

- the maintenance of the vehicle for safety and emissions;
- the assurance of related payments, such as vehicle registration fees that may fund road works, including those for safety and compulsory insurance, which supports postcrash medical care; and
- the requirement that the registration number is valid, to enable identification of the vehicle for enforcement purposes, particularly by speed cameras.

Good practice includes on-road checking of vehicles as part of traffic stops and via ANPR. It also includes demanding strongly that private sector companies maintain their vehicles well, and imposing substantial penalties for observed problems.

11.2.4. Heavy vehicles and dangerous goods carriage

Heavy vehicles present additional risks though their unforgiving nature in crashes, additional weights and stopping distances, and higher centres of gravity. Modules 4 and 8 cover specific aspects of heavy vehicle enforcement, including safely intercepting a heavy vehicle, fatigued driving, and weight and vehicle checking. Staff with additional training are required for mechanical checks of safety and load security. Good practice in many countries is to station specialized enforcement officers at both permanent and mobile heavy vehicle weight and checking stations, especially on significant routes.

Both heavy vehicles and medium commercial vehicles may carry dangerous goods. This adds special risk features in the process of carriage and in the management of the scenes of crashes involving dangerous goods. Such crashes have caused profound damage and many deaths from fires, and, in some cases, toxic fumes.

For effective enforcement, heavy vehicles and dangerous goods carriage will ideally be well regulated, including requirements for prominent markings and notifications of goods being carried to allow the identification of vehicles. Enforcement for dangerous goods carriage requires specialized training, including knowledge of requirements that vary across countries, for each type of dangerous material carried. In addition, specialized management is required at crash scenes involving dangerous materials, necessitating further knowledge and skills.

11.3. Evidence-based RPE actions and good practice

Vehicle safety features make powerful contributions to saving lives and preventing injuries, and further contributions can be anticipated as technology improves, particularly if governments regulate implementation. Enforcement is required to ensure that vehicles have the requisite safety features and to ensure that these features are maintained.

Recommended action 11.1: The general recommended actions in Modules 3 and 4 should be applied to the enforcement of vehicle safety standards. These processes support not only road safety but also emission standards.

Recommended action 11.2: Vehicle standards/requirements should be enforced for both new and imported vehicles. Good practice involves inspection of vehicles, and in some cases destructive testing of sample vehicles, before the relevant model is approved. Rigorous enforcement is required.

Recommended action 11.3: Vehicle safety features should be maintained in suitable working condition. Enforcement of the maintenance of vehicles is achieved through vehicle roadworthiness inspections, which should be required at set intervals (such as annually) as part of the re-registration of vehicles.

Recommended action 11.4: The safety value of vehicle inspections depends on the features inspected, the rigour of the inspection and the rigour of application of unavoidable requirements to rectify problems identified. These features should be managed to achieve safety benefits from inspections.

Recommended action 11.5: Vehicle inspection schemes can be vulnerable to corruption, which should be managed through such means as irregular on-road vehicle checks and digitization of inspections. More recommended actions for good practice are provided by assessment of vehicle inspection systems, which is recommended for LMICs (7).

Recommended action 11.6: On-road patrols and enforcement should be used to check that a vehicle is registered, in support of the above processes, and ANPR is good practice. On-road enforcement should also include enforcement of visible faults, such as non-functioning turn signal lights or headlights or bald tyres.

Recommended action 11.7: A strong demand should be made of private sector companies to maintain their vehicles, with substantial penalties imposed for observed vehicle defects.

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MODULE
12

Deterring other risky behaviours

12.1. Introduction

This module considers the deterrence of behaviours that have not been covered so far and that may compromise road safety. As road users engaging in these behaviours may aggressively seek to avoid detection, one should remember the general principle that deterrence is the most powerful tool in changing their behaviour. This module considers three groups of behaviours:

- extreme-risk behaviours
- enforcement avoidance behaviours
- other behaviours not yet covered.

Module 4 considers high-risk offenders: repeat offenders often show behaviours already covered, such as speeding (Module 5) or drink–driving (Module 7). In considering extreme-risk behaviours, Module 12 has a different focus because those exhibiting extreme-risk behaviours may or may not also be high-risk repeat offenders.

In terms of extreme risk per occasion and of contribution to fatal crashes globally, the behaviours covered in previous modules – speeding, restraint and helmet non-use, and impaired driving – are extremely risky. Other extremely risky behaviours include:

- street racing;
- pedestrians lying on roads (people may lie on roads because they are highly intoxicated, or possibly to sleep at night because the dark road surface has been warmed by the sun during the day) and this behaviour occasionally causes fatalities; and
- car surfing: standing on the roof of a car while it is being driven.

The ideal way to avoid enforcement is to avoid risky behaviour. This is the point of enforcement and both general and specific deterrence. Many other forms of avoidance behaviour may be in use, however, and may allow high-risk behaviour to go undetected. A later section gives examples and considers how to manage them.

Previous modules do not consider many behaviours that can lead to crashes, including:

- overloaded vehicles;
- parking that blocks sight distance, pedestrian access or cycle paths, forcing cyclists onto road lanes;
- driving by unlicensed or disqualified drivers or riders;
- prohibited vehicle access, such as motorcycles in bicycle lanes, motorcycles on banned motorcycle routes, bicycles on banned roads (usually motorways) and lorry weight/dimension limits for various roads;
- driving on the wrong side of the road;
- dangerous overtaking on two-way roads; and
- dangerous road use behaviours by cyclists, pedestrians and e-mobility users.

12.2. Avoiding making the risky behaviour more likely

For the risky behaviours considered in this module, it is more important to avoid making them more likely than to make the right behaviour easier. Attempts to provide education on some extreme-risk behaviours are not effective and are highly likely to increase their prevalence. It is important to resist the assumption that the people taking these risks are behaving rationally in relation to risk and thus to avoid the mistake of thinking that warning them of the danger will help. The danger is the very reason for the behaviour, and people with some personality types, such as particular types of sensation-seeking personalities, are shown to choose behaviours because of the risk *(1)*. In short, identifying the risk makes the behaviour more appealing to such people.

In addition, media coverage of warnings or incidents of extreme-risk behaviour, even when it stresses fatal outcomes, not only makes the behaviour more desirable but may prompt people to engage in it, although they may never have otherwise thought to do so. Research shows that human beings mimic behaviours that they see *(2)*, and that this applies even to extreme behaviours and media coverage of them *(3)*. In this case, following the general principles of normalizing safe behaviours and not promoting extreme behaviours (see Module 3) means not mentioning the latter at all.

12.3. Good practice deterrence

The behaviours considered in this module are rarer than those considered previously. Because they are not involved in serious crashes as often as those covered in earlier modules, much less evidence on them is available. Nevertheless, the general principles of deterrence for behaviour change still apply.

12.3.1. Extreme-risk behaviours

Owing to the rarity of the extreme behaviours noted above, specifically targeting them with dedicated patrols is not considered to be good value. However, they should be addressed in areas and at times where they are known to occur, and should be among the many behaviours that may be identified in broader patrolling.

Some behaviours such as street racing may be arranged via social media, and many participants, and even look-out people, may watch for police. Where and when street racing is known to occur, unmarked patrols, planned operations and street blocks are likely to be necessary to catch offenders without high-speed pursuits.

12.3.2. Enforcement avoidance behaviours

Table 5 provides examples of avoidance behaviours that may limit effective deterrence and behaviour change, and enforcement actions to manage them.

Table 5. Examples of avoidance behaviours and enforcement actions to manage them

Avoidance behaviour	How it works	Enforcement actions for management
Obscuring a vehicle licence/ registration plate	Speed and red-light cameras cannot recognize and enforce the vehicle; officers cannot trace it to follow up offences, etc.	Strong penalties for obscured or illegible vehicle registration plates are needed, along with on-road enforcement.
Failing to register a vehicle	Records may not connect the vehicle with the owner for offence notifications. This also avoids vehicle roadworthiness inspections and compulsory insurance, if it exists.	See the recommended actions in Module 11.
Fleeing the scene of a crash (hit and run)	Severe penalties for causing a serious crash may be avoided.	Comprehensive crash investigation based on paint or other evidence left at the scene allows tracing of vehicles, along with police follow-up of suspect vehicles to check for crash damage.
Holding multiple drivers' licences	This allows drivers to present licences that do not identify them or their addresses, thus avoiding follow-up on penalties. Penalty points applied to driver's licences can be distributed across licences, thus reducing the chance of licence loss.	The licensing system must be well regulated and integrated across all regions/states/authorities that issue licences, so that each driver can only hold one licence. Strong penalties are needed for holding more than one licence.
Complying only around known or visible enforcement locations	This is common behaviour at known speed enforcement and fixed speed camera locations (see research in Module 5) and avoids penalties for speeding.	See Module 5. Mobile, covert (hidden or unmarked) enforcement is critical in addressing this behaviour so that offenders cannot avoid detection by knowing about or seeing enforcement locations. Effective enforcement should be random and unpredictable in time and location, while focusing on key risk times and locations.
Heavily tinted windows in vehicles	In many countries, windows are so heavily tinted that police cannot see inside the vehicle to enforce the use of seat belts and child restraints, or to stop mobile telephone use by drivers.	Standards are required and must be enforced to limit the darkness of vehicle windows. Exemptions may be allowed for official vehicles.
Overloaded lorries using roads with no heavy vehicle weighing stations	Heavy vehicle weighing stations are generally at established, known locations and drivers of overloaded vehicles may avoid them by taking alternative routes.	Good practices are to place weighing stations in locations that are difficult to avoid and to place mobile stations that can weigh lorries at numerous unpredictable locations, particularly including routes used to avoid permanent stations.
Attempted bribery	The offender offers/or an officer seeks, a small informal payment to avoid a larger penalty.	See the section on managing corruption in Module 4.

12.3.3. Other behaviours not yet covered

The list of behaviours that are not covered in earlier modules but can contribute to serious crashes is extensive, yet each particular behaviour is neither common nor a common cause of serious crashes. Thus, addressing these in general patrolling and enforcement operations is the most appropriate method of management.

12.4. Summary and recommended actions

In addition to identified deterrence-avoidance behaviours, many behaviours can contribute to serious crashes, but do so much less often that the behaviours previously discussed in this manual. Their less-common occurrence and smaller contribution to serious crashes must guide the approach to deterring these behaviours.

Recommended action 12.1: The general recommended actions in Modules 3 and 4 should be applied in enforcement of other and extreme risky behaviours.

Recommended action 12.2: Because the people who take extreme risks do not behave rationally in relation to risk, attempts to provide education on extreme-risk behaviours should be avoided. They will not be effective and are highly likely to increase the prevalence of the extreme behaviours, because the danger is the reason for the behaviour and some people deliberately seek it.

Recommended action 12.3: Discussion of extreme-risk behaviours with the public or in the media should be avoided. Such coverage not only makes the behaviour more desirable, but may also identify a behaviour to people who might never otherwise have thought of engaging in it. To follow the general principles of normalizing safe behaviours and not promoting extreme behaviours (see Module 3) in this case, extreme behaviours should therefore not be mentioned in public at all.

Recommended action 12.4: Because the behaviours considered in this module are less common and contribute less to serious crashes than those covered in earlier modules, resources should not be dedicated to enforcement of these behaviours in particular. It is not as effective as using resources for the more common contributors to serious crashes.

Recommended action 12.5: Dedicated action is warranted when behaviour such as street racing is known to occur, so plans should be in place to ensure effective operations that detain offenders without requiring high-speed pursuit.

Recommended action 12.6: Action should be taken to address deterrence-avoidance behaviours; see Table 3 for recommended actions to address:

- obscuring a vehicle licence/registration plate
- failure to register a vehicle
- fleeing the scene of a crash (hit and run)
- holding multiple drivers' licences
- complying only around known or visible enforcement locations
- heavily tinted windows in vehicles
- overloaded lorries using roads with no heavy vehicle weighing stations

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MODULE
13

Other RPE activities

13.1. Introduction

This module considers the many roles played by police beyond behaviour change for road safety, including managing traffic and crash scenes, investigating crashes, collecting and managing crash data, and working as first responders. An enormous volume of crashes occurs globally each day. Attending and reporting on every one would be virtually impossible, and would mean that police would be unable to perform any other role. For this reason, police should focus on the attendance, investigation, and reporting of crashes involving deaths and serious injuries. Thorough investigation and reporting of these crashes ensures that important information on casualties, injury severity, contributing factors, locations, and times can be gathered and analysed to inform preventive plans for road policing.

13.2. Traffic management

Traffic management is a critical component in developing and sustaining a safe road environment in line with the safe system approach. This approach provides a framework for integrating traffic management with other road safety measures to create a comprehensive and integrated approach to road safety *(1)*. Key elements of a safe system approach include traffic management strategies such as speed management, safe road design and the incorporation of facilities for non-motorized transport *(2)*. The objectives of traffic management are to maximize the use of existing road space, and to use traffic operations enforcement, materials, and equipment to achieve safe and efficient movement *(3)*. Challenges for RPE arise in balancing safety and efficiency, to avoid prioritizing faster movement over safety and deploying police for traffic efficiency, taking them away from safety-related RPE.

Traffic management is important, especially for urban areas, where traffic often increases at a higher rate than the infrastructure to replace or support it, causing congestion *(4)*. Traffic management is a broad issue and requires the rational provision of transport infrastructure to ensure the safe, efficient, economical, and sustainable movement of people and goods *(5)*.

Poor traffic management can reduce roadway capacity by up to half in some countries, especially LMICs, where traffic composition characteristics exacerbate the reduction in roadway capacity. These characteristics include the dominance of two- and three-wheeled vehicles; increasing levels of private vehicle ownership; and high levels of pedestrian and bicycle traffic, commercial vehicle traffic and informal transportation *(6)*. Economic growth, urbanization, and changes in transportation patterns that take place without proper consideration of traffic management may lead to a long-term vicious cycle of increased private vehicle use and low-density urbanization *(7)*.

The police are involved in traffic management in many countries, especially in urban areas that face increased congestion during peak hours *(8)*. This role is largely performed by police officers stationed at junctions and possible congestion zones to control, and manage, a smooth and safe flow of traffic.

While traffic management is a significant issue, deploying police for this purpose is not a safe or effective solution. Officers often stand in traffic, with a significant risk of being hit by a vehicle and inhaling toxic vehicle fumes (Image 10). Many better, safer opportunities exist for improving traffic management, including those involving road infrastructure, the provision of mass transit and active transport opportunities, land use planning and the management of demand.

Image 10. Police at risk standing in traffic to undertake traffic management

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In addition to putting officers at risk, redirecting police resources from road safety activities to manage congestion has significant disadvantages, including compromising road safety. Further, police action may not improve the congestion problem (Box 7). Having disproportionately low numbers of traffic police, compared with the total numbers of police and road users, and employing them to manage congestion contributes to inadequate enforcement levels for road safety.

Box 7. Case study on effectiveness of traffic management by traffic police at a junction in Lagos, Nigeria

An assessment was made of the effectiveness of traffic management techniques on traffic flow in Ikotun central business district, Lagos *(4)*. The study involved the collection of data from various sources, including observation of traffic flow, interviews with road users and traffic police officers, and review of traffic management policies. The study found that the presence of traffic control officers was not adequate to relieve traffic congestion in the area and that proper coordination and management of traffic were needed.

This can be achieved through deployment of traffic management techniques such as park and ride, vehicle laybys, off-road bus stops, traffic lights, pedestrian facilities, bus parking areas and motorcycle restrictions.

Police officers should not be used to manage traffic. Instead, authorities should assess and address the various issues that cause traffic congestion, and then create the apparent need for police to control the traffic.

Programmes to improve traffic management should include the following key components:

- provision of mass transit and policies to incentivize its use;
- traffic engineering to increase the efficiency of existing infrastructure;
- safe road infrastructure to reduce the severity of crashes;
- adjustment of road speeds to roadside activities; and
- clear definition and delegation of responsibilities between various actors involved, including traffic police, in the development of transport planning.

13.3. Crash/emergency scene management

Effective management of road crash scenes is a critical component of overall road safety efforts. There is a significant need for rapid and appropriate emergency response, improved access to medical care, and the establishment of comprehensive systems for road safety management that include incident response planning and collaboration between different stakeholders (9).

Traffic incident management is the coordinated and planned use of human, mechanical and electronic resources to manage incidents, and then to restore traffic to normal operating conditions. The chain of events includes incident detection, the mobilization and response of services, situation analysis, scene management, clearance and follow-up. Table 6 provides a sample list of roles and responsibilities of various role players in road crash scene management.

Table 6. Roles and responsibilities of those involved in road crash scene management

Role player	Roles and responsibilities
Traffic Police	• Secure/Cordon off incident scene, including advance warnings, road/lane closures and alternative routes • Control access to the incident scene • Control crowd and bystanders to maintain public order • Assist with traffic control • Mobilize tow operators when needed • Declare road safe and open • Share information with traffic coordinator • Mobilize pathology services, when needed • Conduct incident investigation • Complete the incident report form
Fire Brigade / Firefighters	• Fight/Prevent fires • Conduct search, rescue and, where necessary, safe casualty extraction from vehicles • Deal with hazardous materials • Ensure safety on the scene • Advise management team of risks • Remove patients from the source of exposure • Coordinate specialist teams • Prohibit smoking on scene • Prevent pollution • Warn the public/Coordinate evacuations
Emergency medical services	• Prioritize and treat patients • Notify hospitals • Manage and prioritize/classify casualties: immediate, delayed, minor, deceased
Forensic pathology services	• Conduct specialized investigation (cause of fatality/incident) on scene and post-mortem • Assist in crash investigation in collaboration with police • Remove deceased
Road authority	• Normalize, restore and safeguard any dangerous area

Source: Arrive Alive *(10)*.

A key purpose of traffic management at crash and incident scenes is the avoidance of secondary crashes, owing to the risks such events can create for those involved in the initial crash, bystanders, and police and emergency care providers, who are often exposed to risk in performing these roles. Details on crash/emergency scene management for most jurisdictions are provided in manuals and handbooks on traffic/road incident management, such as Best practice in European traffic incident management *(11)* and the Traffic incident management handbook *(12)*.

The World Road Association's road safety manual *(13)* also provides guidance on managing traffic incidents and unplanned events on roadways. It emphasizes the importance of quick detection and response to incidents, as well as effective communication and coordination among

stakeholders. It considers incident management plans, incident detection and response, traffic control measures and incident clearance.

The following measures are recommended for traffic incident management, many of which guide police roles and activities in incident management *(9,11,12,14)*:

- developing national policies and frameworks for traffic incident management to ensure consistency and coordination across the different organizations involved;
- establishing clear roles and responsibilities for all stakeholders, including the police, fire brigade, ambulance/emergency service providers, vehicle towing companies and road operators;
- ensuring that traffic incident management is included in all relevant training programmes for police, emergency responders and road operators;
- improving incident detection and response through the use of intelligent transport systems, such as traffic monitoring cameras and sensors;
- implementing effective traffic control measures, such as lane closures and speed limit reductions, to manage the flow of traffic around incidents, and setting up traffic diversions for incidents in which such traffic flow is not feasible;
- ensuring that recovery operators – vehicle-towing companies – are properly trained and equipped to remove vehicles and debris from incident scenes safely and efficiently;
- developing a robust system for incident data collection and analysis to inform continuing improvements to management practices;
- establishing effective communication protocols among stakeholders to ensure timely and accurate information sharing during incidents;
- prioritizing the safety of all parties involved, including police, road users, emergency responders and recovery operators; and
- incorporating incident management into broader transportation planning efforts to address the root causes of incidents and reduce their frequency.

13.4. Work as first responders

Postcrash response is the chain of care provided after a road crash that aims to reduce the severity of the injury consequences sustained by the road users involved, including avoiding death *(15)*. The morbidity outcomes of serious injuries from road crashes are high in LMICs: considerably higher than in HICs. A large proportion of fatalities occur before victims reach hospital *(16)*. Prehospital care addresses this problem; LMICs with well-established prehospital trauma care systems have recorded reductions of 25% on average in the fatality risks from road crash injuries *(17)*.

In countries where prehospital care systems have not been established, lay responders such as traffic police officers must often provide prehospital trauma care to road crash victims (18). Some LICs have no formal prehospital emergency care systems and have poorly resourced ambulance transport. The latter means that ambulances are used exclusively to transport patients from rural hospitals to better facilities once the severities of their conditions are identified. Ambulances may also provide no resources for treatment. Image 11 shows an example of the back of an ambulance in an LIC in Africa.

Image 11. The patient area of an ambulance in an LIC, providing no support for patient care

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In these circumstances, police play a vital role in the post-crash response, as first responders and transporters of casualties or by arranging for bystanders to transport crash victims. Thus, training police officers in first aid is helpful in many countries; see Box 7 for a case study.

Box 8. Case study: knowledge and practice by police as first responders in Dar es Salaam, United Republic of Tanzania

In the United Republic of Tanzania, fewer than 10% of serious injury victims of road crashes are transported by an ambulance to a postcrash care centre *(19)*. Most victims receive postcrash care and transportation from untrained civilians and traffic police *(20)*. Traffic police officers in the United Republic of Tanzania are tasked with managing road crash scenes, and providing first aid and transportation to a postcrash care centre for road crash victims, so they receive first aid training as part of their formal curriculum.

Unfortunately, road crash victims evacuated to postcrash care centres by police vehicles have worse outcomes than those transported in private vehicles by lay responders. While this may occur because police are called to more serious crashes and so may transport more seriously injured casualties, training police in first aid may improve outcomes. A cross-sectional study of 340 traffic police officers that investigated their current knowledge, attitudes and practices found that first-responder activity was common, and that some aspects of it were reasonably well known, while others were rarely known:

- 65.3% had received previous on-the-job first aid training;
- 39.4% had provided care to more than six road crash victims in the previous 12 months;
- 65.9% answered correctly about bleeding management;
- 61.2% answered correctly about fracture management;
- only 10% answered correctly about postcrash victim positioning;
- only 8.8% answered correctly about airway management;
- 37.9% answered correctly about priority conditions for the care of mass causalities; and
- only 2.9% had good knowledge of caring for road crash victims, and 37% had a low level of knowledge.

The study recommended the following improvements to the first-responder training programme:

- introducing practical training, not just theory-based training, which has yielded better results in Thailand *(21)* and the United States of America *(22)*; and
- requiring a higher level of education, preferably higher than ordinary secondary education, for traffic police officers who will be involved in the programme.

Traffic police officers can gain increased practical skills in this area if increased resources are devoted to enhancing their training/qualification levels and they receive more robust first aid training, such as competence-based training with a postcrash first aid curriculum and practical resources such as manikins.

13.5. Crash investigation/reconstruction

Road crash investigation is the systematic process of collecting and analysing evidence related to a road crash to determine its causes and contributing factors. It involves a multidisciplinary approach that includes police officers, crash investigators, forensic specialists, engineers, road safety experts, medical professionals and other relevant experts. The investigation aims to establish the sequence of events leading up to the crash, and identify any human, vehicle or environmental factors that contributed to it.

Crash investigations serve multiple purposes, including informing road safety initiatives, identifying trends and patterns, improving road infrastructure and vehicle design, informing road policing strategies, providing closure for victims and their families, and assisting in determining civil and criminal liability *(23)*. Crash investigation also informs safe system development *(24)*.

An assessment by New Zealand Police *(23)* notes that reporting and investigation for fatal crashes are especially labour-intensive, each requiring approximately 100 h of a serious crash unit officer's time, as well as approximately 20 h of preparation for scene examination, and preparing a file for prosecution when appropriate. In many countries, especially LMICs, a shortage of traffic police can limit their ability to conduct thorough investigations. This limitation can hinder efforts to improve road safety, inform RPE activities and prevent similar incidents in the future *(25)*.

13.6. Crash data recording, collation and reporting

Sound crash data are critical for many pillars of road safety, and crucial to the safe system approach, because they provide important insights into the causes of crashes and injuries, and identify patterns and trends that can inform road safety strategies. The analysis of crash data provides a better understanding of factors that contribute to crashes, such as road design, vehicle safety features and road user behaviour, enhancing interventions.

Traffic police are the most crucial contributors to collecting and reporting crash data, because they are usually among the first to respond to road crashes and are responsible for collating and storing data – including on the circumstances of the crash, road users and casualties involved, and contributory factors – from the scene for investigation purposes *(26)*. Following of consistent and standardized reporting practices across jurisdictions, and training of police officers in crash investigation and data collection, are critical in ensuring that accurate and reliable data are collected *(27)*. Thoroughly recording the details of all crash casualties and reporting their injuries in full are particularly important. Often the full extent of injuries does not become known for some hours or even days after a crash. Following up with casualties to confirm injuries a few days after the event ensures that the police collect accurate injury data and demonstrates to injured people that they are taking the collision seriously.

Different types of data – such as police crash reports, hospital and medical records, traffic infringement reports and insurance company records – should be used in combination to provide a comprehensive understanding of road safety issues. Police-reported data are generally reliable and complete, particularly for crash locations and causation. On the other hand, health system data can provide more detailed information on trauma, especially in cases where victims reach hospital and in countries where health system data reliably record deaths at a scene. Owing to their superior, although still imperfect, information on crash locations and contributory factors, police crash data are recommended as the primary source for road safety analysis *(28,29)*.

WHO provides a comprehensive guide for improving the collection, analysis and reporting of data on road safety *(30)*. For LMICs in Africa, Asia and Latin America, many partners have collaborated to develop regional road safety observatories to help countries improve their collection, use, and sharing of crash and other data (Box 9). All LMICs that have not already done so are advised to join these observatories, which provide guidance and assistance with recording and using crash data.

Box 9. Case study: regional road safety observatories

Based on the success of the Ibero-American Road Safety Observatory (known as "OISEVI"), the World Bank, the Global Road Safety Facility, the Africa Transport Policy Program, the International Automobile Federation, the International Transport Forum International Traffic Safety Data and Analysis Group, and the United Nations Economic Commission for Africa partnered with many countries to successfully develop the Africa Road Safety Observatory (also known as "ARSO") *(31)*, which was launched in South Africa in June 2019.

In 2020, the Asia Pacific Road Safety Observatory (also known as "APRSO") was established by a group of international development organizations – the Asian Development Bank, the World Bank Group, the International Automobile Federation, the International Transport Forum International Traffic Safety Data and Analysis Group, and the United Nations Economic and Social Commission for Asia and the Pacific – with support from WHO and UK Aid Direct through the Global Road Safety Facility. The Asian Development Bank serves as the secretariat for the Asia Pacific Road Safety Observatory .

One of main goals of these observatories is to build countries' capacities to effectively to manage their road safety outcome data (on crashes, injuries and deaths), research data (on the prevalence of risk and protective factors) and input data (on enforcement and other indicators of safe system implementation). The observatories also aim to ensure that sound data management processes and policies are implemented at the national, regional and continental levels.

The primary channels for sharing knowledge, lessons learned, and good practices on the ground are through publications and training workshops. These are relevant not only to the regions but also to countries seeking to improve the quantity, variety, reliability and usefulness of their road safety data.

The observatories address the immediate needs of country members while working to create synergies between countries and institutions with extensive experience in road safety policy and data, to accelerate the development of a solid network for road safety data collection and analysis.

Integrated crash data systems are important in ensuring easy sharing and simplifying the analysis of data from multiple sources. In summary, the following measures are recommended for the development of an integrated crash database, including effective management and use of safety data *(13,28)*:

- establishment of a comprehensive data collection strategy, which is regularly monitored to ensure that it is fit for purpose, accurate and complete;
- full implementation of a database that contains all crash data, with spatially coded data and appropriate quality control checks;
- linkages made between key sources of data, particularly between data collected by police and hospitals, and between crash and asset data;
- incorporation of data elements that are relevant to the road safety problem being addressed;
- consistency in definitions and terminology across different data elements;
- inclusion of crash data from multiple sources – such as police, hospital and insurance records – to obtain a more complete picture of the problem
- regular validation of the data to ensure accuracy and completeness;
- use of appropriate software tools for data analysis, such as a geographical information system and statistical analysis software;
- provision of access to a wide range of stakeholders, such as government agencies, researchers and the public; and
- maintenance of the privacy and confidentiality of personal information.

In addition, the database's information on road assets relating to safety outcomes should be contained within a comprehensive roadway inventory database. This may require the development of a new database or linkage to an existing one.

In addition to road safety observatories, support is available in the development of crash data systems (Box 10).

Box 10. Case study: DRIVER

The Philippines Government and the World Bank developed and deployed a web-based and open-source system for geospatially recording and analysing road crashes: the DRIVER system *(32)*. DRIVER answers the challenge of finding a cost–effective road crash data collection system, and offers an effective road safety support solution. DRIVER:

- is easy to procure and deploy at limited cost, with its open-source licence;
- adapts to almost all countries, states and cities, through its use of Open Street Map;
- provides key tools for recording and managing road safety data, including analytical tools for blackspot prediction, estimating the economic costs of crashes for a selected area, and tracking the efficacy of road safety interventions;
- employs a public-facing website with tools for downloading anonymized data for third-party analysis;
- accommodates local crash data records with customizable data entry;
- includes the option of geocoding of crash locations; and
- is available in Arabic, Bengali, Chinese, English, Lao, Portuguese, Spanish and Vietnamese, and can be easily translated into other languages *(32)*).

DRIVER links multiple agencies involved in recording road crash data (local government, the police and the health system), standardizes terms and definitions for reporting, and provides analytical tools to support evidence-based investments and policies, and monitoring of the impact of interventions. To access the platform and basic data, a simple login with a Google account is necessary.

DRIVER is being scaled-up to the national level in the Philippines. Based on requests from different cities and/or countries where funding was available, DRIVER pilot tests are under implementation in Bangladesh, Belarus, Brazil, Côte d'Ivoire, India (in Mumbai), Lao People's Democratic Republic, Malawi, Thailand, Ukraine and Viet Nam. DRIVER offers important opportunities for improved road safety data in many national and subnational jurisdictions, and its code is available free of charge on the World Bank GitHub open-source code repository *(33)*.

DRIVER: Data for Road Incident Visualization, Evaluation and Reporting.

3.6.1. Missing crash data and systemic biases in missed cases

Crash data systems typically miss significant proportions of even serious crashes in HICs, as well as LMICs, with large proportions of fatalities estimated to be missed in LMICs *(34)*. This problem is exacerbated by the non-random nature of the crashes that are missed in police data. Omissions may occur because crashes are not reported to the police, or because fatalities are not recorded, owing to a lack of follow-up with injured victims who may subsequently die.

These problems introduce bias into countries' crash data. For instance, in many countries, pedestrian fatalities are less likely to be reported to police than other types. This issue has been recognized for many years but it remains unresolved *(35)*. Pedestrian fatalities are underreported for several reasons. For example, crashes involving pedestrians have a lower likelihood of

including an altercation and typically make much less noise than vehicle-to-vehicle crashes, thereby attracting less attention and fewer witnesses. Consequently, there are fewer individuals inclined to report the incident to the police *(35)*.

Thus, the official data of most countries underestimate not only the extent of road crash death and trauma, but also the contributions of pedestrian trauma and vulnerable road user trauma in general *(34)*. This means that decision-makers cannot see the real extent of the problem of pedestrian and vulnerable road user death and trauma.

13.7. Summary and recommended actions

Police undertake not only many RPE activities that play an important role in improving road safety, but also some that are of limited road safety value and yet absorb on-road time, which officers might spend more effectively. More rigorous selection of the most effective uses of RPE time is warranted.

Recommended action 13.1: Road police should not be employed to manage traffic, except in emergency situations. Instead, authorities should assess and address the various issues that cause the traffic congestion that creates the apparent need for control by traffic police officers. Better, safer opportunities for improving traffic management include those involving road infrastructure, the provision of mass transit and active transport opportunities, land use planning and the management of demand.

Recommended action 13.2: LMICs seeking to improve the management of their road safety data should consider joining a regional road safety observatory, as observatories provide a platform for sharing knowledge and good practices, as well as building capacity for effective data management at the national, regional and continental levels.

Recommended action 13.3: Each country should establish a comprehensive data collection strategy that includes an integrated crash database with appropriate quality control checks and spatial coding, and linkages between key sources of data. In the absence of a sound crash data system, the country should consider implementation of the Data for Road Incident Visualization, Evaluation and Reporting system (also known as “DRIVER”), for which the code is available free of charge on the World Bank GitHub open-source code repository *(33)*. Further, countries should incorporate into their systems data elements relevant to the road safety problem being addressed, ensure consistency in definitions and terminology, regularly validate data, use appropriate software tools for analysis, provide access to stakeholders, and maintain the privacy and confidentiality of personal information in the database. Crash data in deidentified form should be shared widely with organizations involved in road safety.

Recommended action 13.4: Training for first responders, particularly police officers, should be increased and receive more resources in countries where prehospital care systems have not been established or are not sufficient. This can significantly reduce the morbidity and mortality outcomes of road crash injuries, especially in LMICs.

Recommended action 13.5: Although the detailed systems in use in some countries may not be cost–effective for all, LMICs should consider increasing resourcing for and training in crash investigation. This will:

- enable more effective investigations of road crashes, identifying the causes and contributing factors, and informing road safety initiatives, law enforcement strategies and safe system development;
- help prevent similar crashes in the future; and
- provide closure for victims and their families.

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MODULE
14

Managing, implementing and improving evidence-based RPE

14.1. Introduction

Sound road safety management can prevent crash deaths and serious injuries. Like any product, road safety can be delivered with suitable resourcing, evidence-based actions and effective management *(1)*. This final module applies management principles to RPE, including monitoring and delivering continuous improvement. It brings together many elements covered in earlier modules, including evidenced-based yet also data-driven choices, using multiple data sources.

The overall management of road safety and the management structures required to achieve it are covered elsewhere *(1)*, including in many assessments of road safety management processes *(2,3)*, and so are not considered here. This module focuses on the management of RPE in particular.

14.2. Developing a road policing strategy

A strategy should be developed for delivering and improving RPE. The general principles of strategy setting in road safety apply, including the need to understand the nature of the challenges to be managed and the current strengths, weaknesses, opportunities and risks. These all vary between countries, so country-specific strategic approaches are required.

For example, the nature of the problem varies. It may be strongly related to drink–driving in some countries but not others; motorcycle crashes dominate road safety challenges in some countries in Asia and increasingly in Africa and Latin America, while motorcycles comprise a much smaller road safety challenge in most European countries. However, speed management is a significant problem in all countries. The extent of contribution to deaths and serious injuries of each of the relevant behaviours and target road user groups should guide the prioritization of RPE focus.

Available funding and resources for RPE and the feasibility of opportunities, such as speed cameras, also vary across countries. As an example, Adler et al. describe the approach to RPE adopted in Israel in response to budget and resource limitations *(4)*. Because the general principles of strategy setting apply and can be found in numerous guides *(1)*, and because the so-called “green manuals” *(5,6)* include situational analyses, detailed guidance is not repeated here.

Road safety has many potential interventions and stakeholders, including improving road user behaviour through RPE, or improving the extent to which roads and vehicles protect road users from their mistakes. A strategy for RPE should consider non-RPE solutions, such as improved road safety infrastructure and traffic calming to manage speed, when targeting locations for enforcement. However, it is vital that all stakeholders accept their responsibilities to improve road safety, rather than seeing the problem as something that other stakeholders should fix. For example, speed enforcement may be moved from locations where effective traffic calming has managed speeds down to safe levels, but this should occur only where the traffic calming is already in place, not where it should be in place. Coordination with other road safety stakeholders is required.

In addition to the more usual meaning of strategy as considered above, various conceptual approaches to RPE are sometimes called strategies *(4)*, including:

- the standard policing model, based on random preventive vehicle, bicycle or foot patrol assignment, and rapid response to police calls for service;
- the community policing philosophy, which aims to transform communities from passive consumers of police protection to active coproducers of public safety by reporting offences to the police;
- problem-oriented policing, in which the police focus on specific problems and adapt their strategies to the problems identified;
- hotspot policing, in which the police identify specific, concentrated areas of crime – or in RPE, unsafe road use and serious crash history – and then channel resources to these locations; and
- so-called broken-windows, order-maintenance or zero-tolerance policing, in which public order is achieved by aggressively enforcing all law-breaking, including minor offences.

14.3. Continuous improvement

14.3.1. Continuous improvement in principle

The principle of continuous improvement is increasingly recognized as a key aspect of good management practice. This principle is particularly applicable to the management and leadership of road safety, and specifically RPE. Managing for continuous improvement in RPE involves assessing the current level of performance through inputs, intermediate outcomes and final outcomes, setting agreed targets for improvement and monitoring progress. Target setting should consider existing baseline performance levels and aim for improvements. In relation to speeding, the following examples may be helpful.

Inputs may include the hours of police speed enforcement conducted, the number of infringement notices issued compared with known levels of speeding, the percentage of the road network covered by working speed cameras and monitoring of enforcement tolerances to ensure rigorous enforcement of low-level speeding. The number of infringement notices issued can be a challenging metric in some contexts, so this must be judged within each context, including consideration of how police officers' motivation to issue notices can be enhanced.

Intermediate outcomes are best developed from on-road measurement of speeds and could include the mean free travel speed compared with the speed limit, and the proportion of vehicles travelling above the speed limit. Data should not be taken from enforcement processes, because these will not be representative of speeding more broadly due to the presence of enforcement itself. Another informative intermediate outcome is the percentage of drivers who believe that, if they speed, they are likely to be caught and receive a penalty that they cannot avoid; this information would be taken from surveys.

Final outcomes could be changes in numbers of serious injuries and deaths that involve speeding, noting the deep problems with the reporting of speeding in serious crashes and accuracy of casualty reporting, and how these issues can be managed (see Module 5). In addition, crash data

have significant omissions and uncertainties in many countries. Thus, a legitimate additional outcome measure is the change in percentages of deaths and injuries that can be expected, based on the evidence for the close relationship between speed and trauma and measured mean speeds. For example, a 5% decrease in speed will deliver a 20% decrease in deaths (see Module 5). This measure may be more accurate than crash data.

Targets could include a 10% increase in speeding infringement notices each year overall with infringement levels based on expected levels of offending, a 15% reduction in vehicles exceeding the speed limit by more than 3 km/h, and a 15% reduction in speeding-related deaths and injuries.

Monitoring of progress would require regular data collection and assessment on the above-mentioned factors, and comparison of results to the milestones required to deliver the targets.

14.3.2. Monitoring activity and evaluating progress to guide interventions and continuous improvement

As with road safety interventions in general, sound RPE choices must be both evidence-based and data-driven or intelligence-led, yet these two requirements are often confused. For example, a common reply to the question of why education on alcohol and crash risk is used to address drink–driving is that the evidence shows that drink–driving is a substantial cause of crashes. Such a choice is data-driven but not evidence-based. There is no sound evidence that education on crash risk works to reduce drink–driving, and experience clearly indicates that education is much less effective than enforcement, and thus the creation of general deterrence (see Module 7). Enforcement, through RBT, for example, works to reduce drink–driving making it an evidence-based choice.

In short, the term “evidence-based” refers to sound evidence showing that a particular intervention works effectively to reduce the particular problem to be addressed. The term “data-driven”, or “intelligence-led”, refers to the process of selecting an intervention based on data that show the causes of serious crashes. These data include information about who is involved and where and when the crashes occur, thereby allowing interventions to be targeted effectively.

Interventions can be called effective only if they are effective against the particular problem to be addressed (evidence-based) and if they are used where and when the problem occurs (data-driven or intelligence-led). The effective application of interventions requires both the right choice of intervention and the data to identify the problem.

Monitoring not only highlights the need for relevant data but also facilitates data collection to develop local evidence that a particular intervention works, or does not work, and facilitates incrementally better choices and better focused prioritization.

14.4. Funding and resourcing RPE

Current funding and resourcing levels for RPE are often insufficient. Senior management of RPE should therefore develop strategies and targets that accommodate the reality of available funding and resourcing, and also develop a business case for increased support rather than just accepting current levels.

This manual provides an evidence base to support the business case for RPE, in many cases including BCRs. This may also be connected to plans for continuous improvement. Securing endorsement from senior decision-makers for a strategy that includes continuous improvement is a solid first step in gaining support for the business case. Again, data are critical to show the extent of the problem being addressed, and what can be achieved with better funding and resourcing.

14.5. Management structures

Management structures are vital to effective management. Existing guides provide detailed guidance on management structures for road safety, including the need for a lead agency, as well as collaboration and cooperation across multiple stakeholders including police and enforcement agencies *(1)*, so this content is not repeated here.

Particular challenges to developing effective management structures and capacity in RPE include the following.

- The common practice of rotating police officers through different positions every few years can limit the development of more skilled and experienced road safety management.
- Insufficient focus on road safety, with too few police officers dedicated to RPE, can limit skill development and the level of seniority an officer can achieve in a career in RPE; this in turn creates a disincentive to commit to this field. *The Global Plan for the Decade of Action for Road Safety 2021–2030 (7)* recommends establishing dedicated enforcement agencies, providing training and ensuring adequate equipment for enforcement activities, to address the problem of inconsistent focus on road policing when it is not prioritized in a generalist policing agency.
- Having general police officers undertake RPE is unhelpful. It not only reduces RPE skill development but also limits motivation and commitment to RPE, because in most countries police forces are held accountable for crime rates and the proportion of crime deemed to be solved, but not for serious road crashes. This is yet another negative consequence of victim blaming (see Module 10).

These undesirable consequences should be carefully weighed against the perceived advantages of regular rotation and the lack of both a dedicated management structure and police accountability for road safety. Rotation of locations in RPE, rather than areas of skill, would be preferable.

14.6. Summary and recommended actions

Strategic, evidence-based, intelligence-led management of RPE adds value. This requires sound data, strong monitoring of both inputs (police activity metrics) and outcomes, a commitment to continuous improvement, the right strategy, development of a strong business case for funding and resourcing, and monitoring of progress.

Recommended action 14.1: The general recommended actions in Modules 3 and 4 should be applied to the policies and practices developed for managing RPE.

Recommended action 14.2: A strategy should be developed for delivering and improving RPE. The general principles of strategy setting in road safety should be applied, including the need to understand the nature of the problems to be managed and the current strengths, weaknesses, opportunities and risks.

Recommended action 14.3: Stakeholders, including those responsible for RPE, should accept their responsibilities to improve road safety, rather than seeing the problem as something that others should fix, and coordinate their efforts to avoid duplication and inefficiency. For example, speed enforcement may be moved from locations where effective traffic calming has managed speeds down to safe levels. Thus, the targeting of RPE should consider existing non-RPE solutions, such as improved road safety infrastructure and traffic calming (speed humps, etc.), to manage speed and safety more broadly.

Recommended action 14.4: Senior management of RPE should not only develop strategies and targets that accommodate the reality of current funding and resourcing levels, but also (if these are insufficient) develop a business case for more funding and resourcing. This manual provides an evidence base to support the business case for RPE, in many cases including BCRs.

Recommended action 14.5: Sound strategies and targets should be set (as described in Section 14.3), and good management and continuous improvement should be used to improve RPE. These require monitoring of inputs (RPE activities, including total infringement notices issued and the proportions paid), which means monitoring through sound data collected from multiple sources.

Recommended action 14.6: RPE should be data-driven (intelligence-led) and evidence-based, which calls for sound data and evidence. Management processes should ensure that both these criteria are understood by police and are met in selecting and approving interventions.

Recommended action 14.7: Good practice for RPE is to recognize the expertise required, provide a dedicated force of RPE officers with a sound career structure to senior appointment levels and provide appropriate training, resourcing and funding. In RPE, rotation of locations should be preferred to rotation of areas of skill. Dedicated road policing agencies (the ideal model) should be established to ensure a consistent organizational focus on preventing road trauma.

Recommended action 14.8: The detailed guidance on management structures for road safety provided in existing guides should be applied to RPE. Developing appropriate management structures also facilitates the development of expertise and sound career progression in RPE.

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[14] All references were accessed on 25 November 2025.

Annexes

Annex 1. Making the case for road safety as a police priority

Table A1. Comparison of age-standardised mortality rates for road traffic injury and interpersonal violence in 181 countries

	Age standardised mortality rates (per 100 000 population)		
Country	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Afghanistan	32.4	10.0	3.3
Albania	8.2	3.1	2.7
Algeria	19.6	1.7	11.4
Angola	16.8	9.6	1.8
Antigua and Barbuda	7.1	5.4	1.3
Argentina	8.7	5.9	1.5
Armenia	12.7	3.9	3.3
Australia	4.1	0.9	4.5
Austria	4.1	0.5	8.8
Azerbaijan	17.2	2.5	7.0
Bahamas	15.0	40.7	0.4
Bahrain	9.6	0.3	36.7
Bangladesh	20.6	3.0	6.9
Barbados	8.5	11.7	0.7
Belarus	6.1	1.9	3.3
Belgium	4.0	1.1	3.6
Belize	18.5	42.4	0.4
Benin	30.0	6.4	4.7
Bhutan	12.6	2.7	4.6
Bolivia (Plurinational State of)	22.7	12.2	1.9
Bosnia and Herzegovina	10.1	1.0	9.8
Botswana	18.7	17.6	1.1
Brazil	14.7	31.4	0.5
Brunei Darussalam	4.0	0.8	5.2
Bulgaria	7.7	0.9	8.6
Burkina Faso	37.4	10.7	3.5
Burundi	18.4	7.5	2.4
Cabo Verde	19.0	14.5	1.3
Cambodia	20.0	1.8	10.9
Cameroon	13.4	6.2	2.2
Canada	4.0	1.6	2.4

Table A1. cont.

Country	Age standardised mortality rates (per 100 000 population)		
	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Central African Republic	31.4	23.5	1.3
Chad	35.3	10.3	3.4
Chile	9.4	3.7	2.5
China	14.9	0.6	23.1
Colombia	15.4	33.8	0.5
Comoros	37.9	8.7	4.4
Congo	11.8	10.5	1.1
Costa Rica	14.4	13.0	1.1
Côte d'Ivoire	29.0	12.2	2.4
Croatia	7.1	0.6	11.2
Cuba	4.6	4.8	1.0
Cyprus	3.9	1.2	3.2
Czechia	4.5	0.5	9.2
Democratic People's Republic of Korea	37.7	3.9	9.7
Democratic Republic of the Congo	19.3	14.3	1.4
Denmark	2.2	1.2	1.8
Djibouti	29.1	5.8	5.0
Dominican Republic	27.6	19.6	1.4
Ecuador	23.1	6.5	3.6
Egypt	10.5	4.4	2.4
El Salvador	22.3	95.9	0.2
Equatorial Guinea	15.6	2.8	5.5
Eritrea	24.8	12.9	1.9
Estonia	3.6	1.5	2.3
Eswatini	27.5	17.9	1.5
Ethiopia	25.9	8.1	3.2
Fiji	5.5	2.1	2.6
Finland	3.4	0.9	3.6
France	4.4	1.0	4.4
Gabon	18.7	8.6	2.2
Gambia	34.4	9.3	3.7
Georgia	12.0	1.8	6.8
Germany	2.6	0.9	3.0
Ghana	30.9	6.5	4.8

Table A1. cont.

Country	Age standardised mortality rates (per 100 000 population)		
	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Greece	6.7	0.9	7.4
Grenada	6.4	4.7	1.4
Guatemala	14.3	28.0	0.5
Guinea	46.0	9.6	4.8
Guinea-Bissau	35.6	10.7	3.3
Guyana	15.2	14.7	1.0
Haiti	32.8	20.2	1.6
Honduras	26.4	98.7	0.3
Hungary	6.0	1.2	5.1
Iceland	2.0	0.9	2.2
India	15.1	3.6	4.1
Indonesia	11.6	4.2	2.8
Iran (Islamic Republic of)	21.1	2.9	7.3
Iraq	26.9	15.4	1.8
Ireland	2.4	0.7	3.4
Israel	4.4	1.1	4.2
Italy	4.0	0.6	7.2
Jamaica	17.6	48.5	0.4
Japan	1.5	0.2	9.3
Jordan	16.0	2.6	6.1
Kazakhstan	12.6	4.6	2.8
Kenya	52.2	8.1	6.4
Kiribati	7.0	4.8	1.5
Kuwait	10.3	1.7	6.1
Kyrgyzstan	15.2	5.4	2.8
Lao People's Democratic Republic	17.8	6.4	2.8
Latvia	8.6	3.7	2.3
Lebanon	9.3	5.5	1.7
Lesotho	24.5	40.1	0.6
Liberia	19.3	10.8	1.8
Libya	36.3	2.1	17.1
Lithuania	5.9	3.7	1.6
Luxembourg	3.8	0.4	9.2
Madagascar	29.4	6.8	4.3
Malawi	30.4	2.5	12.1

Table A1. cont.

Country	Age standardised mortality rates (per 100 000 population)		
	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Malaysia	14.1	2.5	5.6
Maldives	1.5	2.1	0.7
Mali	26.2	12.0	2.2
Malta	2.0	0.7	2.9
Mauritania	12.0	12.7	0.9
Mauritius	9.1	2.0	4.6
Mexico	11.9	27.8	0.4
Micronesia (Federated States of)	15.9	5.0	3.2
Mongolia	13.1	5.5	2.4
Montenegro	7.8	2.1	3.6
Morocco	19.0	1.6	12.1
Mozambique	31.2	3.8	8.1
Myanmar	19.5	3.9	5.0
Namibia	25.7	19.7	1.3
Nepal	34.8	2.4	14.6
Netherlands (Kingdom of the)	2.5	0.5	4.9
New Zealand	6.0	1.2	5.0
Nicaragua	14.3	9.3	1.5
Niger	30.0	11.8	2.5
Nigeria	24.9	10.0	2.5
North Macedonia	4.8	0.9	5.3
Norway	1.3	0.5	2.6
occupied Palestinian territory, including east Jerusalem	5.8	7.4	0.8
Oman	13.8	0.8	17.1
Pakistan	14.1	7.1	2.0
Panama	7.3	20.5	0.4
Papua New Guinea	17.1	11.3	1.5
Paraguay	21.8	7.6	2.9
Peru	12.8	6.1	2.1
Philippines	10.6	13.5	0.8
Poland	5.9	0.6	10.2
Portugal	5.4	0.7	8.2
Puerto Rico	10.6	26.6	0.4
Qatar	9.8	0.8	12.4
Republic of Korea	4.6	0.7	6.5

Table A1. cont.

Country	Age standardised mortality rates (per 100 000 population)		
	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Republic of Moldova	8.3	4.0	2.1
Romania	7.7	0.9	8.5
Russian Federation	9.8	6.1	1.6
Rwanda	15.3	4.3	3.6
Saint Lucia	8.1	18.3	0.4
Saint Vincent and the Grenadines	4.8	34.2	0.1
Samoa	11.2	2.8	4.0
Sao Tome and Principe	17.0	6.2	2.7
Saudi Arabia	19.8	2.9	6.9
Senegal	30.3	8.8	3.4
Serbia	5.8	1.4	4.1
Seychelles	6.1	12.9	0.5
Sierra Leone	16.8	7.4	2.3
Singapore	1.9	0.2	11.8
Slovakia	5.4	0.8	6.5
Slovenia	4.6	0.7	6.6
Solomon Islands	14.2	4.2	3.4
Somalia	31.1	6.3	5.0
South Africa	24.3	34.3	0.7
South Sudan	31.2	22.1	1.4
Spain	3.1	0.4	7.2
Sri Lanka	11.0	1.9	5.9
Sudan	27.8	6.0	4.6
Suriname	16.3	5.0	3.3
Sweden	1.7	1.2	1.5
Switzerland	1.8	0.4	4.4
Syrian Arab Republic	35.8	2.6	13.6
Tajikistan	16.0	2.1	7.6
Thailand	24.5	4.4	5.6
Timor-Leste	13.4	5.3	2.5
Togo	26.2	9.6	2.7
Tonga	9.3	3.8	2.5
Trinidad and Tobago	5.4	37.0	0.1
Tunisia	15.8	3.7	4.3
Türkiye	6.4	4.7	1.4

Table A1. cont.

Country	Age standardised mortality rates (per 100 000 population)		
	Road injury	Interpersonal violence	Relative rate (road injury: interpersonal violence)
Turkmenistan	8.6	3.8	2.2
Uganda	27.6	19.3	1.4
Ukraine	9.6	4.8	2.0
United Arab Emirates	8.9	0.6	14.0
United Kingdom	2.1	1.2	1.7
United Republic of Tanzania	22.2	9.3	2.4
United States of America	13.5	6.2	2.2
Uruguay	12.1	9.2	1.3
Uzbekistan	10.0	1.3	7.4
Vanuatu	14.9	2.7	5.5
Venezuela (Bolivarian Republic of)	13.8	67.1	h0.2
Viet Nam	16.7	1.9	8.7
Yemen	37.1	10.2	3.6
Zambia	26.6	6.5	4.1
Zimbabwe	40.2	13.0	3.1

Annex 2. Standardized survey tool on practices for road policing and enforcement for road safety

The information in this annex constitutes a standardized survey tool as presented to respondents.

Country respondent

Country/Entity _____ (please specify)

Responsible Officer _____ (please leave blank if you wish to remain anonymous)

Position _____ (please specify or add generic "Senior Officer")

Policing Institution _____ (please specify)

Email _____ (please leave blank if you wish to remain anonymous)

Telephone _____ (please leave blank if you wish to remain anonymous)

Date of completing this questionnaire: (dd/mm/yyyy) _____

For the following questions, please fill in the blanks in the spaces provide and select all relevant options that describe the current road policing policies and practices, applied in your police jurisdiction.

Human resources for road policing	Cross cutting police practices	Current legislative provisions
• The number of police officers nationally whose primary duty is road policing/ traffic enforcement is _____, and they comprise ___% of the national police force. OR • Data on the number of police are confidential and cannot be provided. OR • The number of road police nationally is estimated at _____ (e.g. 5000). OR • The proportion of road police nationally is estimated at _____% of all police.	• All police wear body cameras while on duty. • Body cameras are being introduced. • Body cameras are not currently being utilized	• Drivers can contest all penalty notices in court. • Demerit points are accrued in conjunction with all penalty noticed. • Police collect payment for penalty notices at the roadside. • Payment for penalty notices is made centrally, never directly to police at the roadside.

Type of agency	Government oversight and funding	Road safety legislation enforced	Geographical jurisdiction
National policing agency	• National government oversight • National government funded • Other: _____	• National legislation only • Legislation of all levels of government • Other: _____	• All roads • National roads only • Other: _____
Regional policing agency (boundaries across multiple states/provinces/ counties, etc.)	• National government oversight • National government funded • Multiple provincial government oversight • Multiple provincial government funding • Other: _____	• State/provincial/county legislation only • Legislation of all levels of government (deputized) • Other: _____	• All roads within regional geographical boundary • Other: _____
State/provincial policing agency	• State government oversight • State/provincial government funded • National government funded • Other: _____	• State/provincial legislation only • Legislation of all levels of government (deputized) • Other: _____	• State roads only • All roads within state/ provincial boundary • Other: _____
Municipal/city policing agency	• Municipal/city government oversight • State/provincial government oversight • National government oversight • Municipal/city government funded • State/provincial government funded • National government funded • Other: _____	• Municipal/city legislation only • Legislation of all levels of government (deputized) • Other: _____	• Municipal/city roads only • All roads within city geographical boundary • Other: _____

For all tables below, complete sections moving left to right, to outline the authorities and processes by which certain road safety behavioural risk factors are enforced. For each column, please select all relevant options and fill in the blanks in the spaces provided.

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Speed	• Maximum urban speed limit of 30 km/h • Maximum urban speed limit of 50 km/h • Default speed limit (unless posted otherwise) of 30 km/h • Default speed limit (unless posted otherwise) of 50 km/h • Maximum urban speed limit of _____ km/h • Maximum motorway speed limit of _____ km/h • Minimum motorway speed limit of _____ km/h • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road police/motorway police officers/units • Police operation of fixed and mobile autonomous speed cameras • Police do not operate fixed and mobile autonomous speed cameras • Non-police (civilian) operators issue speed violation notices from autonomous camera evidence • Police use evidence from autonomous cameras to issue speed violation notices • Only overt (marked) police vehicles are used to intercept drivers • Overt and covert (unmarked/ undercover) police vehicles are used to intercept drivers • Moving-mode radar installed in police vehicles	• Roadside handheld laser/radar with interception and on-the-spot penalty notice • Autonomous fixed-location speed cameras with back-office processing of penalty notices • Autonomous mobile speed cameras with back-office processing of penalty notices • Red-light speed cameras with back-office processing of penalty notices • Speed cameras with infrared flash • Forward-looking speed cameras • Rearward-looking speed cameras • Road safety/Traffic management cameras used as evidence for issuing penalty notices • Police drone footage can be used as evidence for issuing a penalty notice • Police dashcam footage can be used as evidence for issuing penalty notices	• No. speed enforcement operations conducted • No. drivers charged • No. penalty notices issued • No. drivers' licences suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of speed offences • Mean travelling speed (per speed limit zone – km/h) • No. road users killed by speeding drivers • No. road users seriously injured by speeding drivers • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Speed (cont'd)		• Speed of target vehicle determined by pace of intercept vehicle • Approved operations can mobilize additional policing human resources from outside road police units • All officers wear body cameras • Brand of mobile laser/radar speed measurement device(s) used: _____ _____ • Additional information: _____ _____ _____	• Public drone footage can be used as evidence for issuing a penalty notice • Public dashcam footage can be used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerit/ penalty points during holidays) • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____ • Other (please specify): _____ _____ _____	

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Drink–driving	• According to legislation, maximum blood alcohol concentration (BAC) for general population, e.g. ≤0.05 g/dl blood or breath equivalent (give numbers and units): _____ • According to legislation, maximum BAC for novice, probationary or professional drivers, e.g. ≤0.02 g/dl blood or breath equivalent (give numbers and units): _____ • Partition ratio used for conversion of weight of alcohol in blood to weight of alcohol in breath, e.g. 210 L of breath to 100ml of blood (give number): ____ L of breath to 100 ml blood • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used to intercept drivers • Overt and covert police vehicles used to intercept drivers • Approved operations can mobilize additional policing human resources from outside road policing units • Brand of breathalyser(s) used for preliminary tests (e.g. Alcolizer LE5, Lion Alcolmeter 700): _____ • Brand of breathalyser(s) used for evidentiary tests (e.g. Draeger Alcotest 9510, Lion Intoxilyzer 9000): _____ • Additional information: _____ _____ _____	• Field sobriety tests (FST) • Drivers failing FST are arrested for evidentiary alcohol testing • Sobriety check points • Random breath testing legally permitted • Preliminary breath testing followed by evidentiary breath testing • Evidentiary breath testing at the roadside • Evidentiary breath testing of breath at a police station, within maximum of (insert number) _____ hours • Evidentiary testing of blood/urine at a hospital, within maximum (insert number) _____ hours • Drivers refusing testing face additional charges • Demerit/penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerits during holidays) • Automated number plate recognition used to identify recidivist drink–drivers for random testing? • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. drink–driving enforcement operations conducted • No. random breath tests conducted • Strike rate (#drivers exceeding prescribed content of alcohol (XPCA)/ No. drivers tested) • No. drivers charged • No. Penalty notices issued • No. drivers licence suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of an alcohol offence • No. road users killed by an alcohol impaired driver • No. road users seriously injured by alcohol-impaired driver • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Drug–driving	• Drivers prohibited to have any detectable amount of an illicit drug in their systems • Drivers prohibited to have concentration of illicit drugs, exceeding a set limit • Prohibited (illicit and prescription) drugs specified in legislation (give list): _____ _____ _____ • Drivers can be charged for driving under the influence of any impairing drug based on medical/laboratory evidence • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used • Overt and covert police vehicles used • Approved operations can mobilize additional policing human resources from outside road policing units • Brand of commercial oral fluids testing kit used for roadside preliminary testing (e.g. Securetec Drug Wipe, Abbott SoToxa, Draeger DrugTest 5000): _____ • Additional information: _____ _____ _____	• Random drug testing legally permitted • Test for alcohol before drugs and test for drugs only if alcohol test is negative • Roadside oral fluids testing for drugs (give names): _____ _____ • Preliminary roadside oral fluids test only before driver is charged • Preliminary and secondary roadside oral fluids tests conducted before driver is charged • Preliminary oral fluids test, followed by secondary test followed by laboratory confirmation before driver is charged • Driver can be charged at roadside based only on the determination of impairment by a drug recognition expert • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerits during holidays) • Automated number plate recognition used to identify recidivist drug–drivers for random testing • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. drug–driving operations conducted • No. random drug tests conducted • Alcohol strike rate (no. drivers exceeding the prescribed content of alcohol divided by no. tested) • Drug strike rate (no. drivers positive divided by no. tested) • No. drivers charged • No. penalty notices issued • No. drivers' licences suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of a drug offence • No. road users killed by a drug-impaired driver • No. road users seriously injured by drug-impaired driver • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Motorcycle helmets	• All riders must wear a motorcycle helmet • All passengers must wear motorcycle helmet • Motorcycle helmets must be worn on motorcycles of all engine sizes and types • Motorcycle helmets must be worn when riding on all public roads • Motorcycle helmets must be worn when riding on private property/off road • Children under (insert age) _____ years are prohibited from being a passenger on a motorcycle on a public road • All child passengers must wear a child-specific helmet • Riders are legally responsible for passengers' wearing helmets • Motorcycle helmets must meet a recognized quality standard (e.g. EC22, Federal Motor Vehicle Safety Standard (FMVSS) No. 218) to be considered worn • Helmet must be correctly fastened to be considered worn • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used (signage and marking clearly identifying police vehicles) • Overt and covert police vehicles used • Approved policing operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Roadside interception and on-the-spot penalty notices • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• • No. of helmet enforcement operations each year • No. riders not wearing helmets • No. passengers not wearing helmets • No. riders killed not wearing helmets • No. riders seriously injured not wearing helmets • No. passengers killed not wearing helmets • No. passengers seriously injured not wearing helmets • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Seatbelts	• All vehicle occupants required to wear a seatbelt correctly • Driver only required to wear a seatbelt • Driver and frontseat passenger only required to wear seatbelts • Drivers are legally responsible for passengers' wearing seatbelts (drivers are penalized, not passengers) • Passengers are legally responsible for wearing seatbelts (passengers are penalized, not drivers) • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____	• Primary enforcement (a driver will be stopped for a seatbelt violation alone) • Secondary enforcement only (a driver will be stopped for a seatbelt violation only in conjunction with another infringement) • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Fixed or mobile "look down" cameras (e.g. Vitronic, Acusensus) provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment of financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. of seatbelt enforcement operations each year • No. drivers not wearing seatbelts • No. front seat passengers not wearing seatbelts • No. of rear seat passengers not wearing seatbelts • No. of drivers penalized for passengers not wearing seatbelts • No. drivers killed not wearing seatbelt • No. drivers seriously injured not wearing seatbelt • No. passengers killed not wearing seatbelt • No. passengers seriously injured not wearing seatbelt • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Child restraints	• All children under __ years of age and/or under ___ cm in height, and/or under _____ kg in weight must be transported in approved child restraints • Drivers are legally responsible for children to be carried correctly in child restraints • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Primary enforcement • Secondary enforcement only • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. child restraint enforcement operations conducted • No. drivers penalized for children not using age/ weight/height-appropriate child restraints • No. children killed not using or not correctly using child restraints • No. children seriously injured not using or not correctly using child restraints • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Mobile telephone use	• All drivers are prohibited from all use of mobile devices while their motor vehicles are in operation • All drivers are prohibited from handheld use of mobile devices while their motor vehicles are in operation • Use of hands-free devices is permitted/ prohibited • Use of a mobile device while fitted in a vehicle-mounted cradle is permitted • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Primary enforcement? • Secondary enforcement only? • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras with back-office processing of penalty notices • Fixed or mobile "look down" cameras (e.g. Vitronic, Acusensus) with back-office processing of penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Usage data from mobile provider can be used for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. of mobile telephone enforcement operations conducted • No. of drivers using mobile telephone while driving • No. road users killed by driver using mobile telephone • No. road users seriously injured by driver using mobile telephone • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Speed	• Maximum urban speed limit of 30 km/h • Maximum urban speed limit of 50 km/h • Default speed limit (unless posted otherwise) of 30 km/h • Default speed limit (unless posted otherwise) of 50 km/h • Maximum urban speed limit of _____ km/h • Maximum motorway speed limit of _____ km/h • Minimum motorway speed limit of _____ km/h • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road police/motorway police officers/units • Police operation of fixed and mobile autonomous speed cameras • Police do not operate fixed and mobile autonomous speed cameras • Non-police (civilian) operators issue speed violation notices from autonomous camera evidence • Police use evidence from autonomous cameras to issue speed violation notices • Only overt (marked) police vehicles are used to intercept drivers • Overt and covert (unmarked/ undercover) police vehicles are used to intercept drivers • Moving-mode radar installed in police vehicles	• Roadside handheld laser/radar with interception and on-the-spot penalty notice • Autonomous fixed-location speed cameras with back-office processing of penalty notices • Autonomous mobile speed cameras with back-office processing of penalty notices • Red-light speed cameras with back-office processing of penalty notices • Speed cameras with infrared flash • Forward-looking speed cameras • Rearward-looking speed cameras • Road safety/Traffic management cameras used as evidence for issuing penalty notices • Police drone footage can be used as evidence for issuing a penalty notice • Police dashcam footage can be used as evidence for issuing penalty notices	• No. speed enforcement operations conducted • No. drivers charged • No. penalty notices issued • No. drivers' licences suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of speed offences • Mean travelling speed (per speed limit zone – km/h) • No. road users killed by speeding drivers • No. road users seriously injured by speeding drivers • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Speed (cont'd)		• Speed of target vehicle determined by pace of intercept vehicle • Approved operations can mobilize additional policing human resources from outside road police units • All officers wear body cameras • Brand of mobile laser/radar speed measurement device(s) used: _____ _____ • Additional information: _____ _____ _____	• Public drone footage can be used as evidence for issuing a penalty notice • Public dashcam footage can be used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerit/ penalty points during holidays) • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____ • Other (please specify): _____ _____ _____	

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Drink–driving	• According to legislation, maximum blood alcohol concentration (BAC) for general population, e.g. ≤0.05 g/dl blood or breath equivalent (give numbers and units): _____ • According to legislation, maximum BAC for novice, probationary or professional drivers, e.g. ≤0.02 g/dl blood or breath equivalent (give numbers and units): _____ • Partition ratio used for conversion of weight of alcohol in blood to weight of alcohol in breath, e.g. 210 L of breath to 100ml of blood (give number): ____ L of breath to 100 ml blood • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used to intercept drivers • Overt and covert police vehicles used to intercept drivers • Approved operations can mobilize additional policing human resources from outside road policing units • Brand of breathalyser(s) used for preliminary tests (e.g. Alcolizer LE5, Lion Alcolmeter 700): _____ • Brand of breathalyser(s) used for evidentiary tests (e.g. Draeger Alcotest 9510, Lion Intoxilyzer 9000): _____ • Additional information: _____ _____ _____	• Field sobriety tests (FST) • Drivers failing FST are arrested for evidentiary alcohol testing • Sobriety check points • Random breath testing legally permitted • Preliminary breath testing followed by evidentiary breath testing • Evidentiary breath testing at the roadside • Evidentiary breath testing of breath at a police station, within maximum of (insert number) _____ hours • Evidentiary testing of blood/urine at a hospital, within maximum (insert number) _____ hours • Drivers refusing testing face additional charges • Demerit/penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerits during holidays) • Automated number plate recognition used to identify recidivist drink–drivers for random testing? • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. drink–driving enforcement operations conducted • No. random breath tests conducted • Strike rate (#drivers exceeding prescribed content of alcohol (XPCA)/ No. drivers tested) • No. drivers charged • No. Penalty notices issued • No. drivers licence suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of an alcohol offence • No. road users killed by an alcohol impaired driver • No. road users seriously injured by alcohol-impaired driver • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Drug–driving	• Drivers prohibited to have any detectable amount of an illicit drug in their systems • Drivers prohibited to have concentration of illicit drugs, exceeding a set limit • Prohibited (illicit and prescription) drugs specified in legislation (give list): _____ _____ _____ • Drivers can be charged for driving under the influence of any impairing drug based on medical/laboratory evidence • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used • Overt and covert police vehicles used • Approved operations can mobilize additional policing human resources from outside road policing units • Brand of commercial oral fluids testing kit used for roadside preliminary testing (e.g. Securetec Drug Wipe, Abbott SoToxa, Draeger DrugTest 5000): _____ • Additional information: _____ _____ _____	• Random drug testing legally permitted • Test for alcohol before drugs and test for drugs only if alcohol test is negative • Roadside oral fluids testing for drugs (give names): _____ _____ • Preliminary roadside oral fluids test only before driver is charged • Preliminary and secondary roadside oral fluids tests conducted before driver is charged • Preliminary oral fluids test, followed by secondary test followed by laboratory confirmation before driver is charged • Driver can be charged at roadside based only on the determination of impairment by a drug recognition expert • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Additional penalties apply at times of additional risk (e.g. double demerits during holidays) • Automated number plate recognition used to identify recidivist drug–drivers for random testing • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. drug–driving operations conducted • No. random drug tests conducted • Alcohol strike rate (no. drivers exceeding the prescribed content of alcohol divided by no. tested) • Drug strike rate (no. drivers positive divided by no. tested) • No. drivers charged • No. penalty notices issued • No. drivers' licences suspended/cancelled • No. vehicles impounded • No. court summons issued • No. drivers convicted of a drug offence • No. road users killed by a drug-impaired driver • No. road users seriously injured by drug-impaired driver • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Motorcycle helmets	• All riders must wear a motorcycle helmet • All passengers must wear motorcycle helmet • Motorcycle helmets must be worn on motorcycles of all engine sizes and types • Motorcycle helmets must be worn when riding on all public roads • Motorcycle helmets must be worn when riding on private property/off road • Children under (insert age) _____ years are prohibited from being a passenger on a motorcycle on a public road • All child passengers must wear a child-specific helmet • Riders are legally responsible for passengers' wearing helmets • Motorcycle helmets must meet a recognized quality standard (e.g. EC22, Federal Motor Vehicle Safety Standard (FMVSS) No. 218) to be considered worn • Helmet must be correctly fastened to be considered worn • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Only overt police vehicles used (signage and marking clearly identifying police vehicles) • Overt and covert police vehicles used • Approved policing operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Roadside interception and on-the-spot penalty notices • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• • No. of helmet enforcement operations each year • No. riders not wearing helmets • No. passengers not wearing helmets • No. riders killed not wearing helmets • No. riders seriously injured not wearing helmets • No. passengers killed not wearing helmets • No. passengers seriously injured not wearing helmets • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Seatbelts	• All vehicle occupants required to wear a seatbelt correctly • Driver only required to wear a seatbelt • Driver and frontseat passenger only required to wear seatbelts • Drivers are legally responsible for passengers' wearing seatbelts (drivers are penalized, not passengers) • Passengers are legally responsible for wearing seatbelts (passengers are penalized, not drivers) • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____	• Primary enforcement (a driver will be stopped for a seatbelt violation alone) • Secondary enforcement only (a driver will be stopped for a seatbelt violation only in conjunction with another infringement) • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Fixed or mobile "look down" cameras (e.g. Vitronic, Acusensus) provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment of financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. of seatbelt enforcement operations each year • No. drivers not wearing seatbelts • No. front seat passengers not wearing seatbelts • No. of rear seat passengers not wearing seatbelts • No. of drivers penalized for passengers not wearing seatbelts • No. drivers killed not wearing seatbelt • No. drivers seriously injured not wearing seatbelt • No. passengers killed not wearing seatbelt • No. passengers seriously injured not wearing seatbelt • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Child restraints	• All children under __ years of age and/or under ___ cm in height, and/or under _____ kg in weight must be transported in approved child restraints • Drivers are legally responsible for children to be carried correctly in child restraints • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Primary enforcement • Secondary enforcement only • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras provide evidence for issuing penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. child restraint enforcement operations conducted • No. drivers penalized for children not using age/ weight/height-appropriate child restraints • No. children killed not using or not correctly using child restraints • No. children seriously injured not using or not correctly using child restraints • Other (please specify): _____ _____ _____

Risk factor	Current legislation	By whom enforced	Enforcement strategies and practices	Monitoring measures on which police collect data and report
Mobile telephone use	• All drivers are prohibited from all use of mobile devices while their motor vehicles are in operation • All drivers are prohibited from handheld use of mobile devices while their motor vehicles are in operation • Use of hands-free devices is permitted/ prohibited • Use of a mobile device while fitted in a vehicle-mounted cradle is permitted • All penalty notices can be contested in court • Additional information: _____ _____ _____	• All police officers • Only specialized road policing/ motorway policing officers/units • Overt police vehicles used • Overt and covert police vehicles used • Approved operations/ campaigns can mobilize additional policing human resources from outside road policing units • Additional information: _____ _____ _____	• Primary enforcement? • Secondary enforcement only? • Roadside interception and on-the-spot penalty notice • Road safety/Traffic management cameras with back-office processing of penalty notices • Fixed or mobile "look down" cameras (e.g. Vitronic, Acusensus) with back-office processing of penalty notices • Police drone footage used as evidence for issuing penalty notices • Police dashcam footage used as evidence for issuing penalty notices • Public drone footage used as evidence for issuing penalty notices • Public dashcam footage used as evidence for issuing penalty notices • Usage data from mobile provider can be used for issuing penalty notices • Demerit/Penalty points can be accrued towards immediate licence suspension/ cancellation • Police collect payment for financial penalties at the roadside • Drivers pay financial penalties at a central office/online (not at roadside to police) • Additional information: _____ _____ _____	• No. of mobile telephone enforcement operations conducted • No. of drivers using mobile telephone while driving • No. road users killed by driver using mobile telephone • No. road users seriously injured by driver using mobile telephone • Other (please specify): _____ _____ _____

Annex 3. Safe management of roadside checkpoints: standard operating procedures[15]

Introduction

The issue of safety for Police and Enforcement Agencies when stopping a motor vehicle, and any subsequent roadside interaction with either the driver or a passenger(s) is significant and cannot be understated.

These stand operating procedures (SOPs) provide guidance for Police and Enforcement Agencies in order to either eliminate or mitigate risk where vehicle and public interaction occurs on a roadside as a result of a vehicle being stopped.

These SOPs have been developed to assist in implementing effective controls to prevent Enforcement Officers and road users from being injured where a vehicle stop is conducted. It reflects contemporary good practice for effective separation of people and passing vehicles during a vehicle stop or at a static roadside checkpoint.

Goal

These SOPs aim to establish a safe and effective operating environment to deter drivers from offending through highly visible evidence-based road policing operations that are conducted in a standardised manner. The consistent application of these SOPs should minimise the prevalence of violations, with an anticipated reduction in serious crash risk. It will contribute to improved road safety awareness to make roads safer for all road users.

[15] The content of Annex 1 is used with permission of the Global Road Safety Partnership.

Objectives

The objectives are:

- To create an awareness of the inherent risks associated with dangerous and unlawful behaviour on public roads and their contribution to serious road crashes;
- To significantly increase a driver's perceived risk of detection and prosecution and therefore create 'general deterrence';
- To ensure that those stopped who are committing offences are legally penalised;
- To ensure compliance with all laws and regulations governing on road behaviour;
- To establish clear directives and procedures for police involved in road policing activities;
- To conduct roadside road policing activities in a professional manner with the lowest level of inconvenience to road users;
- To conduct monitoring and road policing activities in a safe and secure manner; and
- To develop and maintain a data management systems to guide road policing operations in a statistically defensible manner.

These guidelines must form part of a systematic road policing programme to identify errant behaviour on public roads targeting road users who act in an unsafe and/or unlawful manner.

Managing risk

In performing road policing duties, which includes the detection and stopping of offending drivers, police should commit to providing a general duty of care to colleagues and the general community and engage in systems of work that are safe.

These SOPs give consideration to the identification and mitigation of risk where a vehicle stop is required by:

- Implementing a process of hazard identification, assessment and control by reviewing systems of work;
- Providing appropriate training (induction and ongoing);
- Implementing and reviewing safe and effective control measures.

Risks must be eliminated so far as reasonably practicable, or, where it is not possible to eliminate the risk entirely, the risk must be reduced so far as reasonably practicable.

High-visibility reflective clothing

Police, whether in uniform or not and either day or night, should wear a reflective vest or high-visibility clothing when:

- Performing road policing duties.
- Stopping vehicles.
- Working in areas where interaction with motor vehicles is reasonably foreseeable.

The only recommended exceptions to the above are:

- Where, in the assessment of the police officer, wearing the reflective vest or high visibility clothing represents a serious risk to their health and safety (such as responding to an armed offender);
- When authorised by a supervisor on a specific occasion, for specific duties or planned operations; or
- In exceptional circumstances where, in the assessment of the police officer, there is an extreme operational imperative that prevents wearing a vest or high visibility clothing.

Risk assessment

The process of coordinating and controlling a vehicle stop, and any subsequent separation of people from passing traffic during the interaction, presents many challenges for police. When intending to stop a motor vehicle, conduct an ongoing risk assessment (Hazard Identification – Assess Risks – Risk Control, also known as "HI-AR-RC") and use the following as applicable.

- Hazard identification: firstly, identify all factors that may contribute to a roadside incident and consider keeping a record of any factors that have a potential to cause risk.
- Assess risk: assess each of the risks identified, assessing the likelihood of an event occurring and the expected consequences.
- Risk control: decide on control measures to manage the exposure to an identified roadside risk and implement the controls in a timely manner.
- Monitor and review the effectiveness of control measures and revise if and where necessary.

Monitor and review

Monitor and review the effectiveness of control measures and revise if and where necessary.

Elements of engagement

There are many variables that can directly impact upon how safe the situation is when deciding to conduct a vehicle stop. Some of these factors can be controlled, while the impact of others, such as weather and behaviour of other road users, can only be minimised or mitigated.

Consideration must be given to a 'system of control' required to safely and successfully execute a vehicle stop. This system involves the three elements of engagement, that being:

- preparation;
- safely stopping the vehicle; and
- departure from the roadside.

Preparation

The Preparation phase involves ensuring that the immediate location is suitable in the circumstances and is conducive to undertaking a vehicle stop safely, and that personnel are ready to conduct the stop. Consideration should also be given to the prevailing environment such as

weather conditions, traffic volume and surrounding infrastructure. Consider the reason for the stop and what action should be taken if the driver of the vehicle refuses to stop.

It is crucial that the police officers are appropriately visible to passing traffic and adequately equipped to perform the task.

Checkpoint personnel

In order to plan and execute professional roadside checkpoints, the road policing agency must ensure that the following personnel are designated for each monitoring and enforcement operation (refer to Appendix A for more detailed role descriptions):

- Operation Commander
- Site Supervisor
- Safety Officer
- Enforcement Device Operator(s)
- Vehicle Selection Officer
- Data Collection Officer
- Checkpoint Line Officers.

An authorised Enforcement Device Operator must hold a current Operator Certificate issued by a legally approved authority or at least training certificate for the type of measurement/analysis device used at the monitoring and enforcement site.

The authorised Enforcement Device Operator must ensure that detection equipment:

- Is calibrated and in good technical condition;
- Is prepared to work as device manual instructs;
- Is not subjected to adverse weather conditions;
- Is never carried in a manner that it is subjected to harsh treatment.

Managing risk at enforcement sites

The selection of candidate sites for enforcement interventions shall be undertaken in consideration of the following:

- A thorough analysis of data (including crash data) generated by the road policing agency or alternatively at sites where there are strong indicators that the prevalence of high risk or dangerous behaviour may cause an unacceptable crash risks.
- Checkpoint operations must not be conducted at sites purely based on a high number of perceived violations, but with low risk of serious crashes.
- Sites with a history of serious crashes and complaints from road users; residents or affected institutions.
- Locations where there is an increased risk of serious road crashes due to road construction activities.
- The Site Supervisor and Safety Officer must continuously monitor the safety of officers and road users and report any unsafe conditions to the Checkpoint Commander.
- The checkpoint operation must have an adequate stopping area where road policing activities will be conducted in a safe manner.

- The site must be well lit during night-time operations; and where a site is selected with inadequate lighting, the assistance of other municipal departments should be secured to provide temporary lighting.
- Locations where there is a high serious crash risk associated with vulnerable road users e.g. at schools, shopping strips.
- The time when the monitoring and enforcement operation will be conducted must be such that it will not unnecessarily impede the free flow of traffic during commuter rush hours.
- The exact site must be selected to offer adequate visibility to oncoming traffic.
- There must be adequate space for enforcement equipment, vehicles and officers to safely stop and prosecute errant drivers.
- No checkpoint operation shall be established on the crest of a hill, close to a bend with limited sight and stopping distances, close to an intersection or any other location which is deemed dangerous for monitoring and enforcement operations.

Location features

The following principles apply in relation to monitoring and enforcement operations:

- Road surfaces must be such that it will not create unsafe conditions under hard braking by errant drivers who are stopped in adverse (wet) weather conditions.
- The site shall not be such that it impedes the field of vision of drivers who are driving through the site where enforcement activities are conducted i.e. trees, shrubs, poles, signs or bus shelters, etc.
- The stopping areas shall be appropriate to accommodate heavy vehicles such as trucks, buses and articulated vehicles.
- Traffic flow shall be controlled in all lanes when road policing is conducted on multi-lane roads.
- The area where monitoring and road policing is conducted must have a clear and uninterrupted view between the point at which an offence is detected (i.e. valid speed measurement is taken) and the point where the vehicle is to be stopped, so that the police officer stopping the vehicle and the speed detection device operator can visually monitor the vehicle until the point it is stopped.
- Monitoring and enforcement should generally not be conducted on roads that could be described as the downgrade of a hill, unless there is clearly documented evidence of an elevated crash risk.

Recommended equipment

The following minimum safety equipment shall be available at monitoring and enforcement operations:

- Certified and calibrated enforcement technology (e.g. speed measuring & alcohol testing device);
- Reflective vests for every road policing officer;
- Official vehicle(s) with blue/red flashing warning lights;
- Flashlights for every officer if the enforcement is conducted at night time, and
- In the case of special arranged stopping area, a suitable number of reflective/illuminated traffic cones (circumstances will dictate).

Data recording documentation

Monitoring and enforcement operations shall be planned well in advance to allow affected staff to acquire the requisite equipment, staffing levels and transport arrangements. The operational plan shall contain the following minimum information:

- Purpose;
- Objectives and targeted offences;
- Location of the monitoring and road policing operation; (The location may be kept confidential until deployment);
- Operational time-line;
- Officer allocation (names and responsibilities of each officer); and
- Equipment list.

The Operation Commander shall be the only member who may authorize a change in the approved operational plan.

At each individual checkpoint, device records (Appendix B) must be kept on offence measurements and detected violations. The records are to be maintained and updated by the Data Collection Officer, who shall record all details of the violations. The records may also be presented to a court as evidence of a violation.

Reporting systems should be implemented to ensure that monitoring and road policing operations are conducted professionally and within the parameters established under law.

Results of each monitoring and road policing operation will be reported in the prescribed format and time frames.

The following minimum information must be captured at each monitoring and enforcement operation in (refer to Appendix C for template example):

- The location and time of the operation;
- The number of resources committed;
- The number of vehicles in violation of the law;
- The number of males and females detected;
- The number and type of other prosecutions instituted for other offences detected during the monitoring and enforcement operation.

Briefing, duties and uniform requirements

Monitoring and road policing operations will be conducted in such a manner that they do not create unnecessary distraction for road users where these activities are conducted.

The following must be undertaken prior to any operation being undertaken:

- Officers assigned to work at sites shall attend an orientation briefing before commencement of any operation.
- Duties assigned to each officer shall be explained to them by the Commander or Site Supervisor.
- No Officer shall, without the prior approval of the Operation Commander or Site Supervisor, assume any other role or perform any duties other than those assigned prior to the commencement of the checkpoint operation.

- All Officers must wear uniform, including reflective jackets.
- No vehicle shall be stopped before the site has been set up safely and assessed and cleared by the designated Safety Officer.
- Traffic cones, signage and lighting (if considered necessary) shall be placed in such a manner so as to ensure that road users understand and comply with the instructions so conveyed.
- In the event of inclement weather, the Commander shall be contacted to decide whether the operation shall be suspended or terminated. In their absence, the Site Supervisor shall decide on the feasibility to suspend or terminate the operation.
- Driver interaction shall be conducted in the shortest possible time.

Mobile vehicle stop

The timing and location of the vehicle stop must be planned, with consideration given to minimizing the risks to police officers and the public. The best form of risk control is to stop a vehicle in a location that allows as much clearance from passing traffic as possible.

Other considerations regarding the stopping location should include:

- Sufficient room to stop a vehicle on the shoulder of the road, away from traffic lanes, including the allowance of a 'safety corridor' for the police to work in when out of or away from the police vehicle.
- The surface hardness and gradient of the roadside.
- Visibility of oncoming traffic (line of site, especially around corners).

It is also important to ensure prior to exiting the patrol car that used to stop the vehicle that is has come to a complete stop. The Police Officer must also take all necessary steps to ensure that the vehicle stopped and its occupant(s) are not in danger and consider the surrounding environment.

Departure from roadside

After completion of the vehicle stop, departing from the roadside requires an ongoing risk assessment so as to ensure that departing vehicles safely enter the roadway and merge with traffic. It is important to ensure that sufficient space for vehicles to move off and return into the normal traffic flow is provided.

Appendix A. Role description

Operation commander (OC)

The OC is an officer with an appropriate senior rank, designated to coordinate all monitoring and road policing activities, including the planning, briefing, staffing, and overall supervision and control of checkpoint operations. The OC must ensure that information generated by the Enforcement Agency, is of an appropriate standard to establish an intelligence-led approach to monitoring and enforcement. The OC will on a continuous basis inform senior staff of the status of the operation and report on the activities performed. The OC shall authorize every operation and will be responsible for the overall safety of officers and road users.

Site supervisor (SS)

The SS is a designated officer (supervisor rank) who must ensure the smooth staging area and operation of the checkpoint within the parameters of the applicable law, policy and SOP(s). The SS will ensure that the checkpoint is conducted as approved by the OC.

Safety officer (SO)

The SO shall be responsible to all safety prescriptions applicable to the monitoring and enforcement operations and shall remedy or report to the Commander any serious issues that could endanger the safety of officers and/or road users. The SO shall on a continuous basis inspect all activities within the operation and the conduct of motorists approaching or leaving the designated checkpoint area.

Enforcement device operator (DO)

The DO shall be an officer suitably trained and certified as competent to operate the device and direct officers to stop drivers who exceed the prescribed law (speed/alcohol limit). The DO shall be the primary officer to testify in cases where an officer must report on or testify in a court case.

Vehicle stopper/observer (VS)

The VS shall be responsible to identify and stop vehicles at the checkpoint. VSs shall be trained appropriately to safely slow down and direct drivers to a safe area where prosecution shall be considered. The VS must assist a driver to enter the road and traffic stream safely after conclusion of an inspection and/or prosecution.

Data collection officer (DCO)

The DCO shall be responsible for the recording and collation of data of the number of vehicles that pass through the checkpoint area, the number of vehicles stopped, number and type of prosecutions instituted, and any other information as required by the OC. The DCO is responsible also for preparing a report with all available data.

Appendix B. Road policing site safety checklist

Road Policing Site Safety Checklist

Can be utilised for any planned road policing activity - (e.g: static speed enforcement, roadside alcohol / drug testing, seatbelt and motorcycle helmet wearing inspections, vehicle roadworthiness inspections, other offence categories)

Date..... **Times:** From .....to.....

Site location.....

Direction of vehicle travel..... **Single lane / dual lane** (circle one)

Speed zone..... **Road conditions** Dry/Wet Sealed/Unsealed

Record Name of:

- **Safety Officer (completes this report)** .....
- Enforcement Operation Commander .....
- Site Supervisor .....
- Enforcement Device Operator/s .....
- Vehicle stopper/s .....
- Data Collection Officer/s. .....
- Checkpoint Line Officer/s .....

Risk / Hazard identified	***Control/mitigation considerations***	***Yes/No/NA***
Pre-event safety briefing	Site suitability assessment (per identified risks & hazards)	
	Set up & operational structure (per training undertaken)	
	Safety considerations (high visibility reflective safety vests etc.)	
	Contingency plans (e.g: fail to stop, weather change etc.)	
	Safety Officer tasked & identifiable	
	All involved at site must have & understand designated roles	
	GRSP 'power point' video re 'Safe Roadside Checkpoint Operation' shown	
	GRSP 'Studio' safety video shown	
Site establishment	Ensure site located and established in accordance with training	
	Is a safety corridor available?	
	Are there any natural barriers / is cover present?	
	Is the site visible to passing traffic?	
	Is there sufficient lighting?	
	Is there sufficient traffic management equipment? (e.g: cones, flares, lights, torch/wand)	
	All police wearing high visibility reflective safety vests?	
	Can other traffic and pedestrians pass safely?	
	Can intercepted vehicles safely stop and rejoin traffic without impeding traffic flow?	
	Ensure the site is photographed by Safety Officer and maintain a record on file.	
Vehicle interception	Does the Traffic Stopper have cover available to signal cars from a position of safety?	
	Is the Traffic Stopper using visual aid(s) to direct traffic?	
	Ensure that the intercepted vehicle not impeding traffic flow	

Appendix C. Example – Enforcement device record

UNIT _____

LASER SPEED MEASUREMENTS - DEVICE RECORD

Type and serial number of speed device: _____

Date: _____, Time from / to : _____

Location: _____

Officer who conduct measurements: _____

Officer has successfully completed training in the correct use of this device, as evidenced by the certificate No. _____

Device has been regularly maintained/ calibrated, as evidenced by the certificate No. _____

CHECKS BEFORE MEASUREMENTS:

Self test	»Zero measurement«	Temperature check	Labels checks	Vertical/ horizontal aligment test
YES / NO	YES / NO	YES / NO	YES / NO	YES / NO

DETECTED VIOLATIONS

	SPEED LIMIT (KM/H)	VEHICLE			VIOLATION						
		Reg. Plate	Type of vehicle	Brand	Time	Speed [km/h]	Speed with technical tolerance [km/h]	Distance [m]	Driving direction	Type of sanction	Speed was shown to the driver (YES / NO)
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											

Officer signature: _____

Annex 4. The complexity of evidence on the risks of drug–driving

This annex presents a brief summary of the challenges and complexities in evidence for the effects of drugs on driving, including consideration of evaluations of drug–driving enforcement programmes. It also provides a brief outline of the complexities related to the effects of cannabis in particular.

Summary of challenges in drug–driving research

Debate continues on the extent to which drugs impair driving (especially for cannabis, which is further considered below), so the relevant evidence is briefly reviewed here. This issue is greatly complicated by many factors, presented briefly here.

- Many drugs (medications and recreational drugs) are considered in the broad mix of claims on levels of impairment.
- For legal drugs (medications), complexity is added by the extent to which the illness/condition being treated may itself impair driving. For example, in considering medications that impair relevant skills for driving – such as sedatives, anxiolytics and antidepressants *(1)* – complexity is added by the risk that the effects of the drug may not be worse than the effects of the symptoms they treat, in terms of elevated crash risk. In addition, the presence of the condition being treated confounds evaluations of the effects of relevant drugs *(2,3)*. Thus, there is debate on the net effects of these drugs in clinical use, although best practice is still that people under the influence of these drugs, as well as having relevant clinical conditions that may influence driving, should not drive *(4)*. However, removal of medications may not improve driving safety.
- Laboratory studies of impairment offer the most rigorous control of confounding factors but may lack real-world validity as tests of impairment of actual driving.
- Epidemiological studies of crash risk are seldom comprehensive. To accurately assess risk and odds ratios, these studies require data on drug use rates among both drivers/road users not involved in crashes and those involved in crashes. Obtaining such comprehensive data can be challenging.
- Epidemiological studies of crash risk are often based on drug presence, rather than assessment of levels of the drug *(5)*, so the effects of low and high drug concentrations are mixed into the results.
- Evaluations of the benefits of drug testing and enforcement are also weakened by the small percentages of injured drivers who are screened for drug presence, and the lack of an untreated control group, limiting evaluations to before-and-after comparisons
- The debate on the extent to which drugs show a dose–response relationship with impairment is also complicated by other aspects of blood concentration that influence the extent of drug impacts, including impairment. First, there is short-term tolerance of drugs, which means that, as the concentration of the drug rises after consumption, there is more impairment than for the same concentration as the drug leaves the system, at which stage the user has had more time with the drug on board to adapt their driving. Second, some drugs may impair through withdrawal and thus a drug may, after use, cause impairment through its absence, which is difficult to assess. Third, for some drugs, inactive components remain in the blood for extended periods without causing

impairment. Finally, some tests of drug concentration and impairment confound the extent of use by the user. For example, a recent study reporting a lack of dose–response relationships for delta-9-tetrahydrocannabinol (THC) – the active ingredient in cannabis – was entirely confounded by subjects choosing their level of smoking to reach a high, with more experienced users with more drug tolerance thus likely to choose higher levels *(6)*. This means that the higher concentrations are confounded by more drug experience and thus drug-tolerant users. In contrast to this finding, a study that avoided this confounding by having participants consume cookies with controlled doses of THC did find both dose–effect and blood-concentration–effect relationships with impairment *(7)*.

- The mixed effects of drugs via direct impairment with treatment of conditions that may themselves impair driving is further complicated by the use of such medications for recreational purposes in the absence of the medical condition they are designed to treat.

With these caveats in mind, the following sections briefly summarize the relevant research findings. Cannabis is considered separately as a special case.

Laboratory studies

Laboratory studies in general show that various illegal drugs (including THC, methamphetamine and 3,4-methylenedioxymethamphetamine, the latter also known as "MDMA"), as well as medications that suppress central nervous system activity (such as antianxiety drugs and sleeping pills), impair skills and processes that can be related to driving *(1,8)*. Studies also identify an exacerbation of the impairing effects of alcohol by various drugs *(9)*. However, the well-recognized relaxation effects of cannabis and the evidence that cannabis leads to slower driving, wrongly interpreted as another impairment (10), suggest that laboratory-observed impairment may be countered or more than countered by the powerful safety benefits of slower speeds. The extent of this is not easily assessed but should come out in well-controlled epidemiological studies.

Epidemiological studies of crash risk

Epidemiological studies of crash risk are deeply challenging to conduct to a level that allows rigorous conclusions to be drawn, but indicate that drug presence is a significant factor in fatal injuries to drivers and motorcycle riders. For example, 41% of fatally injured drivers in Victoria, Australia showed evidence of drug presence *(11)*, and studies with control groups have reported evidence for drug risk *(5,12)*. Research also suggests that various drugs exacerbate the impairing effects of alcohol *(9)*, although complexities clearly demonstrating this in crash data have long been recognized *(13)*.

Evaluation of drug–driving enforcement

Evidence of safety benefits in evaluations of drug–driving enforcement would demonstrate that drugs increase crash risk and provide a tool for management. These studies are inevitably rare because drug testing to levels that are likely to have any influence on crash risk is rare. A study in Victoria, Australia reported that increasing the number of drivers undergoing random drug testing from 42 000 to 100 000 per year was associated with a reduction in the prevalence of THC and methamphetamine in fatally and seriously injured drivers *(14)*. However, this was a complex statistical analysis of a situation with complicating policy changes in terms of test regions and

the extent of targeting of days, times and locations when drug–driving was more likely, as well as possible confounding in drug availability. In addition, a deterrent effect on drug use due to increased testing would produce this result simply by reducing total use of drugs by drivers, even if the drug does not have an impairing effect. A control group to assess this interpretation was not included or readily feasible.

The issue is further complicated by the modelling methods used, which may mask important trends. Thus, the attribution of changes in drugs in crash victims and the real safety benefits of these changes warrant further assessment. Other studies suggest that deterrence effects are weak *(15)*.

In some countries, even those with strong penalties, there is little general deterrence of drug–driving. Years of crash records show that no driver has been imprisoned for drug–driving, which highlights the absence of relevant judicial action *(16)*.

Contested safety risk of cannabis

Cannabis (or marijuana) is given specific consideration here for several reasons. Leaving alcohol aside (although it is a drug), cannabis is the oldest and most commonly used recreational drug on Earth. It is also increasingly used for medical purposes. Cannabis is gradually being made legal for medical or recreational purposes in multiple countries and states. In addition, the effects of cannabis on crash risk are complex and disputed, as are the effects of drug enforcement for cannabis.

Despite significant research on the effects of cannabis (or its active ingredient THC) on driving and crash risk, the picture remains unclear. Laboratory studies indicate impairment of skills, although many factors influence its extent *(17)*. In laboratory studies, including driving simulator studies, impairment is shown for some relevant measures but not others *(10)* in close to even proportions when slower driving is corrected to not be recognized as an impairment, as was done in the cited review. Driving impairments are moderate, especially in habitual users *(18,19)*, and appear to be greater in occasional users *(6,20)*. In addition, standard field sobriety testing has poor validity for detection of THC use *(21,22)*.

Further, research on the effects of cannabis on crash risk has delivered inconsistent results, for example, producing the following claims.

- THC concentration predicts cannabis impairment in some studies *(7)*, while others find no dose–effect relationship *(6)* (but note the confounding factor identified above for the latter study).
- Some studies show that cannabis causes increase in crash risk and culpability risk, especially in occasional users *(10)*, but others show inadequate evidence for that claim; the meta-analysis reaching the latter conclusion is not, however, a compelling dismissal of a moderate effect, giving an overall odds ratio of 1.4 for cannabis, albeit this is not significant *(18)*.
- A different type of study indicated a crash impairment risk for cannabis by assessing the effects of legalizing use on fatal crash rates. It found that states in the United States of America that had legalized cannabis showed a significant increase in cannabis-related crash deaths when compared with states that had not legalized the drug *(23)*. This finding may arise in part from introducing less experienced cannabis users (who are less tolerant of the drug's effects) to driving after using cannabis. Other studies have found no relationship between the legalization of recreational cannabis use and an increase in road traffic crashes in Canada *(24,25)*. However, the study in the United States of America

has the advantages of a larger population base, more years of data, a range of dates of legalization reducing the possible effects of systematic confounding with extraneous factors and a control group of states that did not legalize cannabis.

- Cannabis and alcohol combined produce a larger effect on crash risk than either alone, according to Dubois et al. *(26)*. In contrast, a review and meta-analysis found no credible evidence that the combined use of cannabis and alcohol exacerbates the effect of alcohol on the risk of crashing *(18)*. The meta-analysis presents a more rigorous and comprehensive picture.

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WHO/EURO:2026-11317-51089-77774 (PDF)
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